



TEST REPORT

EN ISO12100

Safety of machinery - General principles for design - Risk assessment and risk reduction (ISO 12100:2010)

EN 60204-1

Safety of machinery - Electrical equipment of machines - Part 1: General requirements

Report Number.....: RKEYS260108106

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Applicant's name.....: Grace Group Co. , Ltd.

Address.....: 24-E9, Building 3, Aosheng Building, 1166 Xinlong Street, Jinan, Shandong, China

Manufacturer's name.....: Grace Group Co. , Ltd.

Address.....: 24-E9, Building 3, Aosheng Building, 1166 Xinlong Street, Jinan, Shandong, China

Test specification:

Standard.....: EN ISO12100:2010; EN 60204-1:2018+A1:2025

Test procedure.....: CE-MD

Non-standard test method.....: N/A

Test item description.....: Lawn Mower

Trade Mark.....: N/A

Model/Type reference.....: GLM-90, GLM-50, GLM-55, GLM-60, GLM-65, GLM-70, GLM-75, GLM-80, GLM-85, GLM-95, GLM-100, GLM-105, GLM-110, GLM-115, GLM-120, GLM-125, GLM-130, GLM-135, GLM-140, GLM-A, GLM-B, GLM-C

Ratings.....: DC24V, 4000W Max

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List of Attachments (including a total number of pages in each attachment):

- Measurement Section
- Attachment :Photo document (4 pages)

Summary of testing: N/A**Copy of marking plate:****The artwork below may be only a draft.****Product Name: Lawn Mower****Model: GLM-90****Rating: DC24V, 4000W Max****Grace Group Co. , Ltd.
MADE IN CHINA****Importer: xxx
Address: yyy****Note:**

1. xxx means importer company name; yyy means importer company address information.
2. The marking for the other models are identical as above except the model no. only.
3. As declared by client that the name (or registered trade mark) and address of the certificate holder (manufacturer) or the importer or authorized representative based within the European Economic Area will be clearly affixed on the product or where that is not possible, on the packaging or in a document accompanying the product.
4. The height of letters and numerals was not less than 2mm.
5. The height of symbol “” was not less than 7mm.
6. The height of the other graphical symbols was not less than 5mm.



POSSIBLE TEST CASE VERDICTS:	
- test case does not apply to the test object..... :	N/A
- test object does meet the requirement..... :	P (Pass)
- test object does not meet the requirement..... :	F (Fail)
TESTING:	
Date of receipt of test item..... :	Dec. 31, 2025
Date (s) of performance of tests..... :	Dec. 31, 2025 to Jan. 09, 2026
GENERAL PRODUCT INFORMATION:	
The unit has following features: The equipment under test (EUT) is a “Lawn Mower”. All models are identical, except for model name difference. All test(s) were performed on model “GLM-90” to represent other models also. The EUT Tma is 25°C declared by client.	
Tests performed (name of test and test clause): EN ISO 12100:2010 Safety of machinery - General principles for design - Risk assessment and risk reduction (ISO 12100:2010) EN 60204-1:2018+A1:2025 Safety of machinery - Electrical equipment of machines - Part 1: General requirements	Testing location: Guangdong KEYS Testing Technology Co., Ltd. Building 1, No.18, Shihuan Road, Dongcheng Subdistrict, Dongguan, Guangdong, China Tel:+86-0769-22221088 http://www.keys-lab.com E-mail: info@keys-lab.com
Summary of compliance with National Differences List of countries addressed: ☒ The product fulfils the requirements of -EN ISO12100:2010; - EN 60204-1:2018+A1:2025	
Remark : /	

Risk assessment

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

S: Severity of possible harm

S1: Slight (normally reversible)

S2: Serious (normally irreversible)

S3: Cause a few men die

S4: Calamity or cause many men die

A: Frequency any duration of exposure

A1: Seldom to very often

A2: Frequent to continuous

G: Possibilities of avoidance

G1: Possible

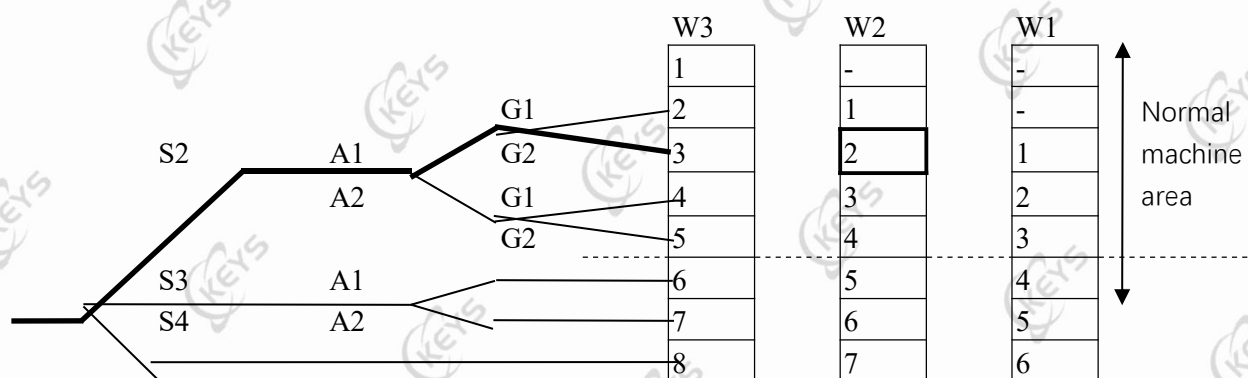
G2: Impossible

W: Probability of occurrence of harm

W1: Low

W2: Medium

W3: High



Solutions for the level of hazards

1: Protected by warning sign

2: Protected by guard and warning sign

3: Consider the other design, choose the best one, add both guard and warning sign

4: Consider another two design, choose the best one, add both guard and warning sign

5: Consider another three design, choose the best one, add both guard and warning sign

NO.	Hazards source	S	A	G	W	Level
Mechanical hazards						
1.0-1	Mechanical hazards due to machine parts or work pieces					
1.0-2	Mechanical hazards due to accumulation of energy inside the machinery					
1.1	Crushing	1	1	1	1	-
1.2	Shearing					
1.3	Cutting or severing					
1.4	Entanglement	1	1	1	1	-
1.5	Drawing-in or trapping	1	1	1	1	-
1.6	Impact	1	1	1	1	-
1.7	Stabbing or puncture					
1.8	Friction or abrasion					
1.9	High pressure fluid injection or ejection					
Electrical hazards						
2.1	Contact with live parts	2	1	1	1	1
2.2	Contact with parts which have become live under faulty conditions	2	1	1	1	1
2.3	Approach to live part under high voltage					
2.4	Electrostatic phenomena					
2.5	Thermal radiation or other phenomena such as projection of molten particles and chemical effects form short-circuits, overloads etc.					
Thermal hazards						
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					
3.2	Damage to health by hot or cold working environment					
Hazards generated by noise						
4.1	Hearing loss (deafness), other physiological disorders	1	1	1	1	-
4.2	Interference with speech communication, acoustic signals, etc.	1	1	1	1	-

Hazards generated by vibration					
5.1	Use of hand-help machines resulting in a variety of neurological and vascular disorder				
5.2	Whole body vibration, particular when combined with poor postures				
Hazards generated by radiation					
6.1	Low frequency, radio frequency radiation, microwaves				
6.2	Infrared, visible and ultraviolet light				
6.3	X and gamma rays				
6.4	Alpha, beta rays, electron or ion beams, neutrons				
6.5	Lasers				
Hazards generated by materials and substances processed or used by the machinery					
7.1	Hazards from contact with or inhalation of harmful fluids, gases, mists, fumes and dusts				
7.2	Fire and explosion hazard				
7.3	Biological and micro-biological (viral or bacterial) hazards				
Hazards generated by neglecting ergonomic principles in machine design					
8.1	Unhealthy postures or excessive effort				
8.2	Inadequate consideration of hand-arm or foot-leg anatomy				
8.3	Neglected use of personal protection equipment				
8.4	Inadequate local lighting				
8.5	Mental overload or underload, stress				
8.6	Human error, human behavior	1	1	1	1
8.7	Inadequate design, location or identification of manual controls				
Combination of hazards					
9	Combination of hazards				
Unexpected start-up, unexpected overrun/over-speed					
10.1	Failure/disorder of the control system	1	1	1	1
10.2	Restoration of energy on supply after an interruption				
10.3	External influences on electrical equipment				
10.4	Other external influences (gravity, wind, etc.)				

10.5	Errors in the software					
10.6	Error made by the operator (due to mismatch of machinery with human characteristics and abilities, see 8.6)					
Impossibility of stopping the machine in the best possible conditions						
11	Impossibility of stopping the machine in the best possible conditions					
Variations in the rotational speed of tools						
12	Variations in the rotational speed of tools					
Failure of the power supply						
13	Failure of the power supply					
Failure of the control circuit						
14	Failure of the control circuit	1	1	1	1	-
Errors of fitting						
15	Errors of fitting	1	1	1	1	-
Break-up during operation						
16	Break-up during operation					
Falling or ejected objects or fluids						
17	Falling or ejected objects or fluids					
Loss of stability / overturning of machinery						
18	Loss of stability / overturning of machinery					
Slip, trip and fall of persons (related to machinery)						
19	Slip, trip and fall of persons(related to machinery)					
Additional hazards, hazardous situations and hazardous events due to mobility						
20	Relating to the traveling function					
20.1	Movement when starting the engine					
20.2	Movement without a driver at the driving position					
20.3	Movement without all parts in a safe position					
20.4	Excessive speed of pedestrian controlled machinery					
20.5	Excessive oscillations when moving					
20.6	Insufficient ability of machinery to be slowed down, stopped and immobilised					

Linked to the work position (including driving station) on the machine						
21.1	Fall of persons during access to (or at/from) the work position					
21.2	Exhaust gases/lack of oxygen at the work position					
21.3	Fire (flammability of the cab, lack of extinguishing means)					
21.4	Mechanical hazards at the work position: contact with the wheels; rollover; fall of objects, penetration by objects; break-up of parts rotation at high speed; contact of persons with machine parts or tools (pedestrian controlled machines)					
21.5	Insufficient visibility form the work positions					
21.6	Inadequate lighting					
21.7	Inadequate seating					
21.8	Noise at the work position					
21.9	Vibration at the work position					
21.10	Insufficient means for evacuation/emergency exit					
Due to the control system						
22.1	Inadequate location of manual controls					
22.2	Inadequate design of manual controls and their mode of operation					
Form handling the machine (lack of stability)						
23	Form handling the machine (lack of stability)					
Due to the power source and to the transmission of power						
24.1	Hazards form the engine and the batteries					
24.2	Hazards form the transmission of power between machines					
24.3	Hazards form coupling and towing					
Form/to third persons						
25.1	Unauthorized start-up/use					
25.2	Drift of a part away from its stopping position					
25.3	Lack or inadequacy of visual or acoustic warning means					
Insufficient instructions for the driver/operator						

26	Insufficient instructions for the driver/operator					
Additional hazards, hazardous situations and hazardous events due to lifting						
27	Mechanical hazards and hazardous events					
27.1	Form load falls, collisions, machine tipping caused by:					
27.1.1	Lack of stability					
27.1.2	Uncontrolled loading-overloading-overturning moments exceeded					
27.1.3	Uncontrolled amplitude of movements					
27.1.4	Unexpected/unintended movement of loads					
27.1.5	Inadequate holding devices/accessories					
27.1.6	Collision of more then one machine					
27.2	Form access of persons to load support					
27.3	Form derailment					
27.4	Form insufficient mechanical strength of parts					
27.5	Form inadequate selection of chains, ropes, lifting and accessories and their inadequate integration into the machine					
27.6	Form inadequate selection of chains, ropes, lifting and accessories and their inadequate integration into the machine					
27.7	Form lowering of the load under the control of friction brake					
27.8	Form abnormal conditions of assembly/testing/use/maintenance					
27.9	Form the effect of load on persons (impact by load or counterweight)					
Electrical hazards						
28.1	Form lightning					
Hazards generated by neglecting ergonomic principles						
29.1	Insufficient visibility from the driving position					
Additional hazards, hazardous and situations and hazardous events due to underground work						
30	Mechanical hazards and hazardous events due to:					
30.1	Lack of stability of powered roof supports					
30.2	Failing accelerator or brake control of machinery running on rails					
30.3	Failing or lack of dead man's control of machinery running on rails					

31	Restricted movement of persons					
32	Fire and explosion					
33	Emission of dust, gases etc.					
Additional hazards, hazardous situations and hazardous events due to the lifting or moving of persons						
34	Mechanical hazards and hazardous events due to:					
34.1	Inadequate mechanical strength-inadequate working coefficients					
34.2	Failing of loading control					
34.3	Failing of controls in person carrier (function, priority)					
34.4	Over speed of person carrier					
35	Falling of person from person carrier					
36	Falling or overturning of person carrier					
37	Human error, human behavior					

NO.	Hazards source	S	A	G	W	Level
1.1	Crushing	1	1	1	1	-
Where	Near machine					
When	loading/unloading,maintenance					
Improvement result						
Method		S	A	G	W	Level
1. Affixing suitable warning signs.		1	1	1	1	-
2. Only operation by training/authorized persons.						
3. Operation of the machine shall conform to the instructions of the instruction manual.						
4. Check and inspection according to the specified durations of the instruction manual.						
5. Provide guards.						

NO.	Hazards source	S	A	G	W	Level
1.4	Entanglement	1	1	1	1	-
Where	Contact with roller of the machine					
When	during operation, inspection and maintenance of machine					

Improvement result					
Method	S	A	G	W	Level
1. Affixing suitable warning signs. 2. Only operation by training/authorized persons. 3. Operation of the machine shall conform to the instructions of the instruction manual. 4. Check and inspection according to the specified durations of the instruction manual. 5. Provide guards.	1	1	1	1	-

NO.	Hazards source	S	A	G	W	Level
1.5	Drawing-in or trapping	1	1	1	1	-
Where	Contact with the conveyor of the machine					
When	during operation, inspection and maintenance of machine					
Improvement result						
Method		S	A	G	W	Level
1. Affixing suitable warning signs.		1	1	1	1	-
2. Only operation by training/authorized persons.						
3. Operation of the machine shall conform to the instructions of the instruction manual.						
4. Check and inspection according to the specified durations of the instruction manual.						
5. Provide guards.						

NO.	Hazards source	S	A	G	W	Level
1.6	Impact	1	1	1	1	-
Where	moving/rotating tool					
When	during operation, inspection and maintenance of machine					
Improvement result						
Method	S	A	G	W	Level	
1. Affixing suitable warning signs.	1	1	1	1	-	
2. Only operation by training/authorized persons.						
3. Operation of the machine shall conform to the instructions of the instruction manual.						



4. Check and inspection according to the specified durations of the instruction manual.						
5. Provide guards.						
NO.	Hazards source	S	A	G	W	Level
2.1	Contact with live parts	2	1	1	1	1
Where	contact with live parts or connections					
When	During commissioning,maintenance					
Improvement result						
Method		S	A	G	W	Level
Only operation by training/authorized persons.		1	1	1	1	-
Operation of the machine shall conform to the instructions of the instruction manual.						
Check and inspection according to the specified durations of the instruction manual.						
Using safety components in accordance with those relevant international standards.						
Use of warning label.						

NO.	Hazards source	S	A	G	W	Level
2.2	Contact with parts which have become live under faulty conditions	2	1	1	1	1
Where	contact with live parts or connections					
When	during operation, inspection and maintenance of machine					
Improvement result						
Method		S	A	G	W	Level
1. Only operation by training/authorized persons.		1	1	1	1	-
2. Operation of the machine shall conform to the instructions of the instruction manual.						
3. Check and inspection according to the specified durations of the instruction manual.						
4. Using safety components in accordance with those relevant international standards.						
5. Use of warning label.						

NO.	Hazards source	S	A	G	W	Level
4.1	Hearing loss (deafness), other physiological disorders	1	1	1	1	-
Where	Near machine					
When	during operation, inspection and maintenance of machine					
Improvement result						
Method		S	A	G	W	Level
1. Only operation by training/authorized persons.		1	1	1	1	-
2. Operation of the machine shall conform to the instructions of the instruction manual.						
3. Check and inspection according to the specified durations of the instruction manual.						
4. Using safety components in accordance with those relevant international standards.						
5. Use of warning label.						

NO.	Hazards source	S	A	G	W	Level
4.2	Interference with speech communication, acoustic signals, etc.	1	1	1	1	-
Where	Near machine					
When	during operation, inspection and maintenance of machine					
Improvement result						
Method		S	A	G	W	Level
1. Only operation by training/authorized persons.		1	1	1	1	-
2.Use of warning label.						
3.Use the PPE.						

NO.	Hazards source	S	A	G	W	Level
8.6	Human error, human behavior	1	1	1	1	-
Where	At load/unload, tool mounting positions					
When	Reasonably foreseeable misuse, inadvertent operation of controls, incorrect work material and cutter handling and setting during loading/ unloading, process control, tool handling.					
Improvement result						
Method		S	A	G	W	Level
1.Only authorized person can use the machine.		1	1	1	1	-
2.Training before using this machine.						
3.Make reference to the instruction manual before using this machine.						

NO.	Hazards source	S	A	G	W	Level
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10.1	Failure/disorder of the control system	1	1	1	1	-
Where	the control system of the machine					
When	Mechanical hazards associated with selected machine movement during setting, cleaning					
Improvement result						
Method		S	A	G	W	Level
Only authorized person can use the machine. Make reference to the instruction manual before using this machine. Check before operation. Periodic maintenance.		1	1	1	1	-

NO.	Hazards source	S	A	G	W	Level
14	Failure of the control circuit	1	1	1	1	-
Where	In the wireway					
When	Unexpected movements of machine during setting, cleaning or maintenance					
Improvement result						
Method		S	A	G	W	Level
Checking before operation.		1	1	1	1	-
Make reference to the instruction manual before operate this machine.						
Daily/periodic inspection and maintenance.						

NO.	Hazards source	S	A	G	W	Level
15	Errors of fitting	1	1	1	1	-
Where	At machine					
When	machine elements fail or swing unexpectedly during process control, tool mounting, maintenance					
Improvement result						
Method		S	A	G	W	Level
1. Only authorized person can use the machine.		1	1	1	1	-
2.Make reference to the instruction manual before using this machine.						
3.Check before operation.						
4. Periodic maintenance.						

