



### TEST REPORT

**Report number.....: BKC24115117KS**  
**Date of issue.....: Nov. 07, 2024**  
**Testing Laboratory.....: Shenzhen BKC Testing Co., Ltd.**  
**Address.....: Room103, 1/F, Huaya Building, Huaya Industrial Park, Yousong Community, Longhua Subdistrict, Longhua District, Shenzhen, Guangdong, China**

**Applicant's name.....: Shandong Dahang Laser Technogy Co., Ltd.**  
**Address.....: Room 301, No.15 Bazi Village, Hehua Road, Licheng District, Jinan City, Shandong Province, China**


**Test specification.....:**  
**Standard.....: EN ISO 12100:2010**  
**EN 60204-1:2018**  
**EN ISO 11553-1:2020+A11:2020**  
**EN 60825-1:2014+A11:2021**  
**Test procedure.....: Type test**  
**Non-standard test method.....: N/A**

**Test Report Form No.:** ISO 12100/ 60204\_1A  
**Test Report Form(s) Originator..** BKC  
**Master TRF.....:** 2021

**Test item description.....: Laser cutting machine**  
**Trademark.....: /**  
**Manufacturer.....: Same as applicant**  
**Model/Type reference.....: DH-3015PT, DH-4015PT, DH-6015PT, DH-4020PT, DH-6020PT, DH-6025PT, DH-8025PT, DH-8020PT**  
**Ratings.....: See the page 3**

**General disclaimer:**The test results presented in this report relate only to the object tested.



<b>Responsible Testing Laboratory (as applicable), testing procedure and testing location(s):</b>	
<input checked="" type="checkbox"/> <b>Testing Laboratory:</b>	Shenzhen BKC Testing Co.,Ltd
<b>Testing location/ address.....:</b>	Room103, 1/F, Huaya Building, Huaya Industrial Park, Yousong Community, Longhua Subdistrict, Longhua District, Shenzhen, Guangdong, China
<b>Tested by.....:</b> Lucy Liu / Test Engineer	<i>Lucy Liu</i>
<b>Checked by.....:</b> Casey Wang / Project Engineer	<i>Casey Wang</i>
<b>Approved by.....:</b> Jerry Liao / Project Manager	

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

- Attachment 1: Photo documentation. (1 page)

**Summary of testing:**

Tests performed:

The submitted samples were found to comply with the requirements of:

EN ISO 12100:2010

EN 60204-1:2018

EN ISO 11553-1:2020+A11:2020

EN 60825-1:2014+A11:2021

**Artwork of marking plate(s):**

The artwork below may be only a draft.

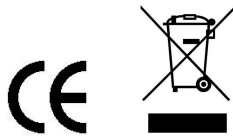
**Laser cutting machine**

**Model: DH-3015PT**

**Rated Voltage: AC 380V**

**Rated Frequency: 50/60Hz**

**Rated Power: 34KW**



**Shandong Dahang Laser Technogy Co., Ltd.**

Room 301, No.15 Bazi Village, Hehua Road, Licheng District, Jinan City, Shandong Province, China

Importer:XXXXXX

Address:XXXXXX

**Made in China**



**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.....:** Oct. 30, 2024

**Date (s) of performance of tests.....:** Oct. 30, 2024 to Nov. 07, 2024

**General remarks:**

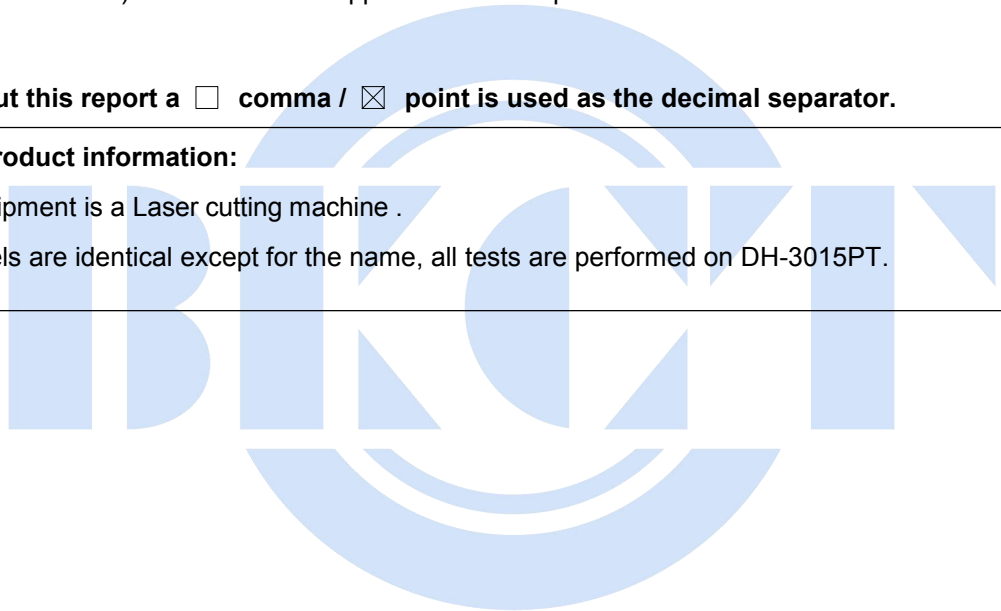
"(See Enclosure #)" refers to additional information appended to the report.

"(See appended table)" refers to a table appended to the report.

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

**General product information:**

1. The equipment is a Laser cutting machine .
2. All models are identical except for the name, all tests are performed on DH-3015PT.



EN ISO 12100: 2010			
Clause	Requirement	Remark	Result
6	Risk reduction		P
6.1	General		P
	<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:</p> <ul style="list-style-type: none"> <li>-severity of harm from the hazard under consideration</li> <li>-probability of occurrence of that harm</li> </ul> <p>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)</p>	This requirement is complied with. See related clauses.	P
6.2	Inherently safe design measures		P
6.2.1	General		P
	<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.</p>	Appropriate machine design has been performed by the manufacturer.	P
	<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.</p> <p>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).</p>	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 such factors include the following.		—

EN ISO 12100: 2010			
Clause	Requirement	Remark	Result
	<p>a) The form of machinery is designed to maximize direct visibility of the working areas and hazard zones from the control position—reducing blind spots, for example—and choosing and locating means of indirect vision where necessary(mirrors, etc.) so as to take into account the characteristics of human vision, particularly when safe operation requires permanent direct control by the operator, for example:</p> <ul style="list-style-type: none"> <li>-the travelling and working area of mobile machines;</li> <li>-the zone of movement of lifted loads or of the carrier of machinery for lifting persons:</li> <li>-the area of contact of the tool of a hand-held or hand-guided machine with the material being worked.</li> </ul> <p>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.</p>	<p>Appropriate machine design has been performed by the manufacturer.</p>	P
	<p>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).</p>	<p>Appropriate machine design has been performed by the manufacturer.</p>	P
	<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.</p>	<p>Appropriate machine design has been performed by the manufacturer.</p>	P

EN ISO 12100: 2010			
Clause	Requirement	Remark	Result
	d) The form of the machine is designed so as to achieve a suitable working position and provide accessible manual controls (actuators).	Appropriate machine design has been performed by the manufacturer.	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 so that the actuated part dose not generate a mechanical hazard.	P
	b)limiting the mass and/or velocity of the movable elements, and hence their kinetic energy;	This have 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)].	The emissions by acting on the characteristics of the source have been limited.	P