EN ISO 12100			
Clause	Requirement-Test	Result-Remark	Verdict
6	Risk reduction		P
6.1	General		P
	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; - probability of occurrence of that harm. 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).	Appropriate machine design has been performed by the manufacturer	P
6.2	Inherently safe design measures		P
6.2.1	General		P
	Inherently safe design measures are the first and most important step in the risk reduction process because protective measures inherent to the characteristics of the machine are likely to remain effective, whereas experience has shown that even well-designed safeguarding may fail or be violated and information for use may not be followed.	Appropriate machine design has been performed by the manufacturer.	P
	Inherently safe design measures are achieved by avoiding hazards or reducing risks by a suitable choice of design features of the machine itself and/or interaction between the exposed persons and the machine. NOTE See 6.3 for safeguarding and complementary measures that can be used to achieve the risk reduction objectives in the case where inherently safe design measures are not sufficient (see 6.1 for the three-step method).	Appropriate machine design has been performed by the manufacturer.	P
6.2.2	Consideration of geometrical factors and physical aspects		P
6.2.2.1	Geometrical factors		P
	Such factors include the following.		
	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	Reducing blind spots	P

EN ISO 12100			
Clause	Requirement-Test	Result-Remark	Verdict
	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: -the travelling and working area of mobile machines; -the zone of movement of lifted loads or of the carrier of machinery for lifting persons; -the area of contact of the tool of a hand-held or hand-guided machine with the material being worked. The design of the machine shall be such that, from the main control position, the operator is able to ensure that there are no exposed persons in the danger zones.		
	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).	By increasing the minimum gap between the moving parts or by reducing the gap.	P
	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 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.	No sharp edges, no sharp angles, no rough surfaces, no protruding parts.	P
	d) The form of the machine is designed so as to achieve a suitable working position and provide accessible manual controls (actuators).	Suitable working position, accessible manual controls.	P
6.2.2.2	Physical aspects		P
	Such aspects include the following:		
	a) limiting the actuating force to a sufficiently low value so that the actuated part does not generate a mechanical hazard;	The actuating force has been limited to be a sufficiently low value.	P

EN ISO 12100			
Clause	Requirement-Test	Result-Remark	Verdict
	b)limiting the mass and/or velocity of the movable elements, and hence their kinetic energy;	The mass of the tool has been limited.	P
	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), 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)], 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 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)].		P
6.2.3	Taking into account the general technical knowledge regarding machine design		P
	This general technical knowledge can be derived from technical specifications for design (e.g. standards, design codes, calculation rules).These should be used to cover :		
	a) mechanical stresses such as - stress limitation by implementation of correct calculation, construction and fastening methods as regards, e.g. bolted assemblies, welded assemblies - stress limitation by overload prevention, (e.g. “fusible” plugs, pressure-limiting valve, breakage points, torque-limiting devices); - avoiding fatigue in elements under variable stresses	The appropriate technical knowledge of mechanical has been taken into account.	P

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Clause	Requirement-Test	Result-Remark	Verdict
	(notably cyclic stresses); - static and dynamic balancing of rotating elements;		
	b) materials and their properties such as - resistance to corrosion, ageing, abrasion and wear; - hardness, ductility, brittleness; - homogeneity; - toxicity; - flammability.	The materials have been treated by appropriate methods.	P
	c) emission values for : - noise; - vibration; - hazardous substances; - radiation.		P
	When the reliability of particular components or assemblies is critical for safety (e.g. ropes, chains, lifting accessories for lifting loads or persons), stress values shall be multiplied by appropriate working coefficients.	Appropriate working coefficients have been taken into account during design and calculation.	P
6.2.4	Choice of an appropriate technology		N
	One or more hazards can be eliminated or risks reduced by the choice of the technology to be used in certain applications, e.g. :		-
	a) on machines intended for use in explosive atmospheres: - fully pneumatic or hydraulic control system and machine actuators; - “intrinsically safe” electrical equipment (see IEC 60079-11)		N
	b) for particular products to be processed such as a solvent: equipment assuring that the temperature will remain far below the flash point.		N
	c) alternative equipment to avoid high noise level, e.g.: - electrical instead of pneumatic equipment - in certain conditions, water cutting instead of mechanical equipment.		N
6.2.5	Applying the principle of the positive mechanical action		P

EN ISO 12100			
Clause	Requirement-Test	Result-Remark	Verdict
	Positive mechanical action is achieved when a moving mechanical component inevitably moves another component along with it, either by direct contact or via rigid elements. An example of this is positive opening operation of switching devices in an electrical circuit (see IEC 60947-5-1 and ISO 14119).		P
6.2.6	Provisions for stability		P
	Machines shall be designed to have sufficient stability to allow them to be used safely in their specified conditions of use.	These machines have been designed to have sufficient stability .	P
	Factors to be taken into account include		-
	- geometry of the base;	The factor has been taken into account during design.	P
	- weight distribution, including loading;	The factor has been taken into account during design.	P
	- dynamic forces due to movements of parts of the machine, of the machine itself, or of elements held by the machine which may result in an overturning moment;	The factor has been taken into account during design.	P
	- vibration	The factor has been taken into account during design.	P
	- oscillations of the centre of gravity;	The factor has been taken into account during design	P
	- characteristics of the supporting surface in case of traveling or installation on different sites (e.g. ground conditions, slope);	The factor has been taken into account during design.	P
	- external forces (e.g. wind pressure, manual forces)	The factor has been taken into account during design.	P
	Stability shall be considered in all phases of the life of the machine, including handling, traveling, installation, use,	The factor has been taken into account	P

EN ISO 12100			
Clause	Requirement-Test	Result-Remark	Verdict
	de-commissioning and dismantling.	during design.	
	Other protective measures for stability relevant to safeguarding are given in 6.3.2.6	Please see the related clause.	P
6.2.7	Provision for maintainability		P
	When designing a machine, the following maintainability factors shall be taken into account:		-
	- accessibility, taking into account the environment and the human body measurements, including the dimensions of the working clothes and tools used;	These factors have been taken into account during design.	P
	- ease of handling, taking into account human capabilities;	The factor has been taken into account during design.	P
	- limitation of the number of special tools and equipment;	The factor has been taken into account during design.	P
6.2.8	Observing ergonomic principles		P
	Ergonomic principles shall be taken into account in designing machinery to reduce mental or physical stress and strain of the operator.	Appropriate ergonomic principles have been taken into account in designing machinery.	P
	These principles shall be considered when allocating functions to operator and machine (degree of automation) in the basic design.	These principles have been taken into account during allocating functions to operator and machine.	P
	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 (see ISO 10075 and ISO 10075-2)	All these factors have been taken into account during design.	P
	All elements of the “operator-machine” interface such as controls, signaling or data display elements, shall be designed to be easily understood so that clear and unambiguous interaction between the operator and the machine is possible.(see EN 614-1, ISO 6385, EN 13861 and IEC	All arrangement and design of manual controls have been checked in compliance with.	P

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Clause	Requirement-Test	Result-Remark	Verdict
	61310-1)		
	Designer's attention is especially drawn to following ergonomic aspects of machine design		-
	a) Avoiding stressful postures and movements during use of the machine (e.g. by providing facilities to adjust the machine to suit the various operators).	Stressful postures and movements during use of the machine have been avoided.	P
	b) Designing machines, and more especially hand-held and mobile machines to enable them to be operated easily taking into account human effort, actuation of controls and hand, arm and leg anatomy.	This machine has been adjusted to the human strength and convenient movement.	P
	c) Limit as far as possible noise, vibration and thermal effects such as extreme temperatures.	This machine has been designed with low noise, vibration.	P
	d) Avoid linking the operator's working rhythm to an automatic succession of cycles.	This situation has been avoided.	P
	e) Select, locate and identify manual controls (actuators) so that		-
	- they are clearly visible and identifiable and appropriately marked where necessary (see6.4.4)	Clearly visible and appropriately marked	P
	- they can be safely operated without hesitation or loss of time and without ambiguity (e.g. a standard layout of controls reduces the possibility of error when an operator changes from a machine to another one of similar type having the same pattern of operation)	Standard layout of controls. See the photos.	P
	- their location(for push-buttons) and their movement (for levers and handwheels) are consistent with their effect (see IEC 61310-3)		P
	- their operation cannot cause additional risk		P
	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.	one-to-one correspondence	N

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Clause	Requirement-Test	Result-Remark	Verdict
	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.	Taking account of ergonomic principles	P
	Constraints due to the necessary or foreseeable use of personal protective equipment(such as footwear, gloves)shall be taken into account.		P
	f) Select, design and locate indicators, dials and visual display units so that		-
	- they fit within the parameters and characteristics of human perception		P
	- information displayed can be detected, identified and interpreted conveniently, i.e. long lasting, distinct, unambiguous and understandable with respect to the operator's requirements and the intended use;	All the information displayed comply with this requirement.	P
	- the operator is able to perceive them form the control position		P
6.2.9	Preventing electrical hazard		P
	For the design of the electrical equipment of machines EN 60204-1 gives general provisions, especially in clause 6 for protection against electric shock.	See the test report of EN 60204-1	P
	For requirements related to specific machines, see corresponding IEC standards (e.g. series of IEC 61029, IEC 60745, IEC 60335).		N
6.2.10	Preventing and hydraulic hazards		N
	Pneumatic and hydraulic equipment of machinery shall be designed so that :		-
	- the maximum rated pressure cannot be exceeded in the circuits (e.g. by means of pressure limiting devices)		N
	- no hazard results from pressure surges or rises, pressure losses or drops or losses of vacuum;		N
	- no hazardous fluid jet or sudden hazardous movement of the hose (whiplash)results from leakage or component failures;		N
	- air receivers, air reservoirs or similar vessels (e.g. in gas loaded accumulators) comply with the design rules for these		N

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Clause	Requirement-Test	Result-Remark	Verdict
	elements;		
	- air elements of the equipment, and especially pipes and hoses, be protected against harmful external effects;		N
	- as far as possible, reservoirs and similar vessels (e.g. in gas loaded accumulators) are automatically depressurized when isolating the machine from its power supply (see 6.3.5.4) and, if it is not possible, means are provided for their isolation, local depressurizing and pressure indication (see also ISO 14118:2000, clause 5)		N
	- 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 drawing attention to the necessity of depressurizing those elements before any setting or maintenance activity on the machine. See also ISO 4413 and ISO 4414		N
6.2.11	Applying inherently safe design measures to control system		P
6.2.11.1	General		P
	The design measures of the control system shall be chosen so that their safety-related performance provides a sufficient amount of risk reduction (see ISO 13849-1 or IEC 62061)	Inherently safe design measures to control system have applied.	P
	The correct design of machine control systems can avoid unforeseen and potentially hazardous machine behaviour.	Inherently safe design measures to control system have applied.	P
	Typical causes of hazardous machine behavior are :		-
	- an unsuitable design or modification (accidental or deliberate) of the control system logic;	No this kind of hazard in this machine	N
	- a temporary or permanent defect or a failure of one or several components of the control system;		N
	- a variation or a failure in the power supply of the control system;	No this kind of hazard in this machine	N
	- inappropriate selection, design and location of the control devices;	No this kind of hazard in this machine	N
	Typical examples of hazardous machine behaviour are :		-

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Clause	Requirement-Test	Result-Remark	Verdict
	- unintended/unexpected start-up(see ISO 14118)	No this kind of hazard in this machine	N
	- uncontrolled speed change;	Speed monitor	N
	- failure to stop moving parts;	Emergency stop devices	N
	- dropping or ejection of a mobile part of the machine or of a workpiece clamped by the machine;		P
	- machine action resulting from inhibition (defeating or failure) of protective devices	No this kind of hazard in this machine	N
	In order to prevent hazardous machine behaviour and to achieve safety functions, the design of control systems shall comply with the principles and methods presented in this subclause 6.2.11 and in 6.2.12.	See the related clause	P
	These principles and methods shall be applied singly or in combination as appropriate to the circumstances (see ISO 13849-1 and EN 60204-1 and IEC 62061).	See the test report of EN 60204-1	P
	Control systems shall be designed to enable the operator to interact with the machine safely and easily; this requires one or several of the following solutions;	The operator interact with the machine safely and easily.	P
	- systematic analysis of start and stop conditions;	Systematic analysis have been applied.	P
	- provision for specific operating modes (e.g. start-up after normal stop, restart after cycle interruption or after emergency stop, removal of the workpieces contained in the machine, operation of a part of the machine in case of a failure of a machine element)	Enough provisions have been provided.	P
	- clear display of the faults;		P
	- measures to prevent accidental generation of unexpected start commands (e.g. shrouded start device) likely to cause dangerous machine behaviour (see ISO 14118:2000, figure 1)	Main switch with lock and related devices are provided.	P
	- maintained stop commands(e.g. interlock) to prevent restarting that could result in dangerous machine behaviour (see ISO 14118:2000, figure 1)	This requirement is complied with.	P
	An assembly of machines may be divided into several zones for emergency stopping, for stopping as a result of protective		P

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Clause	Requirement-Test	Result-Remark	Verdict
	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.		P
	Likewise it shall be obvious which control devices (e.g. emergency stop devices, supply disconnecting devices)and/or protective devices belong to which zone.		P
	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.		P
	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(e.g. range, speed, acceleration, deceleration, load capacity). Allowance shall be made for dynamic effects (e.g. the swinging of loads).	The max. speed	P
	For example:		-
	- the traveling speed of mobile pedestrian controlled machinery other than remote-controlled shall be compatible with walking speed.		N
	- the range, speed, acceleration and deceleration of movements of the person-carrier and carrying vehicle for lifting persons shall be limited to non-hazardous values, taking into account the total reaction time of the operator and the machine.		N
	- the range of movements of parts of machinery for lifting loads shall be kept within specified limits.		P
	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.		N
6.2.11.2	Starting of internal power source/switching on an external power supply		P
	The starting of an internal power source or switching-on of an external power supply shall not result in a hazardous	Not result in the starting of working parts of a	P

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Clause	Requirement-Test	Result-Remark	Verdict
	situation. For example: -starting the internal combustion engine shall not lead to movement of a mobile machine; -connection to mains electricity supply shall not result in the starting of working parts of a machine. See EN 60204-1:2006, 7.5 (see also Annexes A and B).	machine	
6.2.11.3	Starting/stopping of a mechanism		P
	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, by passage from state 0 to state 1 (if state 1 represents the highest energy state)	This requirement has been taken into account during design.	P
	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 (if state 1 represents the highest energy state).	The type of stopping of this machine belongs to state 1 and state 0.	P
	When, in order for the operator to maintain permanent control of deceleration, this principle is not observed (e.g. a hydraulic braking device of a self-propelled mobile machine), the machine shall be equipped with a means of slowing and stopping in case of failure of the main braking system	No such situation exist.	N
6.2.11.4	Restart after power interruption		P
	If it may generate a hazard, the spontaneous restart of a machine when it is re-energized after power interruption shall be prevented (e.g. by use of a self-maintained relay, contactor or valve).	A self-maintained relay	P
6.2.11.5	Interruption of power supply		P
	Machinery shall be designed to prevent hazardous situations resulting from interruption or excessive fluctuation of the power supply. At least the following requirements shall be met:		P
	- the stopping function of the machinery shall remain;		P

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Clause	Requirement-Test	Result-Remark	Verdict
	- all devices whose permanent operation is required for safety shall operation an effective way to maintain safety (e.g. locking, clamping devices, cooling or heating devices, power-assisted steering of self-propelled mobile machinery);		P
	- parts of machinery or workpieces and/or loads held by machinery which are liable to move as a result of potential energy shall be retained for the time necessary to allow them to be safely lowered.		N
6.2.11.6	Use of automatic monitoring		P
	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.		P
	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.		P
	In either case, the protective measure can be initiated immediately or delayed until a specific event occurs (e.g. the beginning of the machine cycle.) The protective measures may be , e.g.:		P
	- the stopping of the hazardous process;		P
	- preventing the re-start of this process after the first stop following the failure;		P
	- the triggering of an alarm		N
6.2.11.7	Safety functions implemented by programmable electronic control systems		P
6.2.11.7.1	General		P
	A control system including programmable electronic equipment (e.g. programmable controllers) can be used to implement safety functions t machinery.		P
	Where a programmable electronic control system is used it is necessary to consider its performance requirements in relation		P

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	to the requirements for the safety functions.		
	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 affect the performance of the safety-related control function(s) are sufficiently low.	Comply with the requirement	P
	Where a programmable electronic control system performs a monitoring function, the system behaviour on detection of a fault shall be considered (see also IEC 61508 series for further guidance)		P
	The programmable electronic control system should be installed and validated to ensure that the specified performance (e.g. safety integrity level (SIL) in IEC 61508 series) for each safety function has been achieved.	Comply with the requirement	P
	Validation comprises testing an analysis (e.g. static, dynamic or failure analysis) to show that all parts interact correctly to perform the safety function and that unintended functions do not occur.		P
6.2.11.7.2	Hardware aspects		P
	The hardware (including e.g. sensors, actuators, logic solvers) shall be selected (and/or designed) and installed to meet both the functional and performance requirements of the safety function(s) to be performed, in particular, by means of :	Logic solvers	P
	- architectural constraints (e.g. the configuration of the system, its ability to tolerate faults, its behaviour on detection of a fault);		P
	- selecting (and/or designing) equipment and devices with an appropriate probability of dangerous random hardware failure;		P
	-Incorporating measures and techniques within the hardware to avoid systematic failures and control systematic faults.		P
6.2.11.7.3	Software aspects		P
	The software (including internal operating software (or system software) and application software) shall be designed	Satisfy the performance specification for the	P

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	so as to satisfy the performance specification for the safety functions (see also IEC 61508-3)	safety functions	
	Application software		-
	Application software should not be re-programmable by the user.		P
	This may be achieved by use of embedded software in a non re-programmable memory (e.g. micro-controller, application specific integrated circuit (ASIC))		N
	When the application requires reprogramming by the user, the access o the software dealing with safety functions should be restricted e.g. by : - locks; - passwords for the authorized persons		N
6.2.11.8	Principles relating to manual control		P
	a) Manual control devices shall be designed and located according to the relevant ergonomic principles given in 6.2.8	See the photo.	P
	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.	A stop control device has been placed near each start control device.	P
	c) Manual controls shall be located out of reach of the danger zones (see IEC 61310-3), except for certain controls where, of necessity, they are located within a danger zone, such as emergency stop or teach pendant.	Manual controls have been located out of reach of the danger zones.	P
	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.	The operator is able to observe the working area or hazard zone.	P
	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 a ride-on mobile machine	N
	On machinery intended for lifting persons, controls for lifting	Not for lifting	N

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Clause	Requirement-Test	Result-Remark	Verdict
	and lowering and, if appropriate, for moving the carrier, shall generally be located in the carrier. If safe operation requires controls to be situated outside the carrier, the operator in the carrier shall be provided with the means of preventing hazardous movements.	persons.	
	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 (teach pendant, for instance), with which the operator may enter danger zones.	Only one control.	N
	f) Control actuators shall be designed or guarded so that their effect, where a risk is involved, cannot occur without intentional operation (see ISO 9355-1 and ISO 447)		P
	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.		N
	h) For cableless control an automatic stop shall be performed when correct control signals are not received, including loss of communication (see EN 60204-1)		P
6.2.11.9	Control mode for setting, teaching, process changeover, fault-finding, cleaning or maintenance		P
	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:		N
	- disables all other control modes;		N
	- 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;		N

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Clause	Requirement-Test	Result-Remark	Verdict
	- permits operation of the hazardous elements only in reduced risk conditions (e.g. reduced speed, reduced power/force, step-by-step operation, e.g. with a limited movement control device)		N
	prevents any operation of hazardous functions by voluntary or involuntary action on the machine's sensors.		N
	This control mode shall be associated with one or more of following measures:		-
	- restriction of access to the danger zone as far as possible.		P
	- emergency stop control within immediate reach of the operator;		P
	- portable control unit (teach pendant) and/or local controls allowing sight of the controlled elements.(see EN 60204-1:2006, 9.2.4)		P
6.2.11.10	Selection of control and operating modes		P
	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 (e.g. to allow for adjustment , setting, maintenance, inspection), it shall be fitted with a mode selector which can be locked in each position.	Fitted with a mode selector which can be locked in each position.	P
	Each position of the selector shall be clearly identifiable and shall exclusively allow one control or operating mode.		P
	The selector may be replaced by another selection means which restricts the use of certain functions of the machinery to certain categories of operators (e.g. access codes for certain numerically controlled functions).		P
6.2.11.11	Applying measures achieve electromagnetic compatibility (EMC)		P
	For guidance on electromagnetic compatibility, see EN 60204-1, and IEC 61000-6 series.	EN 61000-6 series	P
6.2.11.12	Provision of diagnostic systems to aid fault-finding		P
	Diagnostic systems to aid fault finding should be included in the control system so that there is no need to disable any		P

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Clause	Requirement-Test	Result-Remark	Verdict
	protective measures.		
6.2.12	Minimizing the probability of failure of safety functions		P
6.2.12.1	General		P
	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. The continued operation of the safety functions is essential for the safe use of the machine. This can be achieved by :		P
6.2.12.2	Use of reliable components		P
	“Reliable components” means components which are capable of withstanding all disturbances and stresses associated with the usage of the equipment in the conditions of intended use (including the environmental conditions), for the period of time or the number of operations fixed for the use, with a low probability of failures generating a hazardous malfunctioning of the machine. Components shall be selected taking into account all factors mentioned above (see also 6.2.13)	Reliable components have been used.	P
6.2.12.3	Use of “oriented failure mode” components		P
	“Oriented failure mode” components or systems are those in which the predominant failure mode is known in advance and which can be used so that such a failure leads to a non-hazardous alteration of the machine function.		P
	The use of such components should always be considered, particularly in cases where redundancy is (see 6.2.12.4) not employed.		P
6.2.12.4	Duplication (or redundancy) of components or subsystems		-
	In the design of safety-related parts of the machine, duplication (or redundancy) of components may be used so that, if one component fails, another component (or other components) continue(s) to perform its (their) function, thereby ensuring that the safety function remains available.	No duplication (or redundancy) of components	N
	In order to allow the proper action to be initiated, component failure shall be preferably detected by automatic monitoring	Be preferably detected by automatic	P

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Clause	Requirement-Test	Result-Remark	Verdict
	(see 6.2.11.6) or in some circumstances by regular inspection,	monitoring	
	provided that the inspection interval is shorter than the expected lifetime of the components.		P
	Diversity of design and/or technology can be used to avoid common cause failures (e.g. from electromagnetic disturbance) or common mode failures.		P
6.2.13	Limiting exposure to hazards through reliability of equipment		
	Increased reliability of all component parts of machinery reduces the frequency of incidents requiring rectification, thereby reducing exposure to hazards.	This requirement is complied with.	P
	This applies to power systems (operative part) as well as to control systems, to safety functions as well as to other functions of machinery.	This requirement is complied with.	P
	Safety-critical components (as e.g. certain sensors) with a known reliability shall be used.	Safety-critical components are used .	P
	The elements of guards and of protective services shall be particularly reliable, as their failure can expose persons to hazards, and also as poor reliability would encourage attempts to defeat them.		P
6.2.14	Limiting exposure to hazards through mechanization or automation of loading(feeding) /unloading (removal) operations		P
	Mechanization and automation of machine loading/unloading operations and more generally of handling operations (of workpieces, materials, substances) limit the risk generated by these operations by reducing the exposure of persons to hazards at the operating points.		P
	Automation can be achieved e.g. by robots, handling devices, transfer mechanisms, air blast equipment.		N
	Mechanization can be achieved, e.g. by feeding slides, push rods, hand-operated indexing tables.		N
	While automatic feeding and removal devices have much to offer in preventing accidents to machine operators, they can create danger when any faults are being rectified.		N

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	Care shall be taken to ensure that the use of these devices does not introduce further hazards (e.g. trapping, crushing) between the devices and parts of the machine or workpieces/materials being processed.		N
	Suitable safeguards (see 6.3) shall be provided if this cannot be ensured.		N
	Automatic feeding and removal devices with their own control systems and the control systems 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.	Comply with the requirement	P
6.2.15	Limiting exposure to hazards through location of the setting and maintenance points outside of danger zones.		N
	The need for access to danger zones shall be minimized by locating maintenance, lubrication and setting points outside these zones.		N
6.3	Safeguarding and complementary protective measures		P
6.3.1	General		P
	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 (e.g. emergency stop equipment) may have to be implemented.	Appropriate guards and protective devices have been used to protect persons	P
	Certain safeguards may be used to avoid exposure to more than one hazard (e.g. a fixed guard preventing access to a zone where a mechanical hazard is present being used to reduce noise level and collect toxic emissions)	fixed guard is used.	P
6.3.2	Selection and implementation of guards and protective devices		P
6.3.2.1	General	-	
	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 hazard	Please see the related clause.	P

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	generated by moving parts, according to the nature of those parts (see figure 4) and to the need for access to the danger zone(s).		
	The exact choice of a safeguard for a particular machine shall be made on the basis of the risk assessment for that machine.		P
	In selecting an appropriate safeguard for a particular type of machinery or hazard zone, it shall be borne in mind that a fixed guard is simple and shall be used where access of an operator to the danger zone is not required during normal operation (operation without any malfunction) of the machinery.		P
	As the need for frequency of access increase this inevitably leads to the fixed guard not being replaced.		P
	This requires the use of an alternative protective measure (movable interlocking guard, sensitive protective equipment.)		P
	A combination of safeguards may sometimes be required. For example , where, in conjunction with a fixed guard, a mechanical loading (feeding) device is used to feed a workpiece into a machine, thereby removing the need for access to the primary hazard zone, a trip device may be required to protect against the secondary drawing-in or shearing hazard between the mechanical loading (feeding) device, when reachable, and the fixed guard.		P
	Consideration shall be given to the enclosure of control positions or intervention zones to provide combined protection against several hazards which may include:	This requirement has been taken into consideration.	P
	- hazards from falling or ejected objects (e.g. falling object protection structure)		P
	- emission hazards (e.g. protection against noise, vibration, radiation , harmful substances)		P
	- hazards due to the environment (e.g. protection against heat, cold, foul weather)		P
	- hazards due to tipping over or rolling over of machinery (e.g. roll-over or tip-over protection structure)	No such hazards exist in this machine.	N
	The design of such enclosed work stations (e.g. cabs and	No enclosed work	N

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	cabins) shall take into account ergonomic principles concerning visibility, lighting, atmospheric conditions, access, posture.	stations.	
6.3.2.2	Where access to the hazard zone is not required during normal operation		P
	Where access to the hazard zone is not required during normal operation of the machinery, safeguard should be selected from the following:		-
	a) fixed guard (see also ISO 14120)	Fixed guards are provided.	P
	b) interlocking guard with or without guard locking (see also 6.3.3.2.3, ISO 14119, ISO 14120);		N
	c) self-closing guard (see ISO 14120:2002, 3.3.2)		P
	d) sensitive protective equipment, e.g. electro-sensitive protective equipment (see IEC 61496) or pressure sensitive mat (see ISO 13856)	No sensitive protective equipment	N
6.3.2.3	Where access to the hazard zone is required during normal operation		P
	Where access to the hazard zone is required during normal operation of the machinery , safeguards should be selected from the following:		-
	a) interlocking guard with or without guard locking (see also ISO 14119, ISO 14120 and 6.3.3.2.3 of this standard);		N
	b) sensitive protective equipment, e.g electro-sensitive protective equipment (see IEC 61496)	No sensitive protective equipment	N
	c) adjustable guard;		N
	d) self-closing guard (see ISO 14120:2002, 3.3.2)		N
	e) two-hand control device (see ISO 13851)		N
	f) interlocking guard with a start function (control guard) (see 6.3.3.2.5 of this standard)		N
6.3.2.4	Where access to the hazard zone is required for machine setting, teaching, process changeover, fault finding, cleaning or maintenance.		P

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	As far as possible, machines shall be designed so that the safeguards provided for the protection of the production operator may ensure also the protection of personnel in charge of setting, teaching, process changeover, fault finding, cleaning or maintenance without hindering them in performing their task.		P
	Such tasks shall be identified and considered in the risk assessment as parts of the use of the machine (see 5.2)		P
6.3.2.5	Selection and implementation of sensitive protective equipment	No sensitive protective equipment	N
6.3.2.5.1	Selection		N
	Due to the great diversity of the technologies on which their detection function is based, all types of sensitive protective equipment are far from being equally suitable for safety applications.		N
	The following provisions are intended to provide the designer with criteria for selecting , for each application , the most suitable device(s).		N
	Types of sensitive protective equipment include, e.g.:		-
	- light curtains;		N
	- scanning devices as, e.g. laser scanners;		N
	- pressure sensitive mats;		N
	- trip bars, trip wires.		N
	Sensitive protective equipment can be used:		-
	- for tripping purposes;		N
	- for presence sensing;		N
	- for both tripping and presence sensing		N
	- to re-initiate machine operation, a practice which is subject to stringent conditions.		N
	The following characteristics of the machinery, among others, can preclude the sole use of sensitive protective equipment:		N

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	- tendency for the machinery to eject materials or component parts;		N
	- necessity to guard against emissions (noise, radiation, dust, etc.)		N
	- erratic or excessive machine stopping time;		N
	- inability of a machine to stop part-way through a cycle.		N
6.3.2.5.2	Implementation		N
	consideration should be given to :		-
	a) - size, characteristics and positioning of the detection zone (see ISO 13855, which deals with the positioning of some types of sensitive protective equipment)		N
	b) - reaction of the device to fault conditions (see IEC 61496 for electro-sensitive protective equipment)		N
	c)- possibility of circumvention		N
	d)- detection capability and its variation over the course of time (e.g. as a result of its susceptibility to different environmental conditions such as the presence of reflecting surfaces, other artificial light sources, sunlight or impurities in the air.		N
	sensitive protective equipment shall be integrated in the operative part and associated with the control system of the machine so that:		N
	- a command is given as soon as a person or part of a person is detected;		N
	- the withdrawal of the person or part of a person detected does not, by itself, restart the hazardous machine function (s); therefore, the command given by the sensitive protective equipment shall be maintained by the control system until a new command is given;		N
	- restarting the hazardous machine function(s) results from the voluntary actuation , by the operator, of a control device placed outside the hazard zone, where this zone can be observed by the operator;		N

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Clause	Requirement-Test	Result-Remark	Verdict
	- he machine cannot operate during interruption of the detection function of the sensitive protective equipment, except during muting phases,;		N
	- the position and the shape of detection field prevents, ,possibly together with fixed guards, a person or part of a person from entering the hazard zone, or being present in it, without being detected.		N
6.3.2.5.3	Additional requirements for sensitive protective equipment when used for cycle initiation.		N
	In this exceptional application, starting of the machine cycle is initiated by the withdrawal of a person or of the detected part of a person from the sensing field of the sensitive protective equipment, without any additional start command, hence deviating from the general requirement given in the second point of the dashed list in 6.3.2.5.2, above. After switching on the power supply, or when the machine has been stopped by the tripping function of the sensitive protective equipment, the machine cycle shall be initiated only by voluntary actuation of a start control.		N
	Cycle initiation by sensitive protective equipment shall be subject to the following conditions:		-
	a) only active optoelectronic protective devices (AOPDs) complying with IEC 61496 series shall be used;		N
	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;		N
	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;		N
	d) entering the sensing field of the AOPD(s) or opening interlocking guards is the only way to enter the hazard zone;		N
	e) if there is more than one AOPD safeguarding the machine, only one of the AOPD (s) is capable of cycle re-initiation;		N

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Clause	Requirement-Test	Result-Remark	Verdict
	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.		N
6.3.2.6	Protective measures for stability		P
	If stability cannot be achieved by inherently safe design measures such as weight distribution (see 4.6), it will be necessary to maintain it by protective measures such as the use of :		P
	- anchorage bolts;		P
	- locking devices;		P
	- movement limiters or mechanical stops;		N
	- acceleration or deceleration limiters;		N
	- load limiters;		N
	- alarms warning of the approach to stability or tipping limits;		N
6.3.2.7	Other protective devices		N
	When a machine requires continuous control by the operator(e.g. mobile machines, cranes) and an error of the operator can generate a hazardous situation, this machine shall be equipped with the necessary devices to enable the operation to remain within specified limits , in particular:		N
	- when the operator has insufficient visibility of the hazard zone;		N
	- when the operator lacks knowledge of the actual value of a safety –related parameter (e.g. .a distance, a speed, the mass of a load, the angle of a slope)		N
	- when hazards may result from operations other than those controlled by the operator;		N
	The necessary devices include:		-
	- devices for limiting parameters of movement (distance, angle, velocity , acceleration)		N
	- overloading and moment limiting devices:		N

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Clause	Requirement-Test	Result-Remark	Verdict
	- devices to prevent collisions or interference with other machines;		N
	-device for preventing hazards to pedestrian operators of mobile machinery or other pedestrians;		N
	- torque limiting devices, breakage points to prevent excessive stress of components and assemblies;		N
	- devices for limiting pressure, temperature;		N
	- devices for monitoring emissions;		N
	- devices prevent operation in the absence of the operator at the control position;		N
	- device to prevent lifting operations unless stabilizers are in place;		N
	- devices to limit inclination of the machine on a slope;		N
	- devices to ensure that components are in a safe position before traveling;		N
	Automatic protective measures triggered by such devices which take operation of the machinery out of the control of the operator (e.g. automatic stop of hazardous movement) should be preceded or accompanied by a warning signal to enable the operator to take appropriate action (see 6.4.3)		N
6.3.3	Requirements for the design of guards and protective devices		P
6.3.3.1	General requirements		P
	Guards and protective devices shall be designed to be suitable for the intended use, taking into account mechanical and other hazards involved. Guards and protective devices shall be compatible with the working environment of the machine and designed so that they cannot be easily defeated. They shall provide the minimum possible interference with activities during operation and other phases of machine life, in order to reduce any incentive to defeat them.	Guards and protective devices have been appropriately designed.	P
	Guards and protective devices shall :		-
	- be of robust construction.	Steel	P

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Clause	Requirement-Test	Result-Remark	Verdict
	- not give rise to any additional hazard;	No additional hazard	P
	- not be easy to by-pass or render non-operational;	not be easy to by-pass	P
	- be located at an adequate distance from the danger zone (see ISO 13857 and ISO 13855).	an adequate distance from the danger zone	P
	- cause minimum obstruction to the view of the production process;		P
	- enable essential work to be carried out on installation and/or replacement of tools and also for maintenance by allowing access only to the area where the work has to be done, if possible without the guard or protective device having to be moved;		P
	For openings in the guards see ISO 13857		P
6.3.3.2	Requirements for fixed guards		P
6.3.3.2.1	Functions of guards		P
	The functions that guards can achieve are:		P
	- prevention of access to the space enclosed by guard and/or - containment/capture of materials, workpieces, chips, liquids which may be ejected or dropped by the machine and reduction of emissions(noise, radiation, hazardous substances such as dust, fumes, gases) which may be generated by the machine.	The space enclosed. Containment of workpieces, chips, liquids which may be ejected by the machine	P
	Additionally, they may need to have particular properties relating to electricity, temperature, fire, explosion, vibration, visibility(see ISO 14120) and operator position ergonomics(e.g. usability, operator's movements, posture, repetitive movements).		P
6.3.3.2.2	Requirements for fixed guards		P
	Fixed guards shall be securely held in place:		-
	- either permanently (e.g. by welding) - or by means of fasteners (screws, nuts) making removal/opening impossible without using tools; they should	All the fixed guards are securely held in place by appropriate	P

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Clause	Requirement-Test	Result-Remark	Verdict
	not remain closed without their fasteners (see ISO 14120)	fasteners.	
6.3.3.2.3	Requirements for movable guards		P
	a) movable guards which provide protection against hazards generated by moving transmission parts shall :		-
	- as far as possible remain fixed to the machinery or other structure (generally by means of hinges or guides) when open;	by means of guides or hinges	P
	- be interlocking guards (with guard locking when necessary) (see ISO 14119)		N
	b) movable guards against hazards generated by non-transmission moving parts shall be designed and associated with the machine control system so that:		-
	- moving parts cannot start up while they are within the operator's reach and the operator cannot reach moving parts once they have started up ; this can be achieved by interlocking guards, with guard locking when necessary.		N
	- they can be adjusted only by an intentional action , such as the use of a tool or a key;		N
	- the absence or failure of one of their components prevents starting of the moving parts or stops them; this can be achieved by automatic monitoring (see 4.11.6)		N
6.3.3.2.4	Requirements for adjustable guards		N
	Adjustable guards may only be used where the hazard zone cannot for operational reasons be completely enclosed;		N
	They shall :		-
	- be designed so that the adjustment remains fixed during a given operation;		N
	- be readily adjustable without the use of tools;		N
6.3.3.2.5	Requirements for interlocking guards with a start function (control guards)		N
	An interlocking guard with a start function may be used provided that		-
	- all requirements for interlocking guards are satisfied (see		N

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Clause	Requirement-Test	Result-Remark	Verdict
	ISO 14119)		
	- the cycle time of the machine is short		N
	- the maximum opening time of the guard is present to a low value (e.g. equal to the cycle time). When this time is exceeded, the hazardous function(s) cannot be initiated by the closing of the interlocking guard with a start function and resetting is necessary before restarting the machine.		N
	- 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)		N
	- all other guards whether fixed (removable type) or movable are interlocking guards;		N
	- the interlocking device associated with the interlocking guard with a start function is designed in such a way – e.g. by duplication of position detectors and use of automatic monitoring (see 4.11.6)- that its failure cannot lead to an unintended/unexpected start-up;		N
	- the guard is securely held open (e.g. by a spring or counterweight)such that it cannot initiate a start while falling by its own weight;		N
6.3.3.2.6	Hazards from guards		P
	Care shall be taken to prevent hazards which might be generated by :		-
	- the guard construction (e.g. sharp edges or corners, material);	No harp edges and corners.	P
	- the movements of the guards (shearing or crushing zones generated by power-operated guards and by heavy guards which are liable to fall)		N
6.3.3.3	Technical characteristics of protective devices		P
	Protective devices shall be selected or designed and connected to the control system so as to ensure correct implementation of their safety function (s) is ensured.		P

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Clause	Requirement-Test	Result-Remark	Verdict
	Protective devices shall be selected on the basis of their having met the appropriate product standard (for example, IEC 61496 for active optoelectronic protective devices) or shall be designed according to one or several of the principles formulated in ISO 13849-1 or IEC 62061.		P
	Protective devices shall be installed and connected to the control system so that they cannot be easily defeated.		P
6.3.3.4	Provisions for alternative types of safeguards.		N
	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.		N
6.3.4	Safeguarding for reducing emissions		P
6.3.4.1	General		
	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 (see 6.3.4.2 to 6.3.4.5).		P
6.3.4.2	Noise		P
	Additional protective measures include, for example: - enclosures (see ISO 15667) - screens fitted to the machine; - silencers (see ISO 14163)	Enclosures	P
6.3.4.3	Vibration		N
	Additional protective measures include, for example, damping devices for vibration isolation between the source and the exposed person such as resilient mounting or suspended seats.		N
	For measures for vibration isolation of stationary industrial machinery see EN 1299		N
6.3.4.4	Hazardous substances		P
	Additional protective measures include, for example:		-

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Clause	Requirement-Test	Result-Remark	Verdict
	- encapsulation of the machine (enclosure with negative pressure);	Encapsulation of the machine	P
	- local exhaust ventilation with filtration.		N
	- wetting with liquids;		N
	- special ventilation in the area of the machine (air curtains , cabins for operators)		N
6.3.4.5	Radiation		N
	Additional protective measures include, for example:		-
	- use of filtering and absorption;		N
	- use of attenuating screens or guards		N
6.3.5	Complementary protective measures		P
6.3.5.1	General		P
	Protective measures which are neither inherently safe design measures, nor safeguarding (implementation of guards and/or protective devices), 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		P
6.3.5.2	Components and elements to achieve the emergency stop function		P
	If following a risk assessment, a machine needs to be fitted with components and elements to achieve an emergency stop function to enable actual or impending emergency situations to be averted, the following requirements apply:		-
	- the actuators shall be clearly identifiable, clearly visible and readily accessible		P
	- the hazardous process shall be stopped as quickly as possible without creating additional hazards . If this is not possible or the risk cannot be reduced, it should be questioned whether implementation of an emergency stop function is the best solution;		N

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Clause	Requirement-Test	Result-Remark	Verdict
	- the emergency stop control shall trigger or permit the triggering of certain safeguard movements where necessary.		P
	Once active operation of the emergency stop device has ceased following an emergency stop command, the effect of this command shall be sustained until it is reset.		P
	This reset shall be possible only at that location where the emergency stop command has been initiated. The reset of the device shall not restart the machinery , but only permit restarting.		P
	More details for the design and selection of electrical components and elements to achieve the emergency stop function are provided in EN 60204 series.		P
6.3.5.3	Measures for the escape and rescue of trapped persons		P
	Measures for the escape and rescue of trapped persons may consist e.g. of :		-
	- escape routes and shelters in installations generating operator-trapping hazards		P
	- arrangements for moving some elements by hand, after an emergency stop		N
	- arrangements for reversing the movement of some elements		N
	- anchorage points for descender devices;		N
	- means of communication to enable trapped operators to call for help		P
6.3.5.4	Measures for isolation and energy dissipation		P
	Especially with regard to their maintenance and repair , machines shall be equipped with the technical means to achieve the isolation from power supply(ies) and dissipation of stored energy as a result of following actions:		P
	a) isolating (disconnecting, separating) the machine (or defined parts of the machine) from all power supplies;		P
	b) locking (or otherwise securing) all the isolating units in the isolating position;		P
	c) dissipating or , if this is not possible or practicable, restraining (containing) any stored energy which may give		N