EN ISO 12100: 2010			
Clause	Requirement	Remark	Result
6.2.3	Taking into account the general technical knowledge regarding machine design 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 :		P
	a) mechanical stresses such as		—
	-stress limitation by implementation of correct calculation, construction and fastening methods as regards, e.g. bolted assemblies, welded assemblies	Has been taken into account	P
	-stress limitation by overload prevention, (e.g. "fusible" plugs, pressure-limiting valve, breakage points, torque-limiting devices);	Has been taken into account	P
	- avoiding fatigue in elements under variable stresses(notably cyclic stresses);	Has been taken into account	P
	- static and dynamic balancing of rotating elements;	Has been taken into account	P
	b) materials and their properties such as		—
	- resistance to corrosion, ageing, abrasion and wear;	It has appropriate coating	P
	- hardness, ductility, brittleness;	The materials have been treated by appropriate methods	P
	- homogeneity	The materials have been treated by appropriate methods	P
	- toxicity	The materials is non-toxicity	P
	- flammability	The materials no flammability	P
	c) emission values for:		—
	- noise;	No noise will result in hazard in this machine.	P
	- vibration;	No vibration will result in hazard in this machine.	P
	- hazardous substances;	No hazardous substances will result in hazard in this machine.	P
	- radiation.	No radiation will result in hazard in this machine.	P



EN ISO 12100: 2010			
Clause	Requirement	Remark	Result
	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/A
	One or more hazards can be eliminated or risks reduced by the choice of the technology to be used in certain applications, e. g.:		N/A
	a)on machines intended for use in explosive atmospheres: -fully pneumatic or hydraulic control system and machine actuators: -"intrinsically safe" electrical equipment (see IEC60079-11)		N/A
	b)for particular products to be processed such as a solvent:equipment assuring that the temperature will remain far below the flash point.		N/A
	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/A
6.2.5	Applying the principle of the positive mechanical action		P
	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 positive opening operation of switching devices in an electrical circuit (see IEC 60947-5-1 and ISO 14119)	The principle of the positive mechanical action of a component on another component has been applied	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.	Satisfied it.	P
	Factors to be taken into account include		—

EN ISO 12100: 2010			
Clause	Requirement	Remark	Result
	-geometry of the base; -weight distribution,including loading; -dynamic forces due to movements of parts of the machine itself,or of elements held by the machine which may result in an overturning moment; -vibration	Taken into account during design.	P
	-oscillations of the centre of gravity;		N/A
	-characteristics of the supporting surface in case of traveling or installation on different sites (e.g. ground conditions,slope);	Taken into account during design.	P
	-external forces (e.g.wind pressure,manual forces)	Taken into account during design.	P
	Stability shall be considered in all phases of the life of the machine,including handling, traveling, installation,use,de-commissioning and dismantling.	Taken into account during design.	P
	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;	These factors have been taken into account during design.	P
	-limitation of the number of special tools and equipment;	These factors have 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

EN ISO 12100: 2010			
Clause	Requirement	Remark	Result
	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 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 61310-1)	All arrangement and design of manual controls have been checked in compliance with.	P
	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 temperatue	This machine with low noise, low vibration.	P
	d) Avoid linking the operator’s working rhythm to an automatic succession of cycles.	This situation has been avoided.	P



EN ISO 12100: 2010			
Clause	Requirement	Remark	Result
	e) Providing local lighting on or in the machine for the illumination of the working area and of adjusting, setting-up, and frequent maintenance zones when the design features of the machine and/or its guards render the ambient lighting inadequate. Flicker, dazzling, shadows and stroboscopic effects shall be avoided if they can cause a risk. If the position of the lighting source has to be adjusted, its location shall be such that it does not cause any risk to persons making the adjustment.		N/A
	f) Select, locate and identify manual controls(actuators) so that		—
	- they are clearly visible and identifiable and appropriately marked where necessary(see 6.4.4)	All design and arrangement are compliance with this requirement.	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)	All design and arrangement of the control logic have been checked in compliance with this requirement.	P
	-their location(for push-buttons) and their movement (for levers and handwheels) are consistent with their effect (see IEC 61310-3)	All the function has been checked in compliance with this requirement.	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.		N/A
	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.	All the arrangement of the control logic have been checked in compliance with this requirement	P
	Constraints due to the necessary or foreseeable use of personal protective equipment(such as footwear, gloves)shall be taken into account.	There factors have been taken into account during design.	P
	g)Select, design and locate indicators, dials and visual display units so that		—



EN ISO 12100: 2010			
Clause	Requirement	Remark	Result
	-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 from the control position		P
6.2.9	Preventing electrical hazard		P
	For the design of the electrical equipment of machines IEC 60201-1 gives general provisions, especially in clause 6 for protection against electric shock.	Please also make reference to EN 60204-1 test report.	P
	For requirements related to specific machines, see corresponding IEC standards(e.g. series of IEC 61029, IEC 60745, IEC 60335).		N/A
6.2.10	Preventing and hydraulic hazards		P
	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)	Appropriate limiting devices have been provided.	P
	-no hazard results from pressure surges or rises, pressure losses or drops or losses of vacuum;	No such hazards exist.	P
	-no hazardous fluid jet or sudden hazardous movement of the hose (whiplash)results from leakage or component failures;		N/A
	-air receivers, air reservoirs or similar vessels(e.g. in gas loaded accumulators)comply with the design rules for these elements;	The devices are designed appropriately.	P
	-air elements of the equipment, and especially pipes and hoses, be protected against harmful external effects;	The pipes have been protected by appropriated devices.	P

EN ISO 12100: 2010			
Clause	Requirement	Remark	Result
	-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, clause 5)		P
	- all elements which remain under pressure after isolation of 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		P
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 measures of the control systems can avoid unforeseen and potentially hazardous machine behaviour.	Inherently safe design measures to control system have applied.	P
	-an unsuitable design or modification (accidental or deliberate) of the control system logic;		P
	- a temporary or permanent defect or a failure of one or several components of the control system;		P
	- a variation or a failure in the power supply of the control system;		P
	- inappropriate selection, design and location of the control devices;		N/A
	Typical examples of hazardous machine behaviour are:		—
	- unintended/unexpected start-up (see ISO 14188)	No this kind of hazard.	P
	- uncontrolled speed change;	No this kind of hazard.	P
	- failure to stop moving parts;	No this kind of hazard.	P

EN ISO 12100: 2010			
Clause	Requirement	Remark	Result
	- dropping or ejection of a mobile part of the machine or of a workpiece clamped by the machine;	No this kind of hazard.	P
	- machine action resulting from inhibition (defeating or failure) of protective devices	No this kind of hazard.	P
	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.	The design of control systems comply with the related principles and methods	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).	Please see the related clause.	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;		—
	-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 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 devices and/or for isolation and energy dissipation.		N/A

EN ISO 12100: 2010			
Clause	Requirement	Remark	Result
	The different zones shall be clearly defined and it shall be obvious which parts of the machine belong to which zone.		N/A
	Likewise it shall be obvious which control devices (e.g. emergency stop devices, supply disconnecting devices) and/or protective devices belong to which zone.		N/A
	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.		N/A
	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).		N/A
	For example:		-
	-the traveling speed of mobile pedestrian controlled machinery other than remote-controlled shall be compatible with walking speed.		N/A
	-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/A
	-the range of movements of parts of machinery for lifting loads shall be kept within specified limits.		N/A
	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/A
6.2.11.2	Starting of internal power source/switching on an external power supply.		P

EN ISO 12100: 2010			
Clause	Requirement	Remark	Result
	The starting of an internal power source or switching-on of an external power supply shall not result in a hazardous 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, 7.5 (see also Annexes A and B).	Please also make reference to EN 60204-1 test report.	P
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 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 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 not observed(e.g. a hydraulic braking vice 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.	P
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 alter power interruption shall be prevented (e.g. by use of a self-maintained relay, contactor or valve).	The spontaneous restart of amachine when it is re-energized after power interruption has been prevented by contactor.	P
6.2.11.5	Interruption of power supply situations resulting from interruption or excessive fluctuation of the power supply. At least the following requirements shall be met:		—
	-the stopping function of the machinery shall remain;		P