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Clause	Requirement-Test	Result-Remark	Verdict
	rise to a hazard;		
	d) verifying, by means of a safe working procedure, that the actions taken according to a), b) and c) above have produced the desired effect.		P
	See ISO 14118:2000, clause 5 and EN 60204-1:2006, 5.5 and 5.6	See the test report of EN 60204-1.	P
6.3.5.5	Provisions for easy and safe handling of machines and their heavy component parts		P
	Machines and their component parts which cannot be moved or transported by hand shall be provided or capable of being provided with suitable attachment devices for transport by means of lifting gear.	Provided with suitable attachment devices for transport by means of lifting gear.	P
	These attachments may be, among others,		-
	- standardized lifting appliances with slings, hooks, eyebolts, or tapped holes for appliance fixing;	slings	P
	- appliances for automatic grabbing with a lifting hook when attachment is not possible from the ground.		N
	- guiding grooves for machines to be transported by a fork truck;		N
	- lifting gear and appliances integrated into the machine.		N
	Parts of machinery which can be removed manually in operation shall be provided with means for their safe removal and replacement; See also 6.4.4c) (item 3).	Not removed manually in operation	N
6.3.5.6	Measures for safe access to machinery		N
	Machinery shall be so designed as to enable operation and all routine tasks relating to setting and/or maintenance, to be carried out, as far as possible, by a person remaining at ground level.	Comply with requirements	P
	Where this is not possible, machines shall have built-in platforms, stairs or other facilities to provide safe access for those tasks, but care should be taken to ensure that such platforms or stairs do not give access to danger zones of machinery.		N

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Clause	Requirement-Test	Result-Remark	Verdict
	The walking areas shall be made from materials which remain as slip resistant as practicable under working conditions and, depending on the height from the ground, suitable guard-rails (see ISO 14122-3) shall be provided.	Comply with requirements	P
	In large automated installations, particular attention shall be given to safe means of access such as walkways, conveyor bridges or crossover points.		N
	Means of access to parts of machinery located at a height shall be provided with collective means of protection against falls (e.g. guard-rails for stairways, stepladders and platforms and/or safety cages for ladders)		N
	As necessary , anchorage points for personal protective equipment against falls from a height shall also be provided (e.g. in carriers of machinery for lifting persons or with elevating control sations)		N
	Openings shall whenever possible open towards a safe position. They shall be designed to prevent hazards due to unintended opening.		N
	The necessary aids for access shall be provided (e.g. steps, handholds). Control devices shall be designed and located to prevent their being used as aids for access.		N
	When machinery for lifting goods and/or persons includes landings at fixed levels, these shall be equipped with interlocking guards preventing falls when the platform is not present at the level.		P
	Movement of the lifting platform shall be prevented while the guards are open.		P
	For detailed provisions see ISO 14122.		N
6.4	Information for use		P
6.4.1	General requirements		P
6.4.1.1	Drafting information for use is an integral part of the design of a machine (see figure 2).		P
	Information of use consists of communication links, such as texts, words, signs, signals, symbols or diagrams, used		P

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Clause	Requirement-Test	Result-Remark	Verdict
	separately or in combination to convey information to the user. It is directed to professional and/or non-professional users.		
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.	See the instruction	P
	The information shall contain all directions required to ensure safe and correct use of the machine. With this in view, it shall inform and warn the user about residual risk.	See the instruction	P
	The information shall indicate, as appropriate,		-
	- the need for training,	See the instruction	P
	- the need for personal protective equipment,		P
	- the possible need for additional guards or protective devices (see Figure 2, Footnote d).	See the instruction	P
	It shall not exclude uses of the machine that can reasonably be expected from its designation and description and shall also warn about the risk which would result from using the machine in other ways than the ones described in the information, especially considering its reasonably foreseeable misuse.	See the instruction	P
6.4.1.3	Information for use shall cover, separately or in combination, transport, assembly and installation, commissioning, use of the machine (setting, teaching/programming or process changeover, operation, cleaning, fault-finding and maintenance) and, if necessary, dismantling, disabling and scrapping.	See the instruction	P
6.4.2	Location and nature of the information for use		P
	Depending on the risk , the time when the information is needed by the user and the machine design , it shall be decided whether the information – or parts thereof – are to be given:		P
	- in /on the machine itself (see 6.3 and 6.4.4)	Adequate information is stated in the machine itself.	P

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Clause	Requirement-Test	Result-Remark	Verdict
	- in accompanying documents (in particular instruction handbook , see 6.4.5)	See the instruction	P
	- on the packaging	Adequate information is stated on the packaging	P
	- by other means such as signals and warnings outside the machine.	Signals and warnings outside the machine.	P
	Standardized phrases shall be considered where important messages such as warnings need to be given (see also IEC 62079)		P
6.4.3	Signals and warning devices		P
	Visual signals (e.g. flashing lights) and audible signals (e.g. sirens) may be used to warn of an impending hazardous event such as machine start-up or overspeed.	Signals and warning devices are provided.	P
	Such signals may also be used to warn the operator before the triggering of automatic protective measures (see last paragraph of 5.2.7)	Please the related clause.	P
	It is essential that these signals:		-
	- be emitted before the occurrence of the hazardous event; - be unambiguous; - be clearly perceived and differentiated from all other signals used; - be clearly recognized by the operator and other persons.	Unambiguous, clearly perceived, clearly recognized	P
	The warning devices shall be designed and located such that checking is easy.		N
	The information for use shall prescribe regular checking of warning devices.		P
	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.		P
6.4.4	Markings, signs (pictograms), written warnings		P
	Machinery shall bear all markings which are necessary:		-
	a) for its unambiguous identification, at least :		-

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Clause	Requirement-Test	Result-Remark	Verdict
	- name and address of the manufacturer; - designation of series or type; - serial number, if any.		P
	b) in order to indicate its compliance with mandatory requirements; - marking; - written indications (e.g. for machines intended for use in potentially explosive atmosphere)		N
	c) for its safe use, e.g. :		-
	- maximum speed of rotating parts;		N
	- maximum diameter of tools;		N
	- mass (expressed in kilograms) of the machine itself and/or of removable parts		N
	- maximum working load;		N
	-necessity of wearing personal protective equipment;		P
	- guard adjustment data;		P
	- frequency of inspection.	See the instruction	P
	Information printed directly on the machine should be permanent and remain legible throughout the expected life of the machine.	Permanent and remain legible	P
	Signs or written warnings only saying “danger” shall not be used.		P
	Markings, signs and written warnings shall be readily understandable and unambiguous, especially as regards the part of the function(s) of the machine which they are related to.		P
	Readily understandable signs (pictograms) should be used in preference to written warnings.		P
	Signs and pictograms should only be used if they are understood in the culture in which the machinery is to be used.		P
	Markings shall comply with recognized standards (see ISO 2972, ISO 7000, particularly for pictograms, symbols ,	All the markings are standard.	P

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Clause	Requirement-Test	Result-Remark	Verdict
	colours) See EN 60204 series as regards marking of electrical equipment.		
6.4.5	Accompanying documents (in particular, instruction handbook)		P
6.4.5.1	Contents		P
	The instruction handbook or other written instructions (e.g. on the packaging) shall contain among others:		-
	a) information relating to transport, handling and storage of the machine e.g. : - storage conditions for the machine; - dimensions , mass value(s), position of the centre (s) of gravity; - indications for handling (e.g. drawings indicating application points for lifting equipment)	All the related information is stated in the instruction handbook	P
	b) information relating to installation and commissioning of the machine, e.g. - fixing/anchoring and vibration dampening requirements; - assembly and mounting conditions; - space needed for use and maintenance; - permissible environmental conditions (e.g. temperature, moisture, vibration, electromagnetic radiation); - instructions for connecting the machine to power supply (particularly about protection against electrical overloading); - advice about waste removal /disposal; - if necessary, recommendations about protective measures which have to be taken by the user; e.g. additional safeguards, safety distances, safety signs and signals.	All the related information is stated in the instruction handbook	P
	c) information relating to the machine itself, e.g. : - detailed description of the machine, its fittings, its guards and/or protective devices; - comprehensive range of applications for which the machine is intended, including prohibited usages, if any , taking into account variations of the original machine if appropriate. - diagrams ; - data about noise and vibration generated by the machine,	All the related information is stated in the instruction handbook	P

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Clause	Requirement-Test	Result-Remark	Verdict
	about radiation , gases, vapours, dust emitted by it, with reference to the measuring methods used. - technical documentation about electrical equipment - documents attesting that the machine complies with mandatory requirements;		
	d) information relating to the use of the machine, e.g. about: - intended use; - description of manual controls (actuators); - setting and adjustment; - modes and means for stopping - risks which could not be eliminated by the protective measures taken by the designer; - particular risks which may be generated by certain applications, by the use of certain fittings, and about specific safeguards which are necessary for such applications. - reasonably foreseeable misuse and prohibited usages; - fault identification and location , repair, and re-starting after an intervention; - personal protective equipment which need to be used and training required.	All the related information is stated in the instruction handbook	P
	e) information for maintenance e.g. - nature and frequency of inspections for safety functions; - instructions relating to maintenance operations which require a definite technical knowledge or particular skills and hence should be carried out exclusively by skilled persons (e.g. maintenance staff, specialists) - instructions relating to maintenance actions (e.g. replacement of parts) which do not require specific skills and hence may be carried out by users (e.g. operators) - drawings and diagrams enabling maintenance personnel to carry out their task rationally	All the related information is stated in the instruction handbook	P
	f) information relating to de-commissioning , dismantling and disposal;	See the instruction handbook	P
	g) information for emergency situations , e.g. : - type of fire-fighting equipment to be used.		N

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Clause	Requirement-Test	Result-Remark	Verdict
	- warning about possible emission or leakage of harmful substance(s), and if possible, indication of means to fight their effects.		
	h) maintenance instructions provided for skilled persons (second dash in e))and maintenance instructions provided for unskilled persons (third dash in e)), that should appear clearly separated from each other.	All the related information is stated in the instruction handbook	P
6.4.5.2	Production of the instruction handbook		P
	a) type and size of print shall ensure the best possible legibility. Safety warnings and/or cautions should be emphasized the use of colours, symbols and/or large print.	Legibility.	P
	b) 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. If more than one language are to be used, each language should be readily distinguished from the other(s), and efforts should be made to keep the translated text and the relevant illustration together.	English	P
	c) whenever helpful to the understanding, text should be supplemented with written details enabling , for instance, manual controls (actuators) to be located and identified; they should not be separated from the accompanying text and should follow sequential operations.	See the Instruction handbook.	P
	d) consideration should be given to presenting information in tabular form where this will aid understanding. Tables should be adjacent to the relevant text.	See the Instruction handbook.	P
	e) the use of colours should be considered, particularly in relation to components requiring quick identification.		N
	f) when information for use is lengthy, a table of contents and/or an index should be given.		P
	g) safety-relevant instructions which involve immediate action should be provided in a form readily available to the operator.		P
6.4.5.3	Drafting and editing information for use		P

EN ISO 12100			
Clause	Requirement-Test	Result-Remark	Verdict
	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).	See the difference between the models	P
	b) communicate 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.		P
	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.		P
	d) when it is foreseen that a machine will be put to non-professional use, the instructions should be written in a form that is readily understood by the non-professional users. If personal protective equipment is required for the safe use of the machine, clear advice should be given, e.g. on the packaging as well as on the machine, so that this information is prominently displayed at the point of sale.	Not for non-professional use	N
	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 may be useful to mark them “keep for future reference”. Where information for use is kept in electronic form (e.g. CD, DVD, tape) information on safety-related issues that need immediate action shall always be backed up with a hand copy that is readily available.	Kept in electronic form	P
7	Documentation of risk assessment and risk reduction		P
	The documentation shall demonstrate the procedure that has been followed and the results that have been achieved. This includes, when relevant, documentation of		-
	a) the machinery for which the risk assessment has been made (for example, specifications, limits, intended use);		P
	b) any relevant assumptions that have been made (loads, strengths, safety factors, etc.);		P

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	c) the hazards and hazardous situations identified and the hazardous events considered in the risk assessment;		P
	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.);		P
	2) the uncertainty associated with the data used and its impact on the risk assessment;		P
	e) the risk reduction objectives to be achieved by protective measures;		P
	f) the protective measures implemented to eliminate identified hazards or to reduce risk;	Warning sign and wear PPE	P
	g) residual risks associated with the machinery;		P
	h) the result of the risk assessment (see Figure 1);	See the risk assessment report.	P
	i) any forms completed during the risk assessment.		P
	Standards or other specifications used to select protective measures referred to in f) above should be referenced.		P

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4	GENERAL REQUIREMENTS		P
4.1	General		P
	Hazards relevant to the electrical equipment are assessed as part of the overall risk assessment of the machine as described		P
4.2	Selection of equipment		P
4.2.1	Electrical components and devices shall be: -suitable for their intended use -conform to IEC standards where such exist -be applied in accordance with supplier's instructions		P
4.2.2	Where appropriate electrical equipment in compliance with IEC 61439 series		P
4.3	Electrical supply		P
4.3.1	Electrical equipment to be designed for correct operation within the conditions of mains power supply		N
	as stated below (4.3.2 or 4.3.3)		N
	or as specified by the user		N
	or as specified by the supplier (4.3.4)		N
4.3.2	AC supplies		P
	Supply Voltage: Steady state voltage: 0.9 ... 1.1 of nominal voltage		P
	Frequency: 0.99 ... 1.01 of nominal frequency continuously; 0.98 ... 1.02 short time.		P
	Harmonics: not exceeding 12 % of the total r.m.s. etc.		P
	Voltage unbalance: not exceeding 2% deviation		P

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	Voltage interruption: interrupted or at zero voltage for not more than 3 ms at any random time in the supply cycle with more than 1 s between successive interruptions		P
	Voltage dips not exceeding 20 % of the rms voltage of the supply for more than one cycle with more than 1 s between successive dips		P
4.3.3	DC supplies		N
	Supply voltage: -batteries: 0.85 – 1.15 of nominal voltage -battery-operated vehicles: 0.7 – 1.2 of nom. volt. -from converting equipment: 0.9 – 1.1 of nom. volt.		N
	Voltage interruption: - batteries: not exceeding 5 ms - converting equipment: not exceeding 20 ms		N
	Ripple (peak-to-peak): not exceed. 0.15 of nom. volt.		N
4.3.4	Special supply systems (e.g. on-board generators, DC bus) limits acc. 4.3.2 /3 may be exceeded, provided equipment is designed accordingly		N
4.4	Physical environment and operating conditions		P
4.4.1	Electrical equipment suitable for the physical environment and operating conditions of its intended use.		P
4.4.2	The electrical equipment shall not generate electromagnetic disturbances above levels that are appropriate for its intended operating environment. In addition, the electrical equipment shall have a sufficient level of immunity to electromagnetic disturbances so that it can function in its intended environment.		P

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Clause	Requirement + Test	Result - Remark	Verdict
4.4.3	Electrical equipment shall be capable of operating correctly in the intended ambient air temperature. (Minimum requirement: air temperatures of +5 °C and +40 °C)		P
4.4.4	Electrical equipment shall be capable of operating correctly when the relative humidity is up to 50 % at a maximum temperature of +40 °C		P
	Harmful effects of condensation shall be avoided		P
4.4.5	Electrical equipment shall be capable of operating correctly at altitudes up to 1 000 m above mean sea level		P
	For equipment to be used at higher altitudes, it is necessary to take into account changes in parameters for example, the reduction of:		P
	– the dielectric strength, and;		P
	– the switching capability of the devices, and;		P
	– the cooling effect of the air.		P
4.4.6	Electrical equipment shall be adequately protected against the ingress of solids and liquids (see 11.3)		P
4.4.7	When equipment is subjected to radiation, additional measures shall be taken		P
4.4.8	Undesirable effects of vibration, shock and bump avoided by suitable means		P
4.5	Electrical equipment designed to withstand the effects of transportation and storage within a temperature range of - 25 to + 55 °C		P
4.6	Heavy or bulky electrical equipment of the machine provided with suitable means for handling		P

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5	INCOMING SUPPLY CONDUCTOR TERMINATIONS AND DEVICES FOR DISCONNECTING AND SWITCHING OFF		P
5.1	Incoming supply conductor terminations		P
	Recommendation that electrical equipment of a machine is connected to a single supply (For large complex machinery, there can be a need for more than one incoming supply)		P
	Unless a plug is provided, supply conductors should be terminated at the supply disconnecting device		P
	Neutral conductor clearly indicated in technical documentation with “N” (see cl. 16.1)		N
	A separate terminal, labelled N provided (it may be part of the supply disconnecting device)		N
	No connection between neutral conductor and protective bonding circuit		
	Exception: a connection may be made between the neutral terminal and the PE terminal at the point of the connection of the electrical equipment to a TN-C supply system.		N
	For machines supplied from parallel sources the requirements of IEC 60364-1 apply		N
	All terminals of incoming supply clearly marked in ac. with IEC 60445)		P
5.2	Terminal for connection of external protective conductor (PE)		P
	For each incoming supply, a terminal shall be provided in the same compartment as the line conductor terminals for connection to the external protective conductor		P

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Clause	Requirement + Test	Result - Remark	Verdict
	Terminal size according to table 1 in relation to the line conductors		N
	Where an external protective conductor other than copper is used, the terminal size and type shall be selected accordingly		N
	At each incoming point this terminal shall be marked or labelled with the letters PE		N
5.3	Supply disconnecting device		P
5.3.1	A supply disconnecting device shall be provided: – for each incoming supply to a machine – for each on-board power supply		P
	Where two or more such devices exist, interlocks shall be provided to prevent hazardous situations		N
5.3.2	The supply disconnecting device shall be one of the following:		—
	a) a switch-disconnector, acc. to IEC 60947-3 for at least appliance category AC-23 B or DC-23 B		P
	b) a control and protective switching device suitable for insulation acc. to IEC 60947-6-2		P
	c) a circuit-breaker suitable for isolation (acc. to IEC 60947-2)		P
	d) any other switching device in accordance with an IEC product standard for that device and which meets the isolation requirements and the appropriate utilization category and/or specified endurance requirements		N
	e) a plug/socket combination for a flexible cable supply		N
5.3.3	A disconnection device acc. to 5.3.2 a) to d) has to fulfil all of the following requirements		—

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Clause	Requirement + Test	Result - Remark	Verdict
	- isolate the electrical equipment from the supply and have one OFF (isolated) and one ON position marked with "O" and "I"		N
	- have a visible contact gap or a position indicator which cannot indicate OFF (isolated) until all contacts are actually open and the requirements for the isolating function have been satisfied		N
	- have an operating means (see 5.3.4)		N
	- be provided with a means permitting it to be locked in the OFF position (padlocks). When so locked, remote as well as local closing shall be prevented		N
	- disconnect all live conductors of its power supply circuit For TN supply systems, the neutral conductor may or may not be disconnected except in countries where disconnection of the neutral conductor (when used) is compulsory		N
	- have a braking capacity to interrupt the system, when the largest motor is stalled		N
	Where a plug/socket combination is used as a disconnection device it shall: - comply with 13.4.5 - have a braking capacity to interrupt the system, when the largest motor is stalled		P
	Where a plug/socket combination is used as a disconnection device, an appropriate switching device shall be provided for switching the machine on and off		P
5.3.4	Operating means of supply disconnecting devices (e.g. a handle) shall be external to the enclosure		N
	Exception: for power-operated switchgear this can be some other means (e.g. pushbutton) instead of a handle		N