EN ISO 12100: 2010			
Clause	Requirement	Remark	Result
	-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	No such situation exists.	N/A
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	Appropriate automatic monitoring has been used.	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.	Appropriate automatic monitoring has been used.	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.:	Appropriate automatic monitoring has been used.	P
	-the stopping of the hazardous process;	Emergency stop is provided	P
	-preventing the re-start of this process after the first stop following the failure;	Reset before restart is necessary	P
	-the triggering of an alarm		N/A
6.2.11.7	Safety functions implemented by programmable electronic control systems		N/A
6.2.11.7.1	General		N/A
	A control system including programmable electronic equipment(e.g. programmable controllers)can be used to implement safety functions machinery		N/A
	equipment(e.g. programmable controllers) can be used to implement safety functions machinery		N/A

EN ISO 12100: 2010			
Clause	Requirement	Remark	Result
	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		N/A
	Where a programmable electronic control system performs a monitoring function, the system behaviour on detection of a fault shall be considered(see also IEC 61 508 series for further guidance)		N/A
	The programmable electronic control system should be installed and validated to ensure that the specified performance(e.g. safety integrity level(SIL)in IEC 61 508 series)for each safety function has been achieved		N/A
	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		N/A
6.2.11.7.2	Hardware aspects		N/A
	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:		N/A
	-architectural constraints(e.g. the configuration of the system, its ability to tolerate faults ·its behaviour on detection of a fault):		N/A
	-selecting (and/or designing) equipment and devices with an appropriate probability of dangerous random hardware failure;		N/A
	Incorporating measures and techniques within the hardware to avoid systematic failures and control systematic faults.		N/A
6.2.11.7.3	Software aspects		N/A

EN ISO 12100: 2010			
Clause	Requirement	Remark	Result
	The software (including internal operating software (or system software) and application software) shall be designed so as to satisfy the performance specification for the safety functions (see also IEC 61508-3)		N/A
	Application software		N/A
	Application software should not be re-programmable by the user.		N/A
	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/A
	When the application requires reprogramming by the user, the access to the software dealing with safety functions should be restricted e.g. by : -locks; -passwords for the authorized persons		N/A
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	Manual control devices have been designed and located according to the relevant ergonomic principles given in 4.8.7	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

EN ISO 12100: 2010			
Clause	Requirement	Remark	Result
	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 control devices and control positions have been located so that 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.		N/A
	On machinery intended for lifting persons, controls for lifting and lowering and, if appropriate, for moving the carrier, shall generally be located in the carrier. 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.		N/A
	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 unit (teach pendant, for instance), with which the operator may enter danger zones.		N/A
	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.		P

EN ISO 12100: 2010			
Clause	Requirement	Remark	Result
	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.		P
	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)		N/A
6.2.11.9	Control mode for setting, teaching, process changeover, fault-finding, cleaning or maintenance		N/A
	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/A
	-disables all other control modes;		N/A
	-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/A
	-permits operation of the hazardous elements only in reduced risk conditions (e.g. reduced speed, reduced power/force, step-operation, e. g. with a limited movement control device)		N/A
	Prevents any operation of hazardous functions by voluntary or involuntary action on the machine’s sensors.		N/A
	This control mode shall be associated with one or more of following measures:		N/A
	-restriction of access to the danger zone as far as possible.		N/A
	-emergency stop control within immediate reach of the operator;		N/A

EN ISO 12100: 2010			
Clause	Requirement	Remark	Result
	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)		N/A
6.2.11.10	Selection of control and operating modes		N/A
	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.		N/A
	Each position of the selector shall be clearly identifiable and shall exclusively allow one control or operating mode.		N/A
	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).		N/A
6.2.11.11	Applying measures achieve electromagnetic Compatibility		N/A
	For guidance on electromagnetic compatibility, see IEC60204-1, and IEC61000-6 series		N/A
6.2.11.12	Provision of diagnostic systems to aid fault-finding		N/A
	Diagnostic systems to aid fault finding should be included in the control system so that there is no need to disable any protective measures		N/A
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

EN ISO 12100: 2010			
Clause	Requirement	Remark	Result
	“Reliable component” 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 probability 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		N/A
	“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		N/A
	The use of such components should always be considered particularly in cases where redundancy is (see 6.2.12.4) not employed		N/A
6.2.12.4	Duplication (or redundancy) of components or subsystems		N/A
	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		N/A
	In order to allow the proper action to be initiated, component failure shall be preferably detected by automatic monitoring (see 6.2.1 1.6) or in some circumstances by regular inspection,		N/A
	provided that the inspection interval is shorter than the expected lifetime of the components.		N/A
	Diversity of design and/or technology can be used to avoid common cause failures (e.g. from electromagnetic disturbance) or common mode failures.		N/A



EN ISO 12100: 2010			
Clause	Requirement	Remark	Result
6.2.13	Limiting exposure to hazards through reliability of equipment		P
	Increased reliability of all component parts of machinery reduces the frequency of incidents requiring rectification, thereby reducing exposure to hazards.		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.		P
	Safety-critical components (as e.g. certain sensors) with known reliability shall be used.	Safety-critical components are used in this machine.	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 work pieces, 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.		P
	Mechanization can be achieved, e.g. by feeding slides, push rods, hand-operated indexing tables.		P
	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.	Appropriate provisions have been provided.	P
	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.	These devices will not introduce further hazards	P

EN ISO 12100: 2010			
Clause	Requirement	Remark	Result
	Suitable safeguards (see 6.3) shall be provided if this cannot be ensured.	Please see the related clause	P
	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.		P
6.2.15	Limiting exposure to hazards through location of the setting and maintenance points outside of danger zones.		P
	The need for access to danger zones shall be minimized by locating maintenance, lubrication and setting points outside these zones.		P
6.3	Safeguarding and complementary protective measures		—
6.3.1	General		—
	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 whenever inherently safe design does not reasonably make it possible either to remove hazards or to sufficiently reduce risks.	P
	The different kinds of guards and protective devices are defined in 3.27 and 3.28.	Please see the related clause	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)	Such safeguards exist	P
6.3.2	Selection and implementation of guards and protective devices		P
6.3.2.1	General		P

EN ISO 12100: 2010			
Clause	Requirement	Remark	Result
	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 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)	Please see the related clause	P
	The exact choice of a safeguard for a particular machine shall be made on the basis of the risk assessment for that machine	Please see the related clause.	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 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.)	Movable interlocking guard is used.	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 assess to the primary hazard zone, a trip device may be requiring hazard between the secondary drawing-in or shearing hazard between the mechanical loading(feeding) device, when reachable, and the fixed guard.		N/A
	Consideration shall be given 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)	No such hazards exist in this machine.	P



EN ISO 12100: 2010			
Clause	Requirement	Remark	Result
	- emission hazards(e.g. protection against noise, vibration, radiation , harmful substances)	No such hazards exist in this machine.	P
	- hazards due to the environment(e.g. protection against heat, cold, foul weather)	No such hazards exist in this machine.	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.	P
	The design of such enclosed work stations(e.g. cabs and cabins) shall take into account ergonomic principles concerning visibility,lighting, atmospheric conditions, access, posture.	No such hazards exist in this machine.	P
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:		P
	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);	Provided.	P
	c) self-closing guard (see ISO 14120, 3.3.2)		N/A
	d) sensitive protective equipment, e.g. electro-sensitive protective equipment (see IEC 61496) or pressure sensitive mat (see ISO 13856)		N/A
6.3.2.3	Where access to the hazard zone is required during normal operation		N/A
	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); b)sensitive protective equipment, e.g electro-sensitive protective equipment (see IEC 61496) c)two-hand control device (see ISO 13851)		N/A