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Clause	Requirement + Test	Result - Remark	Verdict
	The operating means shall be easily accessible and located between 0,6 m and 1,9 m above the servicing level (upper limit of 1,7 m is recommended)		N
	Where intended for emergency operation, see 10.7.3 or 10.8.3		N
	Where not intended for emergency operation - the colours black or grey are recommended - a supplementary cover or door that can be readily opened without a key or tool may be provided. It shall clearly show its function, e.g. by relevant symbols		N
5.3.5	The following circuits need not be disconnected by the supply disconnecting device: - lighting circuits for lighting needed during maintenance or repair; - socket outlets for the exclusive connection of repair or maintenance tools and equipment; - undervoltage protection circuits that are only provided for automatic tripping in the event of supply failure; - circuits supplying equipment that should normally remain energized for correct operation Such circuits should be provided with their own disconnecting device.		N
	Where expected circuits are not disconnected by the supply disconnecting device:		—
	-permanent warning labels shall be placed close to the operating means		N
	-a statement shall be included in the maintenance manual and		N

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Clause	Requirement + Test	Result - Remark	Verdict
	-the conductors are identified by colour, taking into account the recommendation of Cl.13.2.4, or -expected circuits are separated from other circuits, or -expected circuits are identified by permanent warning labels		N
5.4	Devices for removal of power for prevention of unexpected start-up		N
	Devices for removal of power for the prevention of unexpected start-up shall be provided where this can create a hazard		N
	They shall be appropriate and convenient for the intended use, suitably placed, and readily identifiable as to their function and purpose		N
	Where not obvious, they shall be marked to indicate the extent of removal of power		N
	Devices in accordance with 5.3.2 may be used for this purpose		N
	Disconnectors, withdrawable fuse links and withdrawable links only used, if located in enclosed electrical operator area (see 3.1.23)		N
	Devices that do not fulfil the isolation function (e.g. a contactor switched off by a control circuit etc.) only used for tasks such as: – inspections; – adjustments; – work on the electrical equipment where there are only minor risks (as described)		N
5.5	Devices for isolating electrical equipment		N
	Devices shall be provided for isolating electrical equipment or parts of it to enable work		N

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Clause	Requirement + Test	Result - Remark	Verdict
	Such devices shall be: - appropriate and convenient for the intended use; - suitably placed; - readily identifiable as to which part or circuit of the equipment is served. They shall be marked unless their function and purpose is obvious		N
	Where it is necessary to work on individual parts of the electrical equipment of a machine, or on one of a number of machines fed by a common conductor bar, conductor wire or inductive power supply system, a disconnecting device is provided for each part, or for each machine, requiring separate isolation		N
	In addition, the following devices that fulfil the isolation function may be provided for this purpose: - devices described in 5.3.2; - disconnectors, withdrawable fuse links and withdrawable links only used, if located in enclosed electrical operator area (see 3.1.23) and information provided (see cl 17)		N
5.6	Protection against unauthorized, inadvertent and/or mistaken connection		N
	Where devices acc. to cl. 5.4 and 5. are located outside an enclosed electrical operator area, locking means in OFF position shall be provided When so secured, local and remote reconnection shall be prevented		N
	Where these devices are located inside an enclosed electrical operator area, other means of protection against unintended reconnection can be sufficient		N
	Where a plug/socket combinations is so positioned that it can be kept under the immediate supervision of the person carrying out the work, means for securing in the disconnected state are not needed		N

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Clause	Requirement + Test	Result - Remark	Verdict
6	PROTECTION AGAINST ELECTRIC SHOCK		P
6.1	The electrical equipment shall provide protection against electric shock by basic protection and fault protection		P
	Where the measures for protection as in 6.2, 6.3 and 6.4 are not practicable, other measures from IEC 60364-4-41 may be used (e.g. SELV)		P
6.2	Basic protection		P
6.2.1	For each circuit the measures of 6.2.2, 6.2.3 and, where applicable, 6.2.4 shall apply		P
	Where not appropriate, other measures as defined in IEC 60364-4-41 may be applied (see also 6.2.5 and 6.2.6)		N
	For equipment in places open to all persons including children, 6.2.2 with a minimum protection of IP4X or IPXXD, or 6.2.3 shall be applied		N
6.2.2	Live parts shall be located inside enclosures that provide protection against contact with live parts of at least IP2X or IPXXB.		N
	Where the top surfaces of the enclosure are readily accessible, the minimum degree of protection against contact with live parts provided by the top surfaces shall be IP4X or IPXXD.		N
	Opening an enclosure (i.e. opening doors, lids, covers, etc) shall be possible only under one of the following conditions:		—



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Clause	Requirement + Test	Result - Remark	Verdict
	a) The use of a key or tool is necessary for access All live parts (including those on the inside of doors) likely to be touched when resetting or adjusting devices intended for such operations while the equipment is still connected, are protected against contact to at least IP2X or IPXXB Other live parts on the inside of doors are protected against unintentional direct contact to at least IP1X or IPXXA.		N

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Clause	Requirement + Test	Result - Remark	Verdict
	b) The disconnection of live parts inside the enclosure before it can be opened (see explanation) Exception: a key or tool as prescribed by the supplier can be used to defeat the interlock, provided that the following conditions are met: - it is possible at all times while the interlock is defeated to open the disconnecting device and lock the disconnecting device in the OFF position or otherwise prevent unauthorised closure of the disconnecting device; - upon closing the door, the interlock is automatically restored - all live parts (), likely to be touched ... are protected against unintentional contact to at least IP2X or IPXXB and other live parts on the inside of doors shall be protected against unintentional contact to at least IP1X or IPXXA - relevant information about the procedure for the defeat of the interlock is provided with the instructions for use of the electrical equipment - means are provided to restrict access to live parts behind doors that are not directly interlocked with the disconnecting means to skilled or instructed persons All parts still alive after switching off the disconnecting device shall be protected against direct contact to at least IP 2X or IP XXB and be marked with a warning sign in accordance with 16.2.1 except for: - parts that can be live only because of connection to interlocking circuits and that are distinguished by colour as potentially live in accordance with 13.2.4 - the supply terminals of the supply disconnecting device when the latter is mounted alone in a separate enclosure		N

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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 contact to at least IP2X or IPXXB. Where barriers provide this protection, either they shall require a tool for their removal or all live parts protected by them shall be automatically disconnected when the barrier is removed. Where a hazard can be caused by manual action of devices () , such action shall be prevented by barriers or obstacles that require a tool for their removal		N
6.2.3	Live parts protected by insulation shall be completely covered with insulation that can only be removed by destruction and that is capable of withstanding the mechanical, chemical, electrical, and thermal stresses to which it can be subjected under normal operating conditions		N
	Note: Paint, varnish lacquer etc. alone are generally considered inadequate		N
6.2.4	Live parts having a residual voltage greater than 60 V when disconnected, shall be discharged to 60 V or less within 5 s, if this does not interfere with the proper functioning of the equipment		N
	Exempted are components having stored charges of 60 μ C or less		N
	Where not possible , an appropriate warning shall be placed according to the details given		N
	In case of pins of plugs etc. the discharge time shall not exceed 1s. Otherwise such conductors shall be protected to at least IP2X or IPXXB.		N

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Clause	Requirement + Test	Result - Remark	Verdict
	If above requirements cannot be achieved, additional disconnecting devices or appropriate warning devices shall be provided		N
	When equipment is accessible to all persons incl. children, warnings are not sufficient and a protection of IP4X or IPXXD is required		N
6.2.5	For protection by barriers, the requirements of IEC 60364-4-41 shall apply (412.2)		N
6.2.6	For protection by placing out of reach or protection by obstacles, the requirements of IEC 60364-4-41 shall apply (412.4 and 412.3)		N
	For conductor wire or bar systems with less than IP2X or IPXXB, see 12.7.1		N
6.3	Fault protection		P
6.3.1	For each circuit or part of el. equipment at least one of the measures of 6.3.2 to 6.3.3 shall be applied:		—
	-Prevention of the occurrence of a touch voltage		P
	-Protection by automatic disconnection of supply		P
6.3.2	Prevention of the occurrence of a touch voltage		P
6.3.2.2	Protection by provision of one or more of the following:		—
	- class II electrical devices or apparatus (double insulation, reinforced insulation or by equivalent insulation in accordance with IEC 61140) or		N
	- switchgear and control gear assemblies having total insulation in accordance with IEC 61439-1 or		P
	- supplementary or reinforced insulation in accordance with IEC 60364-4-41(413.2)		P
6.3.2.3	For protection by electrical separation the requirements of IEC 60364-4-41 apply (413.5)		N

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Clause	Requirement + Test	Result - Remark	Verdict
6.3.3	Protection by automatic disconnection of supply		P
	This measure consists of the interruption of one or more line conductors in a time within the limits specified in Annex A for TN and TT systems		P
	This requires co-ordination between: - the type of supply, the source impedance and the earthing system - several impedance values - characteristics of protective devices - (For details see 18.2)		P
	This protective measure comprises both:		—
	protective bonding of exposed parts (8.2.3)		N
	one of the following:		—
	a) In TN systems, the following protective devices may be used:		N
	overcurrent protective device or		N
	residual current protective devices (RCDs) and associated overcurrent protective devices		N
	b) In TT systems either:		N
	RCDs and associated overcurrent protective devices or		N
	overcurrent protective devices provided a low fault loop impedance is assured		N
	c) In IT-Systems the requirements of IEC 60364-4-41 shall be fulfilled		N
	During an insulation fault an acoustic and an optical signal shall be sustained. The acoustic signal may manually be muted		N

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Clause	Requirement + Test	Result - Remark	Verdict
	Where automatic disconnection is provided under a) and disconnection acc. to A.1.1 cannot be assured, supplementary protective bonding shall be provided to fulfil A.1.3		N
	Where protection of a PDS (power drive system) is not provided by the converter, the necessary protection shall be acc. to the converter manufacturer's instructions		N
6.4	Protection by the use of PELV		P
6.4.1	PELV circuits shall satisfy all of the following conditions:		—
	a) the nominal voltage does not exceed: 25 V AC r.m.s. or 60 V ripple-free AC when the equipment is normally used in dry locations and when large area contact of live parts with the human body is not expected; or 6 V AC r.m.s. or 15 V ripple-free DC in all other cases;		N
	b) one side of the circuit or one point of the source of the supply of that circuit is connected to the protective bonding circuit;		N
	c) live parts of PELV circuits shall be electrically separated from other live circuits (see IEC 61558)		N
	d) conductors of each PELV circuit shall be physically separated from those of any other circuit. If this requirement is impracticable, the insulation provisions of 13.1.3 shall apply		N
	e) plugs and socket-outlets for a PELV circuit shall conform to the following: plugs shall not to enter socket-outlets of other voltage systems socket-outlets shall not admit plugs of other voltage systems		N

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Clause	Requirement + Test	Result - Remark	Verdict
6.4.2	The sources for PELV shall be one of the following:		—
	- a safety isolating transformer in accordance with IEC 61558-1 and IEC 61558-2-6 or		N
	- a source of current with a degree of safety equivalent to that of the safety isolating transformer or		N
	- a source independent of circuit with higher voltage (e.g. battery or diesel –driven) or		N
	- electronic power supply conforming to appropriate standards		N
7.	PROTECTION OF EQUIPMENT		P
7.2	Overcurrent protection		P
7.2.1	Overcurrent protection shall be provided where the current in any circuit can exceed the rating of a component or the capacity of a conductor		P
7.2.2	Supply conductors		—
	Unless otherwise specified by the user, the supplier of the electrical equipment is not responsible for providing the supply conductors or the overcurrent protective device for it		P
	In the installation documents, the data necessary for conductor dimensioning and selecting the overcurrent protective device are stated (see 7.2.10 and 17.4)		P
7.2.3	Power circuits		P
	Devices for detection and interruption of overcurrent, selected in accordance with 7.2.10, are applied to each live conductor including supplies to control circuit transformers.		P

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Clause	Requirement + Test	Result - Remark	Verdict
	The following conductors shall not be disconnected without disconnecting all associated live conductors: - the neutral conductor of AC power circuits; - the earthed conductor of DC power circuits; - DC power conductors bonded to exposed conductive parts of mobile machines.		N
	Where the cross-section area of the neutral conductor is at least equal to the line conductor, no overcurrent detection nor disconnecting device is required for that conductor		N
	Otherwise the measures detailed in 524 of IEC 60364-5-52:2009 shall apply		N
	In IT-Systems, it is recommended that no neutral conductor is used. Where a neutral conductor is used, the measures detailed in 431.2.2 of IEC 60364-4-43:2008 shall apply		N
7.2.4	Control circuits		N
	Conductors of control circuits directly connected to the supply shall be protected against overcurrent in accordance with 7.2.3.		N
	Conductors of control circuits supplied by a transformer or DC supply shall be protected against overcurrent (see also 9.4.3.1.1):		—
	In control circuits, connected to the protective bonding circuit, by an overcurrent protective device in the switched conductor		N

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Clause	Requirement + Test	Result - Remark	Verdict
	In circuits, not connected to the protective bonding circuit: Where all control circuits have the same current carrying capacity, by an overcurrent protective device in the switched conductor Otherwise, by an overcurrent protective device in both, switched and common conductors of each control circuit		N
	Exception: Where a supply unit provides current limiting below the capacity of the conductors and the connected components, no overcurrent protective device is required		N
7.2.5	Overcurrent protection shall be provided for circuits feeding general purpose socket outlets		P
7.2.6	Unearthed conductors of lighting circuits shall be protected separately from other circuits.		N
7.2.7	Transformers shall be protected in accordance with the manufacturer's instructions and includes: avoiding tripping due to transformer magnetizing inrush currents avoiding a winding temperature rise in excess of the permitted value for the insulation class when there is a short circuit at the secondary terminals		N
7.2.8	Location of overcurrent protective devices		N
	It shall be located at the point where a reduction in the cross sectional area of the conductors or another change reduces the current-carrying capacity of the conductors except:		N

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Clause	Requirement + Test	Result - Remark	Verdict
	current carrying capacity of the conductors is at least equal to that of the load and conductors between the point of reduction of current-carrying capacity and the position of the overcurrent protective device is ≤ 3 m and the conductor is protected e.g. by an enclosure or duct.		N
7.2.9	Overcurrent protective devices		
	The rated short-circuit breaking capacity I_{cn} shall be at least equal to the prospective fault current at the point of installation. Additional currents other than from the supply (e.g. from motors, from power factor correction capacitors) shall be taken into consideration.		N
	Where fuses are provided as overcurrent protective devices, a type readily available in the country of use shall be selected, or arrangements shall be made for the supply of spare parts.		N
7.2.10	Rating and setting of overcurrent protective devices:		
	Rated current of fuses or overcurrent setting of other protective devices selected as low as possible, but adequate for anticipated overcurrents.		N
	The rated current of overcurrent protective device for conductors is determined by the current carrying capacity of the conductors to be protected in accordance with Cl. 12.4, D.2 and the maximum allowable interrupting time t in accordance with Clause D.3.		N
7.3	Protection of motors against overheating		N
7.3.1	Protection shall be provided for each motor rated at more than 0.5 kW.		N

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Clause	Requirement + Test	Result - Remark	Verdict
	Exception: In applications where an automatic interruption of the motor operation is unacceptable (for example fire pumps), the means of detection shall give a warning signal to which the operator can respond.		N
	Automatic restarting prevented where this can cause a hazard		N
7.3.2	Protection achieved by overload protection device: detection in each live conductor switching off of all live conductors (not necessary to switch of neutral conductor)		N
	For special duty motors, appropriate protective devices are recommended		N
	For motors that cannot be overloaded, overload protection is not required.		N
7.3.3	Protection achieved by over-temperature protection device: Is recommended in situations where the cooling can be impaired (for example dusty environments)		N
7.4	Equipment shall be protected against abnormal temperatures that can result in a hazardous situation.		N
7.5	Protection against the effects of supply interruption or voltage reduction and subsequent restoration		N
	Where a supply interruption or a voltage reduction can cause a hazardous situation, damage to the machine, or to the work in progress, undervoltage protection is provided.		N
	Upon restoration of supply voltage, automatic or unexpected restarting of machine prevented.		N

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Clause	Requirement + Test	Result - Remark	Verdict
	Undervoltage protection does initiate appropriate control responses to ensure necessary coordination of groups of machines working together		N
7.6	Motor overspeed protection shall be provided where overspeeding can occur and could possibly cause a hazardous situation.		N
7.7	Additional earth fault/residual current protection In addition to providing overcurrent protection for automatic disconnection as described in 6.3, earth fault/residual current protection can be provided to reduce damage to equipment due to earth fault currents less than the detection level of the overcurrent protection. The setting of the devices shall be as low as possible consistent with correct operation of the equipment. If fault currents with DC components are possible, an RCD of type B in accordance with IEC TR 60755 can be required.		N
7.8	Phase sequence protection shall be provided, where an incorrect phase sequence of the supply voltage can cause a hazardous situation or damage to the machine.		N
7.9	Surge protective devices (SPDs) can be provided to protect against the effects of overvoltages due to lightning or to switching surges.		N
7.10	The short-circuit current rating of the electrical equipment shall be determined by the application of design rules or by calculation or by test.		N
8	EQUIPOTENTIAL BONDING		P
8.2	Protective bonding circuit		N
8.2.1	All parts of the protective bonding circuit shall be so designed that they are capable of withstanding the highest thermal and mechanical stresses		N

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Clause	Requirement + Test	Result - Remark	Verdict
	Protective conductors which does not form part of a cable shall not be less than:		—
	2.5 mm ² Cu or 16 mm ² Al if protection against mechanical damage is provided		N
	4 mm ² Cu or 16 mm ² Al if protection against mechanical damage is not provided		N
	Exposed conductive parts of equipment in accordance with 6.3.2.3 (Protection by electrical separation) shall not be connected to the protective bonding circuit.		N
	Small parts and other conductive parts that do not constitute a hazard need not to be earthed		N
8.2.2	Protective conductors		P
	Protective conductors shall be identified in accordance with 13.2.2.		P
	Copper conductors are preferred.		P
	Where other material is used, its electrical resistance per unit length shall not exceed that of the allowable copper conductor and such conductors shall be not less than 16 mm ² in cross-sectional area.		P
	Metal enclosures or frames or mounting plates may be used as protective conductors if they satisfy the following three requirements: protection against mechanical, chemical or electrochemical deterioration compliant with 543.1 of IEC 60364-5-54 permit the connection of other protective conductors where foreseen		N
	The cross-section of protective conductors shall be calculated according to 543.1.2 of IEC 60364-5-54, or selected in accordance with Table 1.		N

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Clause	Requirement + Test	Result - Remark	Verdict
	Each protective conductor shall: be part of a multicore cable, or; be in a common enclosure with the line conductor, or; have a cross-sectional area of at least; 2,5 mm ² Cu or 16 mm ² Al if protection against mechanical damage is provided; 4 mm ² Cu or 16 mm ² Al if protection against mechanical damage is not provided.		P
	A protective conductor not forming part of a cable is considered to be mechanically protected if it is installed in a conduit, trunking or protected in a similar way.		N
	The following parts shall be connected to the protective bonding circuit but shall not be used as protective conductors: metal ducts of flexible or rigid construction; metallic cable sheaths or armouring; metallic pipes containing flammable materials such as gases, liquids, powder. flexible or pliable metal conduits; constructional parts subject to mechanical stress in normal service; • flexible metal parts; support wires; cable trays and cable ladders.		N
8.2.3	Continuity of the protective bonding circuit		P
	Where a part is removed the protective bonding circuit for the remaining parts isn't interrupted.		P
	Current-carrying capacity of connection and bonding points not impaired by mechanical, chemical, or electrochemical influences (e.g. electrolytic corrosion on aluminium parts)		N