EN ISO 12100: 2010			
Clause	Requirement	Remark	Result
6.3.2.4	Where access to the hazard zone is required for machine setting, teaching, process changeover, fault finding, cleaning or maintenance.		N/A
	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.		N/A
	Such tasks shall be identified and considered in the risk assessment as parts of the use of the machine (see 5.2)		N/A
6.3.2.5	Selection and implementation of sensitive protective equipment		N/A
6.3.2.5.1	Selection		N/A
	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/A
	The following provisions are intended to provide the designer with criteria for selecting , for each application, the most suitable device(s).		N/A
	Types of sensitive protective equipment include, e.g.:		N/A
	- light curtains;		N/A
	- scanning devices as, e.g. laser scanners;		N/A
	- pressure sensitive mats;		N/A
	- trip bars, trip wires.		N/A
	Sensitive protective equipment can be used:		N/A
	- for tripping purposes;		N/A
	- for presence sensing;		N/A
	- for both tripping and presence sensing		N/A
	- to re-initiate machine operation, a practice which is subject to stringent conditions.		N/A
	The following characteristics of the machinery, among others, can preclude the sole use of sensitive protective equipment:		N/A

EN ISO 12100: 2010			
Clause	Requirement	Remark	Result
	- tendency for the machinery to eject materials or component parts;		N/A
	- necessity to guard against emissions (noise, radiation, dust, etc.)		N/A
	- erratic or excessive machine stopping time;		N/A
	- inability of a machine to stop part-way through a cycle.		N/A
6.3.2.5.2	Implementation		N/A
	consideration should be given to :		N/A
	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/A
	b) reaction of the device to fault conditions (see IEC 61496 for electro-sensitive protective equipment)		N/A
	c) possibility of circumvention		N/A
	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/A
	sensitive protective equipment shall be integrated in the operative part and associated with the control system of the machine so that :		N/A
	- a command is given as soon as a person or part of a person is detected ;		N/A
	- 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/A

EN ISO 12100: 2010			
Clause	Requirement	Remark	Result
	- 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/A
	-the machine cannot operate during interruption of the detection function of the sensitive protective equipment,except during muting phases ;		N/A
	- 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/A
6.3.2.5.3	Additional requirements for sensitive protective equipment when used for cycle initiation .		N/A
	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/A
	Cycle initiation by sensitive protective equipment shall be subject to the following conditions :		N/A
	a)only active optoelectronic protective devices (AOPDs) complying with IEC 61496 series shall be used ;		N/A
	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/A

EN ISO 12100: 2010			
Clause	Requirement	Remark	Result
	c) the cycle time of 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/A
	d) entering the sensing field of the AOPD(s) or opening interlocking guards is the only way to enter the hazard zone;		N/A
	e) if there is more than one AOPD safeguarding the machine, only one of the AOPD(s) is capable of cycle re-initiation;		N/A
	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/A
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 :		-
	- anchorage bolts;		P
	- locking devices		N/A
	- movement limiters or mechanical stops;		N/A
	- acceleration or deceleration limiters;		N/A
	- load limiters;		N/A
	- alarms warning of the approach to stability or tipping limits;		N/A
6.3.2.7	Other protective devices		N/A
	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/A
	- when the operator has insufficient visibility of the hazard zone;		N/A

EN ISO 12100: 2010			
Clause	Requirement	Remark	Result
	- 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/A
	-when hazards may result form operation other then those controlled by the operator;		N/A
	The necessary devices include:		-
	- devices for limiting parameters of movement (distance, angle, velocity , acceleration)		N/A
	- overloading and moment limiting devices:		N/A
	- devices to prevent collisions or interference with other machines;		N/A
	-device for preventing hazards to pedestrian operators of mobile machinery or other pedestrians:		N/A
	- torque limiting devices, breakage points to prevent excessive stress of components and assemblies;		N/A
	- devices for limiting pressure. temperature;		N/A
	- devices for monitoring emissions;		N/A
	- devices prevent operation in the absence of the operator at the control position;		N/A
	- device to prevent lifting operations unless stabilizers are in place;		N/A
	- devices to ensure that components are in a safe position before traveling;		N/A
	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/A
6.3.3	Requirements for the design of guards and protective devices		P
6.3.3.1	General requirements		P

EN ISO 12100: 2010			
Clause	Requirement	Remark	Result
	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.	This requirement has been taken into account during design.	P
	- not give rise to any additional hazard;	This requirement has been taken into account during design.	P
	-not be easy to by-pass or render non-operational;	This requirement has been taken into account during design.	P
	-be located at an adequate distance from the danger zone (see ISO 13857 and ISO 13855).	This requirement has been taken into account during design.	P
	-cause minimum obstruction to the view of the production process:	This requirement has been taken into account during design.	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;	This requirement has been taken into account during design.	P
	For openings in the guards see ISO 13857	This requirement has been taken into account during design.	P
6.3.3.2	Requirements for fixed guards		P
6.3.3.2.1	Functions of guards		P

EN ISO 12100: 2010			
Clause	Requirement	Remark	Result
	The functions that guards can achieve are:	These functions are achieved by fixed guards.	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.	These functions are achieved by fixed guards.	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).	These functions are achieved by fixed guards.	P
6.3.3.2.2	Requirements for fixed guards		P
	Fixed guards shall be securely held in place:		P
	- either permanently (e.g. by welding) -or by means of fasteners (screws, nuts) making removal/opening impossible without using tools; they should not remain closed without their fasteners (see ISO 14120)	All the fixed guards are securely held in place by appropriate fasteners.	P
6.3.3.2.3	Requirements for movable guards		P
	a)movable guards which provide protection against hazards generated by moving transmission parts shall:		P
	-as far as possible remain fixed to the machinery or other structure (generally by means of hinges or guides) when open;	Gemels are used for the movable guards.	P
	-be interlocking guards (with guard locking when necessary ) (see ISO 14119)		N/A
	b) movable guards against hazards generated by non-transmission moving parts shall be designed and associated with the machine control system so that;		—

EN ISO 12100: 2010			
Clause	Requirement	Remark	Result
	- moving parts cannot start up while they are within the operator's reach and the operator cannot reach moving parts once they have start up; this can be achieved by interlocking guards, with guard locking when necessary.	Interlocking guards are provided to comply with these requirements.	P
	- they can be adjusted only by an intentional action, such as the use of tool or a key;	This requirement is complied with.	P
	-they 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)	This requirement is complied with.	P
6.3.3.2.4	Requirements for adjustable guards		N/A
	Adjustable guards may only be used where the hazard zone cannot for operational reasons be completely enclosed; they shall: -be designed so that the adjustment remains fixed during a given operation -be readily adjustable without the use of tools;		N/A
6.3.3.2.5	Requirements for interlocking guards with a start function (control guards)		N/A
	An interlocking guard with a start function may be used provided that		N/A
	- all requirements for interlocking guards are satisfied (see ISO 14119)		N/A
	- the cycle time of the machine is short		N/A
	-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 tart function and resetting is necessary before restarting the machine.		N/A
	- 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/A
	- all other guards whether fixed (removable type) or movable are interlocking guards;		N/A

EN ISO 12100: 2010			
Clause	Requirement	Remark	Result
	-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/A
	-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/A
6.3.3.2.6	Hazards from guards		P
	Care shall be taken to prevent hazards which might be generated by:		P
	- the guard construction (e.g. sharp edges or corners, material);	This requirement has been taken into account during design.	P
	- the movements of the guards (shearing or crushing zones generated by power-operated guards and by heavy guards which are liable to fall )	This requirement has been taken into account during design.	P
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.	This requirement has been taken into account during design.	P
	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 IEC62061.	This requirement has been taken into account during design.	P
	Protective devices shall be installed and connected to the control system so that they cannot be easily defeated.	This requirement has been taken into account during design.	P
6.3.3.4	Provisions for alternative types of safeguards.		N/A
	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/A

EN ISO 12100: 2010			
Clause	Requirement	Remark	Result
6.3.4	Safeguarding for reducing emissions		P
6.3.4.1	General		P
	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).	No such hazard exists.	P
6.3.4.	Noise		P
	Additional protective measures include, for example: -enclosures (see ISO 15667) -screens fitted to the machine; -silencers (see ISO 14163)	No such hazard exists.	P
6.3.4.3	Vibration		P
	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.	No such hazard exists.	P
	For measures for vibration isolation of stationary industrial machinery see EN 1299	No such hazard exists.	P
6.3.4.4	Hazardous substances		N/A
	Additional protective measures include, for example:		N/A
	-encapsulation of the machine (enclosure with negative pressure);		N/A
	- local exhaust ventilation with filtration.		N/A
	- wetting with liquids;		N/A
	- special ventilation in the area of the machine (air curtains, cabins for operators)		N/A
6.3.4.5	Radiation		N/A
	Additional protective measures include, for example:		N/A
	- use of filtering and absorption;		N/A
	- use of attenuating screens or guards		N/A
6.3.5	Complementary protective measures		P
6.3.5.1	General		P

EN ISO 12100: 2010			
Clause	Requirement	Remark	Result
	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.	It meet the requirement.	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	The actuators can be clearly identifiable, clearly visible and readily aessible	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;	The hazardous process can be topped as quickly as possible without creating additional hazards	P
	-the emergency stop control shall trigger or permit the triggering of certain safeguard movements where necessary.	No this situation exists	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 rest.	Reset is necessary before re-start.	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.	This requirement is complied with by appropriate design of the emergency stop	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.	Please see the related clauses.	P

EN ISO 12100: 2010			
Clause	Requirement	Remark	Result
6.3.5.3	Measures for the escape and rescue of trapped persons		N/A
	Measures for the escape and rescue of trapped persons may consist e.g. of:		N/A
	-escape routes and shelters in installations generating operator-trapping hazards		N/A
	-arrangements for moving some elements by hand, after an emergency stop		N/A
	-arrangements for reversing the movement of some elements		N/A
	- anchorage points for descender devices;		N/A
	-means of communication to enable trapped operators to call for help		N/A
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;	A main switch with lock is provided.	P
	b) locking (or otherwise securing ) all the isolating units in the isolating position;	Please see the report for EN 60204	P
	dissipating or , if this is not possible or practicable, restraining (containing) any stored energy which may give rise to a hazard;	Please see the report for EN 60204	P
	verifying, by means of a safe working procedure, that the actions taken according to a), b) and c) above have produced the desired effect.	Please see the report for EN 60204	P
	See ISO 14118, clause 5 and EN 60204-1: 5.5 and 5.6		P
6.3.5.5	Provisions for easy and safe handling of machines and their heavy component parts		P

EN ISO 12100: 2010			
Clause	Requirement	Remark	Result
	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.	Appropriate attachments are provided.	P
	These attachments may be, among others,		P
	standardized lifting appliances with slings, hooks, eyebolts, or tapped holes for appliance fixing;		P
	appliances for automatic grabbing with a lifting hook when attachment is not possible from the ground.	Such devices are used.	P
	guiding grooves for machines to be transported by a fork truck;		N/A
	lifting gear and appliances integrated into the machine.		N/A
	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).		P
6.3.5.6	Measures for safe access to machinery		P
	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.	These requirements have been taken into account during design.	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/A
	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.		N/A
	In large automated installations, particular attention shall be given to safe means of access such as walkways, conveyor bridges or crossover points.		N/A

EN ISO 12100: 2010			
Clause	Requirement	Remark	Result
	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/A
	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 stations)		N/A
	Openings shall whenever possible open towards a safe position, They shall be designed to prevent hazards due to unintended opening.		N/A
	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/A
	When machinery for lifting goods and/or persons includes landings at fixed levels, these shall be equipped with inter locking guards preventing falls when the platform is not present at the level.		N/A
	Movement of the lifting platform shall be prevented while the guards are open.		N/A
	For detailed provisions see ISO 14122.		N/A
	Information for use		N/A
6.4	General requirements		P
6.4.1	Drafting information for use is an integral part of the design of a machine(see figure2).	Please see the related clause.	P
6.4.1.1	Information of use consists of communication links, such as texts, words, signs, signals, symbols or diagrams, used separately or in combination to convey information to the user. It is directed to professional and/or non-professional users.	All the information is stated in the appropriate place.	P
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.		—

EN ISO 12100: 2010			
Clause	Requirement	Remark	Result
	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.	All the information is stated in the appropriate place.	P
	The information shall indicate, as appropriate,		-
	- the need for training,	All the information is stated in the appropriate place.	P
	- the need for personal protective equipment,	All the information is stated in the appropriate place.	P
	- the possible need for additional guards devices (see Figure 2, Footnote d).	All the information is stated in the appropriate place.	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.	All the information is stated in the appropriate place.	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.	All the information is stated in the appropriate place.	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:	All the information is stated in the appropriate place.	P
	- in /on the machine itself (see 6.3 and 6.4.4)	Adequate information stated in the machine itself.	P
	-in accompanying documents ( in particular instruction handbook , see 6.4.5)	Adequate information is stated in the accompanying documents	P
	- on the packaging	Adequate information is stated on the packaging	P

EN ISO 12100: 2010			
Clause	Requirement	Remark	Result
	- by other means such as signals and warnings outside the machine.	Adequate information is stated	P
	Standardized phrases shall be considered where important messages such as warnings need to be given (see also IEC 62079)	This requirement is considered.	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 see the related clause.	P
	It is essential that these signals:		—
	<ul style="list-style-type: none"> <li>- be emitted before the occurrence of the hazardous event;</li> <li>- be unambiguous;</li> <li>- be clearly perceived and differentiated from all other signals used;</li> <li>- be clearly recognized by the operator and other persons.</li> </ul>	This requirement is taken into account during design and selection of the warning devices.	P
	The warning devices shall be designed and located such that checking is easy.	This requirement is taken into account during design and selection of the warning devices.	P
	The information for use shall prescribe regular checking of warning devices.	This requirement is taken into account during design and selection of the 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.	This requirement is taken into account during design and selection of the warning devices.	P
6.4.4	Markings, signs (pictograms), written warnings		P
	Machinery shall bear all markings which are necessary:		—

EN ISO 12100: 2010			
Clause	Requirement	Remark	Result
	a) for its unambiguous identification, at least - name and address of the manufacturer; - designation of series or type; - serial number, if any.	Adequate information is provided.	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)	Adequate information is provided.	P
	c) for its safe use, e.g. : - maximum speed of rotating parts; - maximum diameter of tools; -mass (expressed in kilograms) of the machine itself and/or of removable parts - maximum working load; - necessity of wearing personal protective equipment; - guard adjustment data; - frequency of inspection.	Adequate information is provided.	P
	Information printed directly on the machine should be permanent and remain legible throughout the expected life of the machine.		P
	Signs or written warnings only saying "danger" shall not be used.		P
	Readily understandable signs (pictograms) should be used in preference to written warnings.		P
	Signs and pictograms should only be used if the 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, colours) See EN 60204 series as regards marking of electrical equipment.		P
6.4.5	Accompanying documents ( in particular, instruction handbook)		P
6.4.5.1	Contents		P