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Clause	Requirement + Test	Result - Remark	Verdict
	Where the electrical equipment is mounted on lids, doors, or cover plates, continuity of the protective bonding circuit shall be ensured. The use of a protective conductor (see 8.2.2) is recommended.		N
	For cables that are exposed to damage (for example flexible trailing cables) the continuity of the protective conductors are ensured by appropriate measures (for example monitoring).		N
	Where the continuity can be interrupted, a first make last break contact is required.		N
8.2.4	Protective conductor connecting points are not intended to attach appliances or parts.		N
	Each connecting point shall be marked or labelled as such using the symbol IEC 60417-5019 or the letters PE or by use of bicolour GREEN / YELLOW 		P
8.2.5	Mobile machines with on-board power supplies: The protective bonding system is connected to a single protective bonding terminal. This protective bonding terminal is the connection point for a possible additional external incoming power supply		N
8.2.6	Additional requirements for electrical equipment having earth leakage currents higher than 10 mA		N
	Where electrical equipment has an earth leakage current greater than 10 mA AC or DC the associated protective bonding circuit shall satisfy one of the following:		—
	a) the protective conductor is completely enclosed or otherwise protected		N

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Clause	Requirement + Test	Result - Remark	Verdict
	b) the protective conductor has a cross-sectional area of at least 10 mm ² Cu or 16 mm ² Al		N
	c) a second protective conductor of at least the same cross-sectional area is provided		N
	d) the supply is automatically disconnected in case of loss of continuity of the protective conductor		N
	e) where a plug-socket combination is used, an industrial connector in accordance with IEC 60309 series is provided		N
	A statement shall be given in the instructions for installation that the equipment shall be installed as described in this 8.2.6.		N
8.3	Measures to restrict the effects of high leakage current can be taken as described		N
8.4	If functional bonding is used, the connecting points should be marked with symbol IEC 60417-5020 		N
9	CONTROL CIRCUITS AND CONTROL FUNCTIONS		P
9.1.	Control circuit		P
9.1.1	Where control circuits are supplied from an AC source, transformers having separate windings shall be used to separate the power supply from the control supply.		P
	Examples include: control transformers acc. to IEC 61558-2-2, SMPS acc. to IEC 61558-2-16 power supplies acc. to IEC 61204-7		P

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Clause	Requirement + Test	Result - Remark	Verdict
	Where several transformers are used, it is recommended that the secondary voltages are in phase.		P
	Exception: Transformers or switch mode power supply units fitted with transformers are not mandatory for machines with a single motor starter and/or a maximum of two control devices		P
	Where DC control circuits derived from an AC supply are connected to the protective bonding, they shall be supplied from a separate winding		P
9.1.2	The nominal voltage of control circuits should preferably not exceed - 230 V @ 50 Hz - 277 V @ 60 Hz - 220 V @ DC		P
9.1.3	Control circuits are provided with overcurrent protection in accordance with 7.2.4 and 7.2.10.		P
9.2.	Control functions		P
9.2.2	Categories of stop functions are stop category 0, 1, 2		P
9.2.3	Operation		P
9.2.3.1	Where a machine has more than one control station, measures shall be provided to ensure that initiation of commands from different control stations do not lead to a hazardous situation.		N
9.2.3.2	Start functions shall operate by energizing the relevant circuit.		P
	Start of an operation shall be possible only when all of the relevant safety functions and/or protective measures are in place and are operational.		N

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Clause	Requirement + Test	Result - Remark	Verdict
	For those machines (for example mobile machines) where safety functions and/or protective measures cannot be applied for certain operations, starting of such operations shall be by hold-to-run controls, together with enabling devices, as appropriate.		N
	The provision of acoustic and/or visual warning signals before the starting of hazardous machine operation shall be considered during the risk assessment. Where the risk assessment determines that either or both are required the emission level of these warning signals shall be suitable for the intended environment.		N
	Suitable interlocks shall be provided where necessary for correct sequential starting.		N
	In the case of machines requiring the use of more than one control station to initiate a start, each of these control stations shall have a separate manually actuated start control device. The conditions to initiate a start are: - all required conditions for machine operation shall be met and - all start control devices shall be in the released (off) position, then - all start control devices have to be actuated concurrently (see 3.1.7).		N
9.2.3.3	Stop category 0 and/or stop category 1 and/or stop category 2 stop functions are provided as indicated by the risk assessment and the functional requirements of the machine (see 4.1).		N
	Stop functions shall override related start functions		N

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Clause	Requirement + Test	Result - Remark	Verdict
	Where more than one control station is provided, stop commands from any control station is effective when required by the risk assessment of the machine.		N
9.2.3.4	Emergency operations (emergency stop, emergency switching off)		P
9.2.3.4.1	Emergency stop or emergency switching off commands shall be sustained until it is reset.		P
	This reset shall be possible only by a manual action at that location where the command has been initiated.		P
	The reset of the command shall not restart the machinery but only permit restarting.		P
	It shall not be possible to restart the machinery until all emergency stop commands are reset.		N
	It shall not be possible to reenergize the machinery until all emergency switching off commands are reset.		N
9.2.3.4.2	The emergency stop does function either as a stop category 0 or as a stop category 1.		N
	-it shall override all other functions and operations in all modes -it shall stop the hazardous motion as quickly as practicable without creating other hazards a reset shall not initiate a restart		N
9.2.3.4.3	Emergency switching off should be provided where: Protection against direct contact is achieved only by placing out of reach or by obstacles (see 6.2.6) or there is the possibility of other hazards or damage caused by electricity		N
	Emergency switching off is accomplished by electromechanical switching devices, effecting a stop category 0 of machine actuators connected to this incoming supply		N

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

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Clause	Requirement + Test	Result - Remark	Verdict
	Type II: a Type I control requiring the release of both control devices before machine operation can be reinitiated		N
	Type III: a Type II control requiring concurrent actuation of the control devices as follows: it shall be necessary to actuate the control devices within a certain time limit of each other, not exceeding 0.5 s where this time limit is exceeded, both control devices shall be released before machine operation can be initiated		N
9.2.3.9	Enabling control shall be so arranged as to minimize the possibility of defeating, for example by requiring the de-activation of the enabling control device before machine operation may be reinitiated		N
9.2.3.10	Combined start and stop controls: Push-buttons etc. that alternately initiate and stop motion shall only be provided for functions, which cannot result in a hazardous situation.		P
9.2.4	Cableless control system		N
9.2.4.1	Where a safety function of a CCS relies on data transmission the transmission reliability shall be considered.		N
	The CCS shall have functionality and a response time suitable for the application based on the risk assessment.		N
9.2.4.2	The ability of a CCS to control a machine shall be automatically monitored, either continuously or at suitable intervals.		N

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Clause	Requirement + Test	Result - Remark	Verdict
	If the communication signal has degraded (e.g., reduced signal level, low battery power) a warning shall be given		N
	When the ability to control a machine has been lost, an automatic stop of the machine shall be initiated.		N
	Its restoration shall not restart the machine.		N
9.2.4.3	Measures shall be taken to prevent the machine from responding to signals other than those from the intended operator control station(s).		N
	Cableless operator control station(s) shall only control the intended machine(s) and shall affect only the intended machine functions.		N
9.2.4.4	When more than one cableless operator control station is used, then:		—
	only one control station shall be enabled at a time except as necessary for the operation		N
	transfer of control shall require a deliberate manual action at the station having control		N
	transfer shall only be possible if both stations are in the same mode		N
	a transfer shall not change the mode of operation or function		N
	on the station that has control, a visual indication shall indicate this		N
9.2.4.5	Portable cableless operator control stations shall be provided with means to prevent unauthorized use		N
	Each machine should have an indication when it is under cableless control		N
	When possible to be connected to several machines, means shall be provided on the portable device to select		N

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Clause	Requirement + Test	Result - Remark	Verdict
	Selecting a machine shall not initiate control commands.		N
9.2.4.6	A deliberate disabling shall meet the requirements of 9.2.4.2.		P
	Where disabling without interrupting machine operation is necessary, appropriate means shall be provided to transfer control		P
9.2.4.7	Emergency stop devices on portable cableless operator control stations shall not be the sole means of initiating an emergency stop		N
	Confusion between active and inactive emergency stop devices shall be avoided		N
9.2.4.8	Restarting of a cableless control shall not result in a reset of an emergency stop condition		P
	The instructions shall state that a reset shall only be performed when it can be seen that the reason has been cleared		P
	Where the risk assessment shows that resetting of an emergency stop actuator on the portable cable less operator control station is not adequate then one or more supplementary fixed resets shall be provided.		P
9.3	Protective interlocks		P
9.3.1	The reclosing or resetting of an interlocking safeguard does not initiate hazardous machine operation		P
9.3.2	Where an operating limit (for example speed, pressure, position) can be exceeded leading to a hazardous situation, means shall be provided to detect when a predetermined limit(s) is exceeded and initiate an appropriate control action		N

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Clause	Requirement + Test	Result - Remark	Verdict
9.3.3	The correct operation of auxiliary functions shall be checked by appropriate devices		N
	Where the non-operation of a device can cause a hazard, appropriate interlocking shall be provided		P
9.3.4	Interlocks between different operations and for contrary motions shall be provided, if these operations can lead to hazardous situations		N
9.3.5	Where braking of a motor is accomplished by current reversal, measures shall prevent the motor starting in the opposite direction at the end of braking where that reversal can cause a hazardous situation or damage to the machine or to the work in progress		N
	For this purpose, a device operating exclusively as a function of time is not permitted		N
	Control circuits shall be so arranged that rotation of a motor shaft, for example manually, does not result in a hazardous situation		N
9.3.6	Where it is necessary to suspend safety functions and/or protective measures, the control or operating mode selector shall simultaneously:		N
	disable all other operating (control) modes		N
	permit operation only by the use of a hold-to-run device or by a similar control device positioned so as to permit sight of the hazardous elements		N
	prevent any operation of hazardous functions by voluntary or involuntary action on the machine's sensors		N
	If these four conditions cannot be fulfilled, the mode selector shall activate other protective measures to ensure a safe intervention zone. In addition, the operator shall be able to control operation of the parts he is working on from the adjustment point.		N

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Clause	Requirement + Test	Result - Remark	Verdict
9.4	Control functions in the event of failure		N
9.4.1	The electrical control system(s) shall have an appropriate performance that has been determined from the risk assessment of the machine		N
	The requirements for safety-related control functions of IEC 62061 and/or ISO 13849-1, ISO 13849-2 shall apply		N
	Where memory retention is achieved for example, by battery power, measures shall be taken to prevent hazardous situations arising from failure, undervoltage or removal of the battery		N
	Means shall be provided to prevent unauthorized or inadvertent memory alteration by, for example, requiring the use of a key, access code or tool		N
9.4.2	Measures to minimize risk in the event of failure		P
9.4.2.2	Use of proven circuit techniques and components (see examples)		N
9.4.2.3	Provisions of partial or complete redundancy		N
9.4.2.4	Provision of diversity (see examples)		N
9.4.2.5	Provision for functional tests		N
9.4.3	Protection against malfunction of control circuits		P
9.4.3.1.1	Measures shall be provided to reduce the probability that insulation faults on any control circuit can cause malfunction		P
9.4.3.1.2	Method a) – Earthed control circuits fed by transformers		N
	The common conductor shall be connected to the protective bonding circuit at the point of supply.		N

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Clause	Requirement + Test	Result - Remark	Verdict
	All control elements are to be inserted on the other side of the components		N
9.4.3.1.3	Method b) – Non-earthed control circuits fed by transformers shall either		N
	1) have 2-pole control switches that operate on both conductors; or		N
	2) be provided with a device that interrupts the circuit automatically in the event of an earth fault; or		P
	3) where 2) above would increase the risk, it can be sufficient to provide an insulation monitoring device that will initiate an acoustic and optical signal		N
9.4.3.1.4	Method c) – Control circuits fed by transformer with an earthed centre-tap winding shall have overcurrent protective devices that break both the conductors		P
	The control switches shall be 2-pole types that operate on both conductors		N
9.4.3.1.5	Method d) – Control circuits not fed by a transformer are only allowed for machines with a maximum of one motor starter and/or maximum of two control devices, in accordance with 9.1.1		P
	Possible cases are:		—
	1) directly connected to an earthed supply system (TN- or TT-system)		P
	If powered between two lines, multi-pole control switches are required		N
	2) directly connected to a supply system that is not earthed or is earthed through a high impedance (IT-system)		N

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Clause	Requirement + Test	Result - Remark	Verdict
	A device shall be provided that interrupts the circuit automatically in the event of an earth fault		N
9.4.3.2	Where the loss of memory due to a power failure can result in a hazardous situation, appropriate measures shall be taken		N
9.4.3.3	Where the loss of continuity of control circuits depending upon sliding contacts can result in a hazard, appropriate measures shall be taken		N
10	OPERATOR INTERFACE AND MACHINE-MOUNTED CONTROL DEVICES		P
10.1.1	Control devices for operator interface shall, as far as is practicable, be selected, mounted, and identified or coded in accordance with IEC 61310 series		P
10.1.2	As far as is practicable, machine-mounted control devices shall be:		—
	-readily accessible for service and maintenance		P
	-mounted in such a manner as to minimize the possibility of damage from activities such as material handling		P
	The actuators of hand-operated control devices are selected and installed so that:		—
	-they are not less than 0,6 m above the servicing level and are within easy reach of the normal working position of the operator		P
	-the operator is not placed in a hazardous situation when operating them		P
	The actuators of foot-operated control devices are selected and installed so that:		—
	-they are within easy reach of the normal working position of the operator		N
	-the operator is not placed in a hazardous situation when operating them		P

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Clause	Requirement + Test	Result - Remark	Verdict
10.1.3	The degree of protection (IP rating in accordance with IEC 60529) together with other appropriate measures shall provide protection against:		N
	– the effects of liquids, vapours, or gases found in the physical environment or used on the machine		N
	– the ingress of contaminants (for example swarf, dust, particulate matter)		P
	The operator interface control devices shall have a minimum degree of protection against contact with live parts of IPXXD (see IEC 60529)		N
10.1.4	Position sensors (for example position switches, proximity switches) are so arranged that they will not be damaged in the event of overtravel		N
	Position sensors in circuits with safety-related control functions shall have direct opening action (see IEC 60947-5-1) or shall provide similar reliability (see 9.4.2)		N
10.1.5	Portable and pendant operator control stations and their control devices are so selected and arranged as to minimize the possibility of machine operations caused by inadvertent actuation, shocks and vibrations		N
10.2	Actuators		N
10.2.1	Actuators shall be colour-coded as follows:		N
	The colours for START/ON actuators should be WHITE, GREY, BLACK or GREEN with a preference for WHITE. RED shall not be used		N
	The colour RED shall be used for emergency stop and emergency switching off actuators		N
	If a background exists, it shall be coloured YELLOW		N

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Clause	Requirement + Test	Result - Remark	Verdict
	The colours for STOP/OFF actuators should be BLACK, GREY, or WHITE with a preference for BLACK. GREEN shall not be used. RED is permitted		N
	WHITE, GREY, or BLACK are the preferred colours for actuators that alternately act as START/ON and STOP/OFF actuators. The colours RED, YELLOW, or GREEN shall not be used		N
	The same is applicable for “hold-to-run” actuators		N
	Reset actuators shall be BLUE, WHITE, GREY, or BLACK. Where they also act as a STOP/OFF actuator, the colours WHITE, GREY, or BLACK are preferred with the main preference being for BLACK. GREEN shall not be used.		N
	The colour YELLOW is reserved for use in abnormal conditions		N
	Where the same colours are used for various functions, a supplementary means of coding shall be used for the identification		N
10.2.2	Recommended markings for actuators are given in table 2 and 3		N
10.3	Indicator lights and displays		P
10.3.1	Indicator lights and displays shall be selected and installed in such a manner as to be visible from the normal position of the operator (see also IEC 61310-1).		N
	Circuits used for visual or audible devices used to warn persons of an impending hazardous event shall be fitted with facilities to check the operability of these devices		P

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Clause	Requirement + Test	Result - Remark	Verdict
10.3.2	Indicator lights should be colour-coded with respect to the condition (status) of the machine in accordance with Table 4.		N
	Indicating towers on machines have the applicable colours in the following order from the top down; RED, YELLOW, BLUE, GREEN and WHITE.		P
10.3.3	For further distinction or information and especially to give additional emphasis, flashing lights and displays can be provided		N
	Where flashing lights or displays are used to provide higher priority information, additional acoustic warnings should be considered		N
10.4	illuminated push-button actuators shall be colour-coded in accordance with Tables 2 and 4. Where there is difficulty in assigning an appropriate colour, WHITE is used.		N
	The colour RED for the emergency stop actuator shall not depend on the illumination of its light.		P
10.5	Devices having a rotational member , such as potentiometers and selector switches, shall have means of prevention of rotation of the stationary member. Friction alone isn't considered sufficient.		P
10.6	Actuators used to initiate a start function or the movement of machine elements shall be constructed and mounted so as to minimize inadvertent operation		N
10.7	Emergency stop devices		P
10.7.1	Devices for emergency stop are readily accessible		P
	Emergency stop devices shall be provided at each location where the initiation of an emergency stop can be required		P

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Clause	Requirement + Test	Result - Remark	Verdict
	In circumstances where confusion can occur between active and inactive emergency stop devices caused by disabling the operator control station, means (for example, information for use) are provided to minimise confusion.		P
10.7.2	The types of device for emergency stop include, but are not limited to: – a push-button device for actuation by the palm or the fist (e.g. mushroom) – a pull-cord operated switch – a pedal-operated switch without mechanical guard		P
	The devices shall be in accordance with IEC 60947-5-5.		P
10.7.3	Where a stop category 0 is suitable, the supply disconnecting device may serve the function of emergency stop where: – it is readily accessible to the operator; and – it is of the type described in 5.3.2 a), b), c), or d)		P
	Where intended for emergency use, the supply disconnecting device shall meet the colour requirements of 10.2.1		N
10.8	Emergency switching off devices		P
10.8.1	Such devices shall be located as necessary for the given application.		P
	Means are provided, where necessary, to avoid confusion between these devices.		P
10.8.2	The types of device for emergency switching off include: – a push-button operated switch with a palm or mushroom head type of actuator – a pull-cord operated switch		P

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Clause	Requirement + Test	Result - Remark	Verdict
	The devices shall have direct opening action		N
10.8.3	Where the supply disconnecting device is to be locally operated for emergency switching off, it shall be readily accessible and shall meet the colour requirements of 10.2.1		N
10.9	Enabling control device		P
	Enabling control devices shall be selected and arranged so as to minimize the possibility of defeating		N
	They shall be designed in accordance with ergonomic principles		P
	Functions of two-position types: position 1: off-function of the switch (actuator is not operated); position 2: enabling function (actuator is operated)		P
	Functions of three-position types: position 1: off-function of the switch (actuator is not operated) position 2: enabling function (actuator is operated in its mid position) position 3: off-function (actuator is operated past its mid position) when returning from position 3 to position 2, the enabling function is not activated		N

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Clause	Requirement + Test	Result - Remark	Verdict
11	CONTROLGEAR: LOCATION, MOUNTING AND ENCLOSURES		P
11.2.1	All items of controlgear (inclusively terminals that are not part of controlgear components or devices) are placed and oriented so that they can be identified without moving them or the wiring		P
	For items that require checking for correct operation or that are liable to need replacement, those actions should be possible without dismantling other equipment or parts of the machine (except opening doors or removing covers, barriers or obstacles)		N
	All controlgear are mounted so as to facilitate its operation and maintenance		N
	Necessary tools to adjust, maintain, or remove a device are supplied		N
	Where access is required for regular maintenance or adjustment, the relevant devices shall be located between 0.4 m and 2.0 m above the servicing level		N
	Recommendation, that terminals be least 0.2 m above the servicing level and so placed that conductors and cables can be easily connected		N
	Only operating, indicating, measuring, and cooling devices are mounted on doors or on normally removable access covers of enclosures		P
	Where connected through plug-in arrangements, their association shall be made clear by type (shape), marking or reference designation		P
	Plug-in devices that are handled during normal operation shall be provided with non-interchangeable features		N