EN ISO 12100: 2010			
Clause	Requirement	Remark	Result
	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. : <ul style="list-style-type: none"> <li>- storage conditions for the machine;</li> <li>-dimensions , mass value(s), position of the centre (s) of gravity;</li> <li>-indications for handling (e.g. drawings indicating application points for lifting equipment)</li> </ul>	All the related information is stated in the instruction handbook	P
	b) information relating to installation and commissioning of the machine, e.g. <ul style="list-style-type: none"> <li>- fixing/anchoring and vibration dampening requirements</li> <li>- assembly and mounting conditions;</li> <li>- space needed for use and maintenance;</li> <li>- permissible environmental conditions (e.g. temperature, moisture, vibration,electromagnetic radiation);</li> <li>-instructions for connecting the machine to power supply (particularly about protection against electrical overloading);</li> <li>- advice about waste removal /disposal;</li> <li>-if necessary, recommendations about protective measures which have to be taken by the user; e.g. additional safeguards, safety distances, safety signs and signals.</li> </ul>	All the related information is stated in the instruction handbook	P

EN ISO 12100: 2010			
Clause	Requirement	Remark	Result
	<p>c) information relating to the machine itself, e.g. :</p> <ul style="list-style-type: none"> <li>-detailed description of the machine, its fittings, its guards and/or protective devices;</li> <li>-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.</li> <li>-diagrams (especially schematic representation of safety functions);</li> <li>- data about noise and vibration generated by the machine, about radiation, gases, vapours, dust emitted by it, with reference to the measuring methods used.</li> <li>-technical documentation about electrical equipment (see EN 60204 series)</li> <li>-documents attesting that the machine complies with mandatory requirements;</li> </ul>	<p>All the related information is stated in the instruction handbook</p>	P
	<p>d)information relating to the use of the machine, e.g. about:</p> <ul style="list-style-type: none"> <li>- intended use;</li> <li>- description of manual controls (actuators);</li> <li>- setting and adjustment;</li> <li>- modes and means for stopping (especially emergency stop )</li> <li>- risks which could not be eliminated by the protective measures taken by the designer;</li> <li>- 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.</li> <li>-reasonably foreseeable misuse and prohibited usages;</li> <li>- fault identification and location , repair, and re-starting after an intervention;</li> <li>- personal protective equipment which need to be used and training required.</li> </ul>	<p>All the related information is stated in the instruction handbook</p>	P

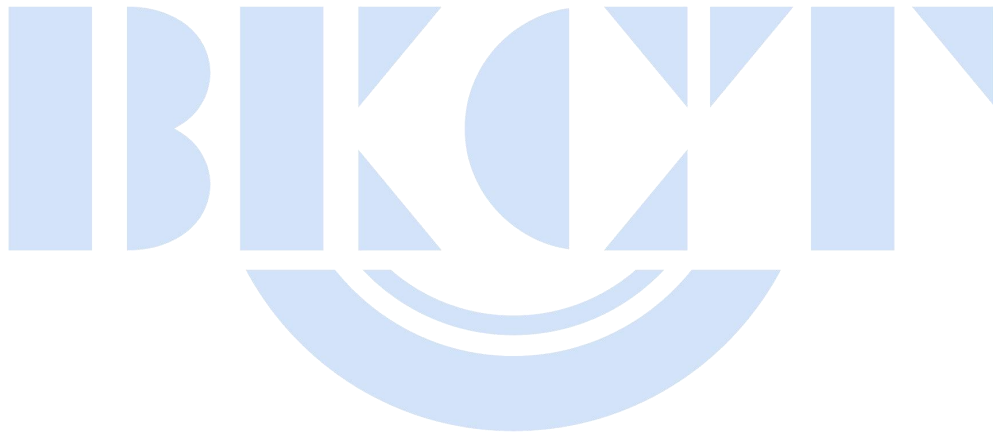
EN ISO 12100: 2010			
Clause	Requirement	Remark	Result
	<p>e) information for maintenance e.g.</p> <ul style="list-style-type: none"> <li>-nature and frequency of inspections for safety functions;</li> <li>-instructions relating to maintenance operations which require a definite technical knowledge or particular skills and hence should be carried out exclusively by skilled persons (e.g. maintenance staff, specialists)</li> <li>- 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)</li> <li>-drawings and diagrams enabling maintenance personnel to carry out their task rationally (especially fault-finding tasks)</li> </ul>	All the related information is stated in the instruction handbook	P
	f) information relating to de-commissioning , dismantling and disposal;	All the related information is stated in the instruction handbook	P
	<p>g) information for emergency situations , e.g. :</p> <ul style="list-style-type: none"> <li>- type of fire-fighting equipment to be used.</li> <li>- warning about possible emission or leakage of harmful substance(s), and if possible, indication of means to fight their effects.</li> </ul>	All the related information is stated in the instruction handbook	P
	h) maintenance instructions provided for skilled persons and maintenance instructions provided for unskilled persons, 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	All the related information is stated in 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.	All the related information is stated in the instruction handbook	P

EN ISO 12100: 2010			
Clause	Requirement	Remark	Result
	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.	All the related information is stated in the instruction handbook	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.	All the related information is stated in 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.	All the related information is stated in the instruction handbook	P
	e) the use of colours should be considered, particularly in relation to components requiring quick identification.	All the related information is stated in the instruction handbook	P
	f) when information for use is lengthy, a table of contents and/or an index should be given.	All the related information is stated in the instruction handbook	P
	g) safety-relevant instructions which involve immediate action should be provided in a form readily available to the operator.	All the related information is stated in the instruction handbook	P
6.4.5.3	Drafting and editing information for use		P
	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).	All the related information is stated in the instruction handbook	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.	All the related information is stated in the instruction handbook	P

EN ISO 12100: 2010			
Clause	Requirement	Remark	Result
	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.	All the related information is stated in the instruction handbook	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.	All the related information is stated in the instruction handbook	P
	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.	All the related information is stated in the instruction handbook	P

<b>7</b>	<b>Documentation of risk assessment and risk reduction</b>		<b>P</b>
	The documentation shall demonstrate the procedure that has been followed and the results that have been achieved. This includes, when relevant, documentation		P
	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
	c) the hazards and hazardous situations identified and the hazardous events considered in the risk assessment		P

EN ISO 12100: 2010			
Clause	Requirement	Remark	Result
	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.); 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;		P
	g) residual risks associated with the machinery;		P
	h) the result of the risk assessment (see Figure 1);		P
	i) any forms completed during the risk assessment.		P



EN 60204-1			
Clause	Requirement - Test	Result - Remark	Verdict
4	<b>GENERAL REQUIREMENTS</b>		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	This requirement has been considered during design.	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		P
	-as stated below (4.3.2 or 4.3.3)		P
	-or as specified by the user		N/A
	-or as specified by the supplier (4.3.4)		N/A
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
	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

EN 60204-1			
Clause	Requirement - Test	Result - Remark	Verdict
	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/A
	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/A
	Voltage interruption: - batteries: not exceeding 5 ms - converting equipment: not exceeding 20 ms		N/A
	Ripple (peak-to-peak): not exceed. 0.15 of nom. volt.		N/A
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/A
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	Immunity and/or emission tests required unless		P
	-incorporated devices and components comply with the relevant product standard and		N/A
	-installation and wiring according supplier instructions or Annex H:		N/A
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

EN 60204-1			
Clause	Requirement - Test	Result - Remark	Verdict
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 the reduction of dielectric strength, switching capability and cooling effects shall be taken into account		N/A
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		N/A
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

<b>5</b>	<b>INCOMING SUPPLY CONDUCTOR TERMINATIONS AND DEVICES FOR DISCONNECTING AND SWITCHING OFF</b>		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)		N/A
	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)	Neutral conductor has been used and satisfied this requirement.	P
	A separate terminal, labelled N provided (it may be part of the supply disconnecting device)		P

EN 60204-1			
Clause	Requirement - Test	Result - Remark	Verdict
	No connection between neutral conductor and protective bonding circuit		P
	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/A
	For machines supplied from parallel sources the requirements of IEC 60364-1 apply		N/A
	All terminals of incoming supply clearly marked in acc. 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	A terminal has been provided for each incoming supply.	P
	Terminal size according to table 1 in relation to the line conductors		P
	Where an external protective conductor other than copper is used, the terminal size and type shall be selected accordingly		N/A
	At each incoming point this terminal shall be marked or labelled with the letters PE		P
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	A supply disconnecting device is provided.	P
	Where two or more such devices exist, interlocks shall be provided to prevent hazardous situations		N/A
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

EN 60204-1			
Clause	Requirement - Test	Result - Remark	Verdict
	b) a control and protective switching device suitable for insulation acc. to IEC 60947-6-2		N/A
	c) a circuit-breaker suitable for isolation (acc. to IEC 60947-2)		N/A
	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/A
	e) a plug/socket combination for a flexible cable supply		N/A
5.3.3	A disconnection device acc. to 5.3.2 a) to d) has to fulfil all of the following requirements		—
	- isolate the electrical equipment from the supply and have one OFF (isolated) and one ON position marked with "O" and "I"		P
	- have a visible contact gap or a position indicator which cannot indicate OFF (isolated) until all contacts are actually open and the requirements for the isolating function have been satisfied		P
	- have an operating means (see 5.3.4)		P
	- be provided with a means permitting it to be locked in the OFF position (padlocks). When so locked, remote as well as local closing shall be prevented		P
	- disconnect all live conductors of its power supply circuit For TN supply systems, the neutral conductor may or may not be disconnected except in countries where disconnection of the neutral conductor (when used) is compulsory		P
	- have a braking capacity to interrupt the system, when the largest motor is stalled		P

EN 60204-1			
Clause	Requirement - Test	Result - Remark	Verdict
	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		N/A
	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		N/A
5.3.4	Operating means of supply disconnecting devices (e.g. a handle) shall be external to the enclosure		P
	Exception: for power-operated switchgear this can be some other means (e.g. pushbutton) instead of a handle		N/A
	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)		P
	Where intended for emergency operation, see 10.7.3 or 10.8.3		P
	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/A

EN 60204-1			
Clause	Requirement - Test	Result - Remark	Verdict
5.3.5	<p>The following circuits need not be disconnected by the supply disconnecting device:</p> <ul style="list-style-type: none"> <li>- lighting circuits for lighting needed during maintenance or repair;</li> <li>- socket outlets for the exclusive connection of repair or maintenance tools and equipment;</li> <li>- undervoltage protection circuits that are only provided for automatic tripping in the event of supply failure;</li> <li>- circuits supplying equipment that should normally remain energized for correct operation</li> </ul> <p>Such circuits should be provided with their own disconnecting device.</p>		P
	Where expected circuits are not disconnected by the supply disconnecting device:		—
	-permanent warning labels shall be placed close to the operating means		N/A
	-a statement shall be included in the maintenance manual and		N/A
	-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/A
5.4	Devices for removal of power for prevention of unexpected start-up		P
	Devices for removal of power for the prevention of unexpected start-up shall be provided where this can create a hazard		P
	They shall be appropriate and convenient for the intended use, suitably placed, and readily identifiable as to their function and purpose		P
	Where not obvious, they shall be marked to indicate the extent of removal of power		P



EN 60204-1			
Clause	Requirement - Test	Result - Remark	Verdict
	Devices in accordance with 5.3.2 may be used for this purpose		P
	Disconnectors, withdrawable fuse links and withdrawable links only used, if located in enclosed electrical operator area (see 3.1.23)		N/A
	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/A
5.5	Devices for isolating electrical equipment		P
	Devices shall be provided for isolating electrical equipment or parts of it to enable work		P
	Such devices shall be: - appropriate and convenient for the intended use; - suitably placed; - readily identifiable as to which part or circuit of the equipment is served. They shall be marked unless their function and purpose is obvious		P
	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		P
	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)		P
5.6	Protection against unauthorized, inadvertent and/or mistaken connection		P

EN 60204-1			
Clause	Requirement - Test	Result - Remark	Verdict
	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		P
	Where these devices are located inside an enclosed electrical operator area, other means of protection against unintended reconnection can be sufficient		P
	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/A

<b>6</b>	<b>PROTECTION AGAINST ELECTRIC SHOCK</b>		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/A
	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/A
6.2.2	Live parts shall be located inside enclosures that provide protection against contact with live parts of at least IP2X or IPXXB.		P

EN 60204-1			
Clause	Requirement - Test	Result - Remark	Verdict
	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/A
	Opening an enclosure (i.e. opening doors, lids, covers, etc) shall be possible only under one of the following conditions:		—
	a) The use of a key or tool is necessary for access All 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.		P

EN 60204-1			
Clause	Requirement - Test	Result - Remark	Verdict
	<p>b) The disconnection of live parts inside the enclosure before it can be opened (see explanation)</p> <p>Exception: a key or tool as prescribed by the supplier can be used to defeat the interlock, provided that the following conditions are met:</p> <ul style="list-style-type: none"> <li>- 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;</li> <li>- upon closing the door, the interlock is automatically restored</li> <li>- 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</li> <li>- relevant information about the procedure for the defeat of the interlock is provided with the instructions for use of the electrical equipment</li> <li>- 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</li> </ul> <p>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:</p> <ul style="list-style-type: none"> <li>- 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</li> <li>- the supply terminals of the supply disconnecting device when the latter is mounted alone in a separate enclosure</li> </ul>		P

EN 60204-1			
Clause	Requirement - Test	Result - Remark	Verdict
	<p>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.</p> <p>Where barriers provide this protection, either they shall require a tool for their removal or all live parts protected by them shall be automatically disconnected when the barrier is removed.</p> <p>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</p>		N/A
6.2.3	<p>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</p>		P
	<p>Note: Paint, varnish lacquer etc. alone are generally considered inadequate</p>		P
6.2.4	<p>Live parts having a residual voltage greater than 60 V when disconnected, shall be discharged to 60 V or less within 5 s, if this does not interfere with the proper functioning of the equipment</p>		P
	<p>Exempted are components having stored charges of 60 <math>\mu</math>C or less</p>		N/A
	<p>Where not possible , an appropriate warning shall be placed according to the details given</p>		N/A
	<p>In case of pins of plugs etc. the discharge time shall not exceed 1s.</p> <p>Otherwise such conductors shall be protected to at least IP2X or IPXXB.</p>		N/A
	<p>If above requirements cannot be achieved, additional disconnecting devices or appropriate warning devices shall be provided</p>		N/A

EN 60204-1			
Clause	Requirement - Test	Result - Remark	Verdict
	When equipment is accessible to all persons incl. children, warnings are not sufficient and a protection of IP4X or IPXXD is required		N/A
6.2.5	For protection by barriers, the requirements of IEC 60364-4-41 shall apply (412.2)		N/A
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/A
	For conductor wire or bar systems with less than IP2X or IPXXB, see 12.7.1		N/A
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/A
	- switchgear and control gear assemblies having total insulation in accordance with IEC 61439-1or		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)		P
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

EN 60204-1			
Clause	Requirement - Test	Result - Remark	Verdict
	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)		P
	one of the following:		—
	a) In TN systems, the following protective devices may be used:		—
	•overcurrent protective device or		P
	•residual current protective devices (RCDs) and associated overcurrent protective devices		N/A
	b) In TT systems either:		N/A
	•RCDs and associated overcurrent protective devices or		N/A
	•overcurrent protective devices provided a low fault loop impedance is assured		N/A
	c) In IT-Systems the requirements of IEC 60364-4-41 shall be fulfilled		N/A
	During an insulation fault an acoustic and an optical signal shall be sustained. The acoustic signal may manually be muted		P
	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		P
	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/A