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Clause	Requirement + Test	Result - Remark	Verdict
	Plug/socket combinations that are handled during normal operation are unobstructedly accessible.		N
	Test points for connection of test equipment shall be: – mounted to provide unobstructed access – clearly identified to correspond with the documentation – adequately insulated – sufficiently spaced		N
11.2.2	Physical separation or grouping		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 (for example in a separate compartment)		N
	Control devices mounted in the same location and connected to the supply voltage, or to both supply and control voltages, should be grouped separately from those connected only to the control voltages		N
	Terminals shall be separated into groups for: – power circuits – associated control circuits – other control circuits, fed from external sources (for example for interlocking)		N
	The clearances and creepage distances specified by the supplier shall be maintained, taking into account the external influences or conditions of the physical environment.		N
11.2.3	The temperature rise inside electrical equipment enclosures shall not exceed the ambient temperature specified by the component manufacturers		N

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Clause	Requirement + Test	Result - Remark	Verdict
	Heat generating components (for example heat sinks, power resistors) are located so, that the temperature of each component in the vicinity remains within the permitted limit		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, lubricants and swarf		N
	Enclosures of controlgear provide a degree of protection of at least IP22 (see IEC 60529)		N
	Exception, where: a) an electrical operating area provides an appropriate degree of protection b) removable collectors on conductor wire or conductor bar systems are used and the measures of 12.7.1 are applied		N
11.4	Enclosures, doors and openings		P
	Enclosures shall be constructed using materials capable of withstanding the mechanical, electrical and thermal stresses as well as the effects of humidity and other environmental factors that are likely to be encountered in normal service		P
	Fasteners used to secure doors and covers should be of the captive type		P
	Windows of enclosures shall be of a material suitable to withstand expected mechanical stress and chemical attack		P

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Clause	Requirement + Test	Result - Remark	Verdict
	It is recommended that enclosure doors having vertical hinges be not wider than 0,9 m, with an angle of opening of at least 95°		N
	Joints or gaskets of doors, lids, etc. shall withstand the chemical effects of the aggressive liquids, vapours, or gases used on the machine.		N
	They shall: -be securely attached -not deteriorate due to removal or replacement of the door		N
	Openings in enclosures (for example, for cable access), including those towards the floor or foundation or to other parts of the machine shall be equipped with means to ensure the degree of protection specified for the equipment.		N
	A suitable opening may be provided in the base of enclosures within the machine so that moisture due to condensation can drain away		N
	Openings for cable entries shall be easily re-opened on site		N
	There shall be no opening between enclosures containing electrical equipment and compartments containing coolant, lubricating or hydraulic fluids, or those into which oil, other liquids, or dust can penetrate.		N
	Holes in an enclosure for mounting shall not impair the required protection.		P

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Clause	Requirement + Test	Result - Remark	Verdict
	Equipment that, in normal or abnormal operation, can attain a surface temperature sufficient to cause a risk of fire or detrimental effect to an enclosure material shall: – be located within an enclosure that will withstand, such temperatures; and – be located at a sufficient distance from adjacent equipment allowing safe dissipation of heat (see also 11.2.3); or – be otherwise screened by material that can withstand to the harmful effect.		N
11.5	Access to electrical equipment		P
	Doors in gangways for access to electrical operating areas shall: -be at least 0.7 m wide and 2.0 m high -open outwards -have a means (for example panic bolts) to allow opening from the inside without the use of a key or tool		P
12	CONDUCTORS AND CABLES		P
12.1	Conductors and cables shall be selected so as to be suitable for the operating conditions and external Influences that can exist		P
	These requirements do not apply to the integral wiring of assemblies, subassemblies, and devices that are manufactured and tested in accordance with their relevant IEC standard (for example IEC 61800 series).		—
12.2	Conductors should be of copper. Where aluminium conductors are used, the cross-sectional area shall be at least 16 mm ² .		P
	The cross-sectional area of conductors should not be less than as shown in Table 5		N

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Clause	Requirement + Test	Result - Remark	Verdict
	Smaller cross-sectional areas or other constructions than shown in Table 5 may be used, provided adequate mechanical strength is achieved by other means		N
	Class 1 and class 2 conductors are primarily intended for use between rigid, non-moving parts where vibration is not likely to cause damage		P
	All conductors that are subject to frequent movement should have flexible stranding of class 5 or class 6.		N
12.3	Where the insulation of conductors and cables can constitute hazards due for example to the propagation of a fire or the emission of toxic or corrosive fumes, guidance from the cable supplier shall be considered. It is important to give special attention to the integrity of a circuit having a safety-related function.		N
	The insulation of cables and conductors used, shall be suitable for a test voltage:		—
	not less than 2 000 V AC for a duration of 5 min for operation at voltages higher than 50 V AC or 120 V DC, or		P
	not less than 500 V AC for a duration of 5 min for PELV circuits (see IEC 60364-4-41, class III equipment).		N
	The insulation shall be such that it cannot be damaged in operation or during laying, especially for cables pulled into ducts.		N
12.4	Current-carrying capacity in normal service in accordance with table 6. Or in accordance with suppliers recommendation.		N
12.5	The voltage drop from the point of supply to the load in any power circuit cable shall not exceed 5 % of the nominal voltage under normal operating conditions.		N

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Clause	Requirement + Test	Result - Remark	Verdict
	In control circuits, the voltage drop shall not reduce the voltage at any device below the manufacturer's specification for that device, taking into account inrush currents.		N
12.6	Flexible cables		N
12.6.1	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 -kinking due to operation without guides -stress resulting from guide rollers and forced guiding, being wound and re-wound on cable drums		N
12.6.2	The tensile stress applied to copper conductors shall not exceed 15 N/mm ² of cross-sectional area Or special measures are taken to withstand the applied stress		N
	For material other than copper the applied stress shall be within the cable manufacturer's specification		N
12.6.3	For cables of circular cross-sectional area installed on drums, the maximum current should be derated in accordance with Table 7		N
12.7	Conductor wires, conductor bars and slip-ring assemblies		P
12.7.1	During normal access to the machine, protection to conductor wires, conductor bars and slip-ring assemblies shall be achieved by the application of one of the following protective measures:		P
	-protection by partial insulation of live parts, or where this is not practicable		P

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Clause	Requirement + Test	Result - Remark	Verdict
	-protection by enclosures or barriers of at least IP2X or IPXXB		N
	Horizontal top surfaces of barriers or enclosures that are readily accessible shall provide a degree of protection of at least IP4X or IPXXD		N
	Where the required degree of protection is not achieved, protection by placing live parts out of reach in combination with emergency switching off in accordance with 9.2.5.4.3 shall be applied		N
	Conductor wires and conductor bars shall be so placed and/or protected as to:		—
	- prevent contact, especially for unprotected conductor wires and conductor bars, with conductive items such as the cords of pull-cord switches, strain-relief devices and drive chains		P
	-prevent damage from a swinging load		N
12.7.2	Protective conductor circuit (PE) and the neutral conductor (N) each use a separate conductor wire, conductor bar or slip-ring		N
	The continuity of the protective conductor circuit using sliding contacts shall be ensured by taking appropriate measures (for example, duplication of the current collector, continuity monitoring)		N
12.7.3	Protective conductor current collectors shall have a shape or construction so that they are not interchangeable with the other current collectors. Such current collectors shall be of the sliding contact type		N
12.7.4	Removable current collectors with disconnecter function: The protective conductor circuit interrupts after and reconnects before any live conductor		N

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Clause	Requirement + Test	Result - Remark	Verdict
12.7.5	Clearances in air between conductors and adjacent systems shall be suitable for at least a rated impulse voltage of an overvoltage category III in accordance with IEC 60664-1		P
12.7.6	Creepage distances between conductors and adjacent systems shall be suitable suitable for operation in the intended environment, e.g. open air, inside buildings, protected by enclosures		P
	In abnormally dusty, moist or corrosive environments, the following creepage distance requirements apply:		N
	-unprotected conductor wires, conductor bars, and slip-ring assemblies: 60 mm		N
	-enclosed conductor wires, insulated multipole conductor bars and insulated individual conductor bars: 30 mm		N
12.7.7	Conductor system divided into isolated sections: suitable design measures shall be employed to prevent the energization of adjacent sections by the current collectors themselves		N
12.7.8	Conductor wires, conductor bars and slip-ring assemblies in power circuits shall be grouped separately from those in control circuits		N
	They shall be capable of withstanding, without damage, the mechanical forces and thermal effects of short-circuit currents		N
	Removable covers cannot be opened by one person without the aid of a tool		N
	Where common metal enclosures are used, the individual sections shall be bonded together and connected to the protective bonding circuit		N

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Clause	Requirement + Test	Result - Remark	Verdict
	Conductor bar ducts that can be subject to accumulation of liquid shall have drainage facilities		N
13	WIRING PRACTICES		P
13.1	Connections and routing		P
13.1.1	All connections shall be secured against accidental loosening		P
	The means of connection shall be suitable for the cross-sectional areas and nature of the conductors being terminated		P
	No connection of two or more conductors to one terminal, unless the terminal is designed for it		N
	No soldered connections to terminals unless they are suitable for it		N
	Terminals on terminal blocks are plainly marked or labelled corresponding with the diagrams		N
	Installations of flexible conduits and cables are such that liquids drain away from the fittings		N
	Retaining means for conductor strand and shields provided (no soldering for that purpose)		N
	Identification tags shall be legible, permanent, and appropriate for the physical environment		P
	Terminal blocks mounted and wired so that the wiring does not cross over the terminals		N
13.1.2	Conductors and cables shall be run from terminal to terminal without splices or joints		N

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Clause	Requirement + Test	Result - Remark	Verdict
	Connections using plug/socket combinations with suitable protection against accidental disconnection are not considered to be splices or joints for the purpose of this subclause		N
	Exceptions are possible as described		N
	Terminations of cables shall be adequately supported to prevent mechanical stresses at the terminations of the conductors		N
	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 for circuits that operate at different voltages are separated by suitable barriers, or are insulated for the highest voltage that occurs within the same duct		N
13.1.4	Conductors of AC circuits installed in ferromagnetic enclosures shall be arranged so that all conductors of each circuit, including the protective conductor of each circuit, are contained in the same enclosure		N
	Single-core cables armoured with steel wire or steel tape should not be used for AC circuits		N
13.1	The cable between the pick-up and the pick-up converter of an inductive power supply system shall be:		
	-as short as practicable		N
	-adequately protected against mechanical damage		N
13.2.1	Each conductor shall be identifiable at each termination in accordance with the technical documentation		N

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Clause	Requirement + Test	Result - Remark	Verdict
13.2.2	When identification of the protective conductor is by colour alone, the bicolour combination GREEN-AND-YELLOW shall be used throughout the length of the conductor		P
	Where the protective conductor can be easily identified colour coding throughout its length is not necessary, but the ends or accessible locations are clearly identified by the graphical symbol or by the bicolour combination GREEN-AND-YELLOW		P
	Exception: Protective bonding conductors may be marked with the letters PB and/or the symbol IEC 60417-5021		P
13.2.3	Where a neutral conductor is identified by colour alone, the colour shall be BLUE (preferably light blue)		P
	In this case that colour shall not be used for identifying any other conductor where confusion is possible		P
	Bare conductors used as neutral conductors shall have at minimum a stripe in LIGHT BLUE 15 mm to 100 mm wide in each compartment or unit and at each accessible location		P
13.2.4	Where colour-coding is used, BLACK, BROWN, RED, ORANGE, YELLOW, GREEN, BLUE (including LIGHT BLUE), VIOLET, GREY, WHITE, PINK, TURQUOISE may be used		P
	GREEN and YELLOW should not be used where there is a possibility of confusion with the bicolour combination GREEN-AND-YELLOW		P
13.3	Wiring inside enclosures		P
	Conductors inside enclosures shall be supported where necessary		P

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Clause	Requirement + Test	Result - Remark	Verdict
	Non-metallic supports shall be made with a flame-retardant insulating material (see IEC 60332 series)		P
	Connections to devices mounted on doors or to other movable parts shall be made using flexible conductors in accordance with 12.2 and 12.6.		P
	Conductors and cables that do not run in ducts shall be adequately supported		P
13.4	Wiring outside enclosures		P
13.4.1	Conductors of a circuit shall not be distributed over different multi-core cables, conduits, etc.		N
13.4.2	Conductors and their connections external to the electrical equipment shall be placed in suitable ducts (see cl.13.5) Exceptions: -Cables with special suitable protection. -Position switches or proximity switches supplied with a dedicated cable which is sufficiently short		N
13.4.3	Connections to moving parts shall take into account the foreseeable frequency of movement and shall be made using conductors in accordance with 12.2 and 12.6		P
	The bending radius of the cable shall be 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 (run over, forces, rubbing, heat, etc.)		P
	Cables close to moving parts, shall maintain a space of at least 25 mm between the moving parts and the cables or barriers are provided		P

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Clause	Requirement + Test	Result - Remark	Verdict
	Cable handling systems: Lateral cable angles not exceeding 5°, at being wound on and off cable drums or approaching and leaving cable guidance devices. The bending radius shall be in accordance with Table 8		N
	Flexible conduit shall not be used for connections subject to rapid or frequent movements except when specifically designed for that purpose		N
13.4.4	Where several machine-mounted devices are connected in series or in parallel, it is recommended that the connections between those devices be made through terminals forming intermediate test points		N
13.4.5	Plug/socket combinations		P
	Components or devices inside an enclosure, terminated by fixed plug/socket combinations (no flexible cable), or components connected to a bus system by a plug/socket combination, are excluded		P
	Where the plug/socket contains a contact for the protective bonding circuit, it shall have a first make last break contact (see also 8.2.4).		P
	Plug/socket combinations intended to be connected or disconnected during load conditions shall have sufficient load-breaking capacity		P
	Where the plug/socket combination is rated at 30 A, or greater, it shall be interlocked		P
	Plug/socket combinations that are rated at more than 16 A shall have a retaining means to prevent unintended or accidental disconnection.		N
	Where an unintended or accidental disconnection of plug/socket combinations can cause a hazardous situation, they shall have a retaining means.		N

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Clause	Requirement + Test	Result - Remark	Verdict
	The installation of plug/socket combinations shall fulfil the following requirements as applicable: a) The component which remains live after disconnection shall have a degree of protection of at least IP2X or IPXXB b) Metallic housings of plug/socket combinations shall be connected to the protective bonding circuit c) Plug/socket combinations intended to carry power loads but not to be disconnected during load conditions shall have a retaining means to prevent unintended or accidental disconnection and shall be clearly marked accordingly d) Where more than one plug/socket combination is provided in the same electrical equipment, the associated combinations shall be clearly identifiable. Mechanical coding is recommended e) Plug/socket combinations used in control circuits shall fulfil the applicable requirements of IEC 61984. Exception: combinations in accordance with IEC 60309-1, only those contacts shall be used for control circuits which are intended for those purposes. This exception does not apply to control circuits using high frequency signals superimposed on the power circuits.		P
13.4.6	Where it is necessary that wiring be disconnected for shipment, terminals or plug/socket combinations shall be provided at the sectional points.		P
13.4.7	When spare conductors are provided, they shall be connected to spare terminals or isolated to prevent contact with live parts		N
13.5	Ducts, connection boxes and other boxes		N

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Clause	Requirement + Test	Result - Remark	Verdict
	Ducts shall provide a degree of protection (see IEC 60529) suitable for the application		N
	No sharp edges, flash, burrs, rough surfaces, or threads with which the insulation of the conductors can come into contact		N
	Where human passage is required, least 2 m above the working surface		N
	Where cable trays are only partially covered, the cables used shall be of a type suitable for installation on open cable trays.		N
13.5.2	Rigid metal conduit and fittings shall be of galvanized steel or of a corrosion-resistant material suitable for the conditions. Where galvanic action is possible between dissimilar metals these metal combinations shall not be used.		N
	Fittings shall be compatible with the conduit and should be threaded		N
	Conduit bends shall be properly made		N
13.5.3	A flexible metal conduit shall consist of a flexible metal tubing or woven wire armour		N
13.5.4	Flexible non-metallic conduit shall be resistant to kinking		N
13.5.5	Cable trunking systems external to enclosures shall be rigidly supported and clear of all moving and of sources of contamination		N
	Where furnished in sections, the joints shall fit tightly but need not be gasketed		N
	The only openings permitted shall be those required for wiring or for drainage		N

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Clause	Requirement + Test	Result - Remark	Verdict
13.5.6	The use of compartments or cable trunking systems within the column or base of a machine to enclose conductors is permitted provided they are isolated from coolant or oil reservoirs and are entirely enclosed		P
	Conductors shall be so secured		P
13.5.7	Connection boxes and other boxes used for wiring purposes shall be accessible for maintenance.		P
	Those boxes shall provide protection against the ingress of solid bodies and liquids		P
	They shall not have opened but unused knockouts nor any other openings		N
13.5.8	Motor connection boxes shall enclose only connections to the motor and motor-mounted devices (e.g. brakes, temperature sensors		N
14	ELECTRIC MOTORS AND ASSOCIATED EQUIPMENT		P
14.1	Electric motors should conform to the relevant parts of IEC 60034 series		P
14.2	Enclosures for motors should be in accordance with IEC 60034-5		P
	The degree of protection shall be dependent on the application and the physical environment		P
	The dimensions of motors shall conform to those given in the IEC 60072 series		P
14.4	Motors and its accessories shall be so mounted that they are adequately protected and are easily accessible for inspection, maintenance, etc.		N

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Clause	Requirement + Test	Result - Remark	Verdict
	Proper cooling shall be ensured and the temperature rise shall remain within the limits of the insulation class (see IEC 60034-1)		P
	There shall be no opening between the motor compartment and any other compartment that does not meet the motor compartment requirements		P
14.5	The characteristics of motors and associated equipment shall be selected in accordance with the anticipated service and physical environmental conditions		P
14.6	Operation of the overload and overcurrent protective devices for mechanical brake actuators shall initiate the simultaneous de-energization (release) of the associated machine actuators		P
15	SOCKET-OUTLETS AND LIGHTING		P
15.1	For socket-outlets intended for accessory equipment, the following apply:		P
	- they should conform to IEC 60309-1. Where not practicable, they should be clearly marked with the voltage and current ratings		P
	- the continuity of the protective bonding circuit to the socket-outlet shall be ensured		P
	- all unearthed conductors connected to the socket-outlet shall be protected against overcurrent and, when required, overload		N
	- where the power supply to the socket-outlet is not disconnected by the supply disconnecting device for the machine or the section of the machine, the requirements of 5.3.5 apply		N

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Clause	Requirement + Test	Result - Remark	Verdict
	– where fault protection is provided by automatic disconnection of supply, the disconnection time shall be in accordance with Table A.1 for TN systems or Table A.2 for TT systems		N
	–socket-outlets with a rating not exceeding 20 A shall be provided with an RCD not exceeding 30 mA		N
15.2	Local lighting of the machine and of the equipment		P
15.2.1	The ON/OFF switch shall not be incorporated in the lampholder or in the flexible connecting cord		P
	Stroboscopic effects from lights shall be avoided		P
15.2.2	The nominal voltage of the local lighting circuit shall not exceed 250 V between conductors. A voltage not exceeding 50 V is recommended		P
	Lighting circuits shall be supplied from one of the following sources:		N
	– a dedicated isolating transformer connected to the supply disconnecting device. Overcurrent protection shall be provided in the secondary circuit		P
	– a dedicated isolating transformer connected before the supply disconnecting device. This is permitted for maintenance lighting in control enclosures only. Overcurrent protection shall be provided in the secondary circuit		P
	– a circuit of the electrical equipment of the machine for lighting, with dedicated overcurrent protection		N
	– an isolating transformer connected before the supply disconnecting device, provided with a dedicated primary disconnecting means (see 5.3.5) and secondary overcurrent protection, and mounted within the control enclosure adjacent to the supply disconnecting device		N

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Clause	Requirement + Test	Result - Remark	Verdict
	– an externally supplied lighting circuit (for example factory lighting supply). This shall be permitted in control enclosures only, and for the machine work light(s) where their total power rating is not more than 3 kW		N
	– power supply units, for DC supply to LED light sources, fitted with isolating transformers		N
	Exception: where fixed lighting is out of reach of operators during normal operations, the provisions of this 15.2.2 do not apply		N
15.2.3	Local lighting circuits shall be protected in accordance with 7.2.6		N
15.2.4	Adjustable lighting fittings shall be suitable for the physical environment		P
	The lampholders shall be:		P
	– in accordance with the relevant IEC standard		
	– constructed with an insulating material protecting the lamp cap so as to prevent unintentional contact		P
	Reflectors shall be supported by a bracket and not by the lampholder		N
	Exception: where fixed lighting is out of reach of operators during normal operations, the provisions of this 15.2.4 do not apply		N

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Clause	Requirement + Test	Result - Remark	Verdict
16	MARKING, WARNING SIGNS AND REFERENCE DESIGNATIONS		P
16.1	Warning signs, nameplates, markings, labels and identification plates shall be of sufficient durability		P
16.2.1	Enclosures that do not otherwise clearly show that they contain electrical shall be marked with the graphical symbol ISO 7010-W012 		P
	It may be omitted (see also 6.2.2 b)) for: – an enclosure equipped with a supply disconnecting device – an operator-machine interface or control station – a single device with its own enclosure (for example position sensor)		N
16.2.2	Where the risk assessment shows the need to warn against the possibility of hazardous surface temperatures, the graphical symbol ISO 7010-W017 shall be used 		N
16.3	Control devices and visual indicators, shall be clearly and durably marked with regard to their functions		N

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Clause	Requirement + Test	Result - Remark	Verdict
16.4	The following information shall be legibly and durably marked - plainly visible after installation on enclosures that receive incoming power supplies: • name or trade mark of supplier • type designation or model, where applicable • serial number where applicable • main document number (see IEC 62023) where applicable • rated voltage, number of phases and frequency (if AC), and full-load current for each incoming supply It is recommended that this information is provided adjacent to the main incoming supply(ies)		P
16.5	All enclosures, assemblies, control devices, and components shall be plainly identified with the same reference designation as shown in the technical documentation		N
17	TECHNICAL DOCUMENTATION		N
17.1	The information necessary for identification, transport, installation, use, maintenance, decommissioning and disposal of the electrical equipment shall be supplied		N
	Annex I should be considered as guidance for the preparation of information and documents		N
17.2	Information related to the electrical equipment		P
	The following shall be supplied:		N
	a) where more than one document is provided, a main document for the electrical equipment as a whole, listing the complementary documents		N
	b) identification of the electrical equipment		P

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Clause	Requirement + Test	Result - Remark	Verdict
	c) information on installation and mounting including: • a description of installation and mounting, and its connection to the electrical and other supplies • short-circuit current rating for each incoming power supply • rated voltage, number of phases and frequency (if AC.), type of distribution system (TT, TN, IT) and full-load current for each incoming supply • any additional electrical supply(ies) requirements (for example maximum supply source impedance, leakage current) for each incoming supply • space required for servicing • installation requirements regarding cooling • environmental limitations (for example lighting, vibration, EMC environment, atmospheric contaminants) • functional limitations (for example peak starting currents and permitted voltage drops) • precautions to be taken for the installation regarding electromagnetic compatibility		P
	d) an instruction for the connection of conductive-parts in the vicinity of the machine to the protective bonding circuit: • metallic pipes • fences • ladders • handrails		N
	e) information on the functioning and operation as applicable: • an overview of the structure of the electrical equipment • procedures for programming or configuring • procedures for restarting after an unexpected stop • a sequence of operation		N

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Clause	Requirement + Test	Result - Remark	Verdict
	f) information on maintenance, as appropriate: • frequency and method of functional testing • instructions for safe maintenance and where necessary suspend a safety function and/or protective measure (see 9.3.6) • guidance on the adjustment, repair, and frequency and method of preventive maintenance • details of the interconnections subject to replacement • required special devices or tools; • spare parts; • possible residual risks, indication of particular training and specification of personal protective equipment • instructions to restrict availability of keys or too(s to skilled or instructed persons • settings (DIP-switches, programmable parameter values, etc); • information for validation of safety related control functions after repair or modification, and for periodic testing where necessary;		N
	g) information on handling, transportation and storage		N
	h) information for proper disassembly and handling of components		P

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Clause	Requirement + Test	Result - Remark	Verdict
18	VERIFICATION		N
18.1	The extent of verification will be given in the dedicated product standard for a particular machine. Where there is no such standard, the verifications shall always include the items a), b), c) and h) and may include one or more of the items d) to g): a) verification that the electrical equipment complies with its technical documentation b) verification of continuity of the protective bonding circuit (Test 1 of 18.2.2) c) in case of fault protection by automatic disconnection of supply, conditions shall be verified according to 18.2; d) insulation resistance test (see 18.3) e) voltage test (see 18.4) f) protection against residual voltage (see 18.5) g) verification that the relevant requirements of 8.2.6 are met h) functional tests (see 18.6) When these tests are performed, it is recommended that they follow the sequence listed above. Where the sequence cannot be followed verification a) and b) shall be conducted first.		—
	The results of the verification shall be documented		N
18.2	Verification of conditions for protection by automatic disconnection of supply		N
18.2.1	Test 1 verifies the continuity of the protective bonding circuit. Test 2 verifies the conditions for protection by automatic disconnection of the supply in TN systems For TN-systems, those test methods are described in 18.2.2 and 18.2.3; their application for different conditions of supply are specified in 18.2.4 For TT systems, see Clause A.2 For IT systems, see IEC 60364-6		N

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Clause	Requirement + Test	Result - Remark	Verdict
	Where RCDs are used in the electrical equipment, their function shall be verified in accordance with the manufacturer's instructions. The test procedure and test interval shall be specified in the maintenance instructions		N
18.2.2	Test 1: Verification of the continuity of the protective bonding circuit		—
	The resistance between the PE terminal (see 5.2 and Figure 4) and relevant points that are part of the protective bonding circuit shall be measured with a current between 0.2 A and approximately 10 A derived from an electrically separated supply source having a maximum no-load voltage of 24 V	See appended table	N
	The resistance measured shall be in the expected range		N
18.2.3	Test 2: Fault loop impedance verification and suitability of the associated overcurrent protective device		N
	The connections of each power supply including the connection of the associated protective conductor to the PE terminal of the machine, shall be verified by inspection		N
	The conditions for the protection by automatic disconnection of supply in accordance with 6.3.3 and Annex A shall be verified by both		N
	a) verification of the fault loop impedance by - calculation, or - measurement in accordance with A.1.4 for TN-systems or A.2.4 for TT-systems, and		N
	b) confirmation that the setting and characteristics of the associated overcurrent protective device are in accordance with the requirements of Annex A, and		N

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

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Clause	Requirement + Test	Result - Remark	Verdict
	Components and devices that are not rated to withstand the test voltage and surge protection devices shall be disconnected		N
18.5	Protection against residual voltages		N
	Where appropriate, tests shall be performed to ensure compliance with 6.2.4		N
18.6	Functional tests		N
	The functions of electrical equipment shall be tested		N
18.7	Retesting		N
	Where a portion of the machine or its associated equipment is changed or modified, the need for re-verification and testing of the electrical equipment shall be considered		N
A	ANNEX A (NORMATIVE) FAULT PROTECTION BY AUTOMATIC DISCONNECTION OF SUPPLY		P
A.1	Fault protection for machines supplied from TN-systems		N
A.1.1	Fault protection shall be provided by an overcurrent protective device within a sufficiently short disconnecting time.		N
	5 s is considered sufficiently short for machines that are neither hand-held nor portable.		P
	Where not possible, supplementary protective bonding shall be provided in accordance with A.1.3		N
	For Class 1 hand-held equipment or portable equipment table A.1 specifies the maximum disconnecting times		N
A.1.2	Conditions for protection by overcurrent protective devices fulfilled		N

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Clause	Requirement + Test	Result - Remark	Verdict
A.1.3	Condition for protection by reducing the touch voltage below 50 V fulfilled		N
A.1.4	Verification of conditions for protection by automatic disconnection of the supply (A.1.2) by		N
	- verification of the characteristics of the associated protective device and		N
	- measurement of the fault loop impedance (Zs)		N
	Exception: Verification of the continuity of the protective conductors may replace the measurement where appropriate		N
A.2	Fault protection for machines supplied from TT-systems		N
	Expand if applicable		N
B	ANNEX B (INFORMATIVE) ENQUIRY FORM FOR THE ELECTRICAL EQUIPMENT OF MACHINES		N
	The use of this form can facilitate an exchange of information between the user and supplier		N
C	ANNEX C (INFORMATIVE) EXAMPLES OF MACHINES COVERED BY THIS PART OF IEC 60204		N
	Non exhaustive list of examples This standard does not apply to machines within the scope of the IEC 60335 series		N

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Clause	Requirement + Test	Result - Remark	Verdict
D	ANNEX D (INFORMATIVE) CURRENT-CARRYING CAPACITY AND OVERCURRENT PROTECTION OF CONDUCTORS AND CABLES		N
D.2.1	Correction factors for PVC conductors at higher temperatures		N
D.2.2	Methods of installation		N
D.2.3	Grouping and derating factors		N
D.4	Guidance for overcurrent protection of conductors		N
E	ANNEX E (INFORMATIVE) EXPLANATION OF EMERGENCY OPERATION FUNCTIONS		N
	Description of emergency stop, start, switching off, switching on		N
F	ANNEX (INFORMATIVE) GUIDE FOR THE USE OF THIS PART OF IEC 60204		P
	This standard gives a large number of general requirements that may or may not be applicable to the electrical equipment of a particular machine.		P
G	ANNEX (INFORMATIVE) COMPARISON OF TYPICAL CONDUCTOR CROSS-SECTIONAL AREAS		N
	Comparison of the American Wire Gauge (AWG), square millimetres, square inches, and circular mil		N

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Clause	Requirement + Test	Result - Remark	Verdict
H	ANNEX (INFORMATIVE) MEASURES TO REDUCE THE EFFECTS OF ELECTROMAGNETIC INFLUENCES		P
	Expand if applicable		P
H.3.1	Only electrical equipment which meets the requirements of the appropriate EMC standards, or the EMC requirements of the relevant product standard, should be used		P
I	ANNEX I (INFORMATIVE) DOCUMENTATION / INFORMATION		N
	Table I.1 gives a list of Documentation / Information that can be applicable		N

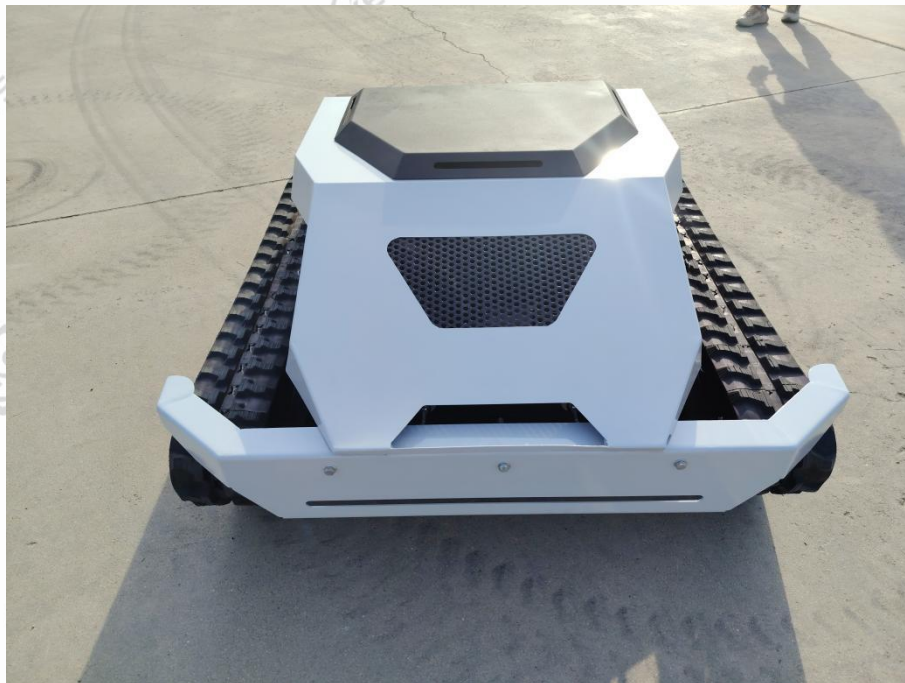
4.2	TABLE: Critical components information					P
Object / part No.	Manufacturer/ trademark	Type / model	Technical data	Standard	Mark(s) of conformity ¹⁾	
Plastic parts of enclosure	interchangeable	interchangeable	V-0	UL 94	UL	
Metal enclosure	interchangeable	interchangeable	Min: 1mm	EN 60204-1	Tested with appliance	
Supplementary information:						
¹⁾ Provided evidence ensures the agreed level of compliance. See OD-CB2039.						

18.2.2	TABLE: Test continuity of the protective bonding circuit				N/A
Measuring current ≥ 0.2 A; U $\leq$ 24VAC/DC					—
Nr	Test point	Cross-section [mm ²]	R [Ω]	Remarks	
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--	--	--	--	--	
--	--	--	--	--	
--	--	--	--	--	
Supplementary information:					

Photograph(s) of Sample

Detail of:

- ☒ front
- ☐ rear
- ☐ right side
- ☐ left side
- ☐ top
- ☐ bottom
- ☐ internal



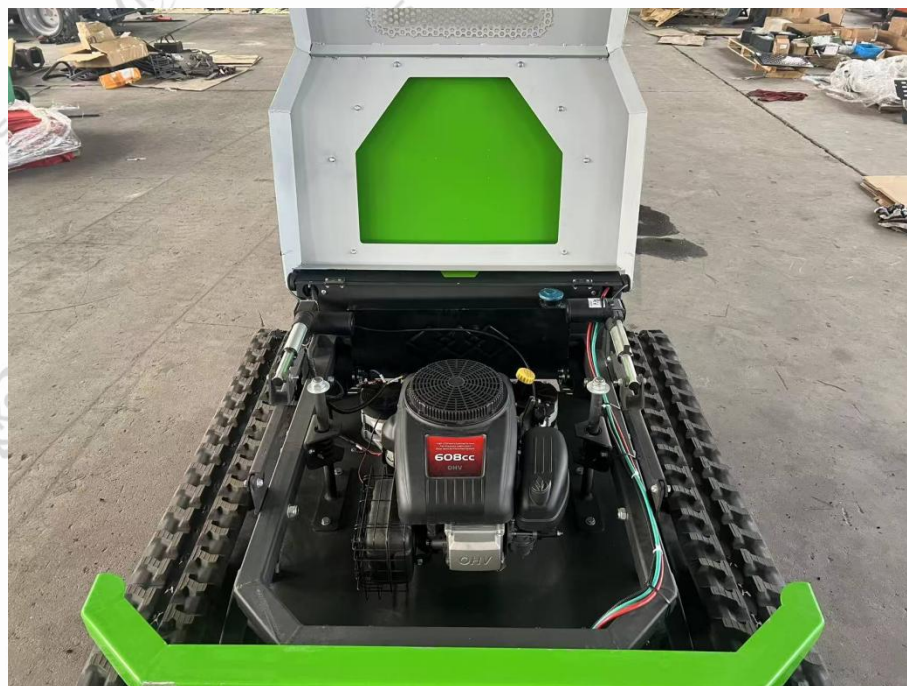
Detail of:

- ☐ front
- ☒ rear
- ☐ right side
- ☐ left side
- ☐ top
- ☐ bottom
- ☐ internal



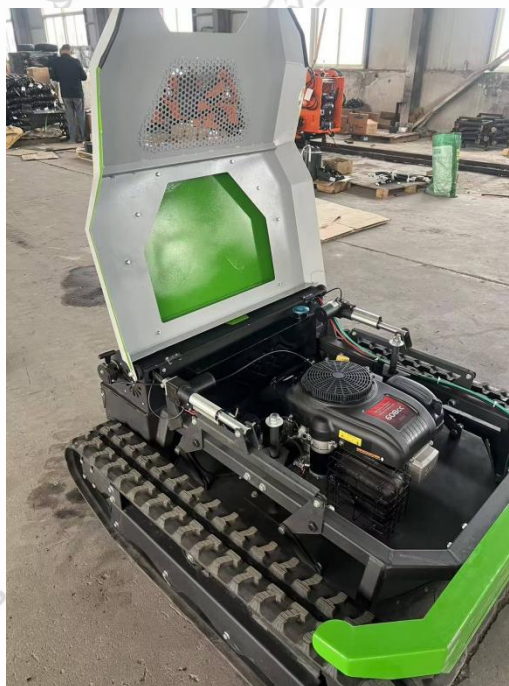
Detail of:

- ☐ front
- ☐ rear
- ☐ right side
- ☐ left side
- ☐ top
- ☐ bottom
- ☒ internal



Detail of:

- ☐ front
- ☐ rear
- ☐ right side
- ☐ left side
- ☐ top
- ☐ bottom
- ☒ internal



Detail of:

- ☐ front
- ☐ rear
- ☐ right side
- ☐ left side
- ☐ top
- ☐ bottom
- ☒ internal



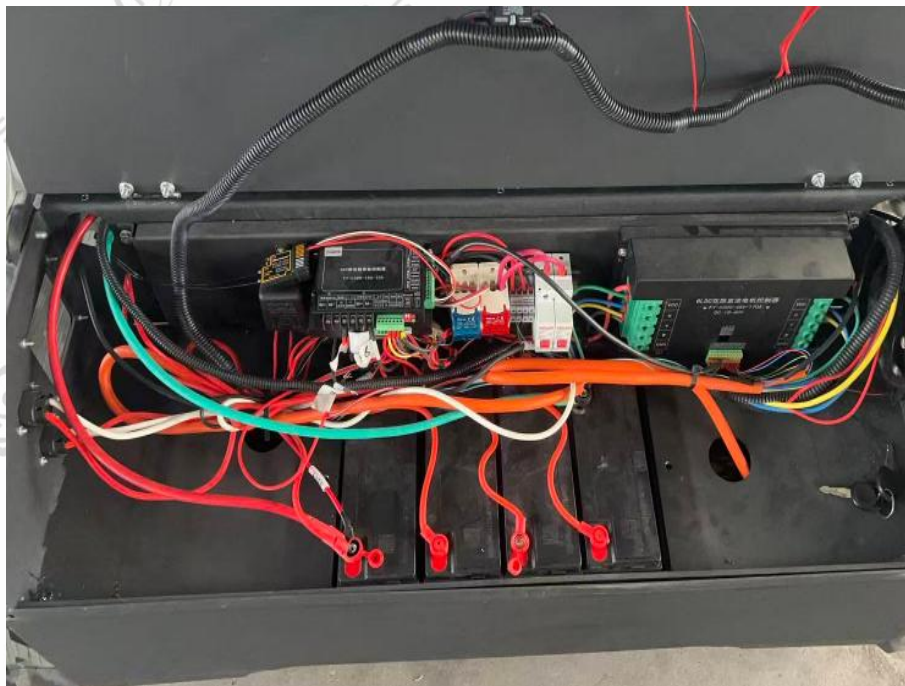
Detail of:

- ☐ front
- ☐ rear
- ☐ right side
- ☐ left side
- ☐ top
- ☐ bottom
- ☒ internal



Detail of:

- ☐ front
- ☐ rear
- ☐ right side
- ☐ left side
- ☐ top
- ☐ bottom
- ☒ internal



*** End of Report ***