EN 60204-1			
Clause	Requirement - Test	Result - Remark	Verdict
6.4	Protection by the use of PELV		N/A
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/A
	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/A
	c) live parts of PELV circuits shall be electrically separated from other live circuits (see IEC 61558)		N/A
	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/A
	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/A
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
	- a source of current with a degree of safety equi-valent to that of the safety isolating transformer or		N/A
	- a source independent of circuit with higher voltage (e.g. battery or diesel –driven) or		N/A
	- electronic power supply conforming to appropriate standards		N/A



EN 60204-1			
Clause	Requirement - Test	Result - Remark	Verdict
7.	<b>PROTECTION OF EQUIPMENT</b>		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
	The following conductors shall not be disconnected without disconnecting all associated live conductors: - the neutral conductor of AC power circuits; - the earthed conductor of DC power circuits; - DC power conductors bonded to exposed conductive parts of mobile machines.		P
	Where the cross-section area of the neutral conductor is at least equal to the line conductor, no overcurrent detection nor disconnecting device is required for that conductor		P
	Otherwise the measures detailed in 524 of IEC 60364-5-52:2009 shall apply		N/A

EN 60204-1			
Clause	Requirement - Test	Result - Remark	Verdict
	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/A
7.2.4	Control circuits		N/A
	Conductors of control circuits directly connected to the supply shall be protected against overcurrent in accordance with 7.2.3.		N/A
	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/A
	- 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/A
	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/A
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/A

EN 60204-1			
Clause	Requirement - Test	Result - Remark	Verdict
7.2.7	Transformers shall be protected in accordance with the manufacturer's instructions and includes: -avoiding tripping due to transformer magnetizing inrush currents -avoiding a winding temperature rise in excess of the permitted value for the insulation class when there is a short circuit at the secondary terminals		P
7.2.8	Location of overcurrent protective devices		P
	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:		P
	-current carrying capacity of the conductors is at least equal to that of the load and -conductors between the point of reduction of current-carrying capacity and the position of the overcurrent protective device is $\leq 3$ m and -the conductor is protected e.g. by an enclosure or duct.		N/A
7.2.9	Overcurrent protective devices		P
	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.		P
	Where fuses are provided as overcurrent protective devices, a type readily available in the country of use shall be selected, or arrangements shall be made for the supply of spare parts.		P
7.2.10	Rating and setting of overcurrent protective devices:		P
	Rated current of fuses or overcurrent setting of other protective devices selected as low as possible, but adequate for anticipated overcurrents.		P


EN 60204-1			
Clause	Requirement - Test	Result - Remark	Verdict
	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.		P
7.3	Protection of motors against overheating		P
7.3.1	Protection shall be provided for each motor rated at more than 0.5 kW.		P
	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/A
	Automatic restarting prevented where this can cause a hazard		P
7.3.2	Protection achieved by overload protection device: -detection in each live conductor -switching off of all live conductors (not necessary to switch of neutral conductor)		P
	For special duty motors, appropriate protective devices are recommended		N/A
	For motors that cannot be overloaded, overload protection is not required.		P
7.3.3	Protection achieved by over-temperature protection device: Is recommended in situations where the cooling can be impaired (for example dusty environments)		P
7.4	Equipment shall be protected against abnormal temperatures that can result in a hazardous situation.		P
7.5	Protection against the effects of supply interruption or voltage reduction and subsequent restoration		P


EN 60204-1			
Clause	Requirement - Test	Result - Remark	Verdict
	Where a supply interruption or a voltage reduction can cause a hazardous situation, damage to the machine, or to the work in progress, undervoltage protection is provided.		P
	Upon restoration of supply voltage, automatic or unexpected restarting of machine prevented.		P
	Undervoltage protection does initiate appropriate control responses to ensure necessary coordination of groups of machines working together		P
7.6	Motor overspeed protection shall be provided where overspeeding can occur and could possibly cause a hazardous situation.		P
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.		P
7.9	Surge protective devices (SPDs) can be provided to protect against the effects of overvoltages due to lightning or to switching surges.		N/A
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.		P

<b>8</b>	<b>EQUIPOTENTIAL BONDING</b>		P
8.2	Protective bonding circuit		P
8.2.1	All parts of the protective bonding circuit shall be so designed that they are capable of withstanding the highest thermal and mechanical stresses		P
	Protective conductors which does not form part of a cable shall not be less than:		—
	-2.5 mm <sup>2</sup> Cu or 16 mm <sup>2</sup> Al if protection against mechanical damage is provided		P
	-4 mm <sup>2</sup> Cu or 16 mm <sup>2</sup> Al if protection against mechanical damage is not provided		N/A

EN 60204-1			
Clause	Requirement - Test	Result - Remark	Verdict
	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.		P
	Small parts and other conductive parts that do not constitute a hazard need not to be earthed		P
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 <sup>2</sup> in cross-sectional area.		N/A
	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		P
	The cross-section of protective conductors shall be calculated according to 543.1.2 of IEC 60364-5-54, or selected in accordance with Table 1.		P
	Each protective conductor shall: -be part of a multicore cable, or; -be in a common enclosure with the line conductor, or; -have a cross-sectional area of at least; -2.5 mm <sup>2</sup> Cu or 16 mm <sup>2</sup> Al with protection against mechanical damage -4 mm <sup>2</sup> Cu or 16 mm <sup>2</sup> Al without protection against mechanical damage		P

EN 60204-1			
Clause	Requirement - Test	Result - Remark	Verdict
	A protective conductor not forming part of a cable is considered to be mechanically protected if it is installed in a conduit, trunking or protected in a similar way.		P
	The following parts shall be connected to the protective bonding circuit but shall not be used as protective conductors: -conductive structural parts of the machine; -metal ducts of flexible or rigid construction; -metallic cable sheaths or armouring; -metallic pipes containing flammable materials such as gases, liquids, powder. -flexible or pliable metal conduits; -constructional parts subject to mechanical stress in normal service; -flexible metal parts; support wires; cable trays and cable ladders.		P
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)		P
	Where the electrical equipment is mounted on lids, doors, or cover plates, continuity of the protective bonding circuit shall be ensured. The use of a protective conductor (see 8.2.2) is recommended.		P
	For cables that are exposed to damage (for example flexible trailing cables) the continuity of the protective conductors are ensured by appropriate measures (for example monitoring).		P
	Where the continuity can be interrupted, a first make last break contact is required.		P

EN 60204-1			
Clause	Requirement - Test	Result - Remark	Verdict
8.2.4	Protective conductor connecting points are not intended to attach appliances or parts.		P
	Each connecting point shall be marked or labelled as such using the symbol IEC 60417-5019 or the letters PE or by use of bicolour GREEN / YELLOW 		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/A
8.2.6	Additional requirements for electrical equipment having earth leakage currents higher than 10 mA		N/A
	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/A
	b) the protective conductor has a cross-sectional area of at least 10 mm <sup>2</sup> Cu or 16 mm <sup>2</sup> Al		N/A
	c) a second protective conductor of at least the same cross-sectional area is provided		N/A
	d) the supply is automatically disconnected in case of loss of continuity of the protective conductor		N/A
	e) where a plug-socket combination is used, an industrial connector in accordance with IEC 60309 series is provided		N/A
	A statement shall be given in the instructions for installation that the equipment shall be installed as described in this 8.2.6.		N/A
8.3	Measures to restrict the effects of high leakage current can be taken as described		P

EN 60204-1			
Clause	Requirement - Test	Result - Remark	Verdict
8.4	If functional bonding is used, the connecting points should be marked with symbol IEC 60417-5020		P

<b>9</b>	<b>CONTROL CIRCUITS AND CONTROL FUNCTIONS</b>		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
	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		N/A
	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 <ul style="list-style-type: none"> <li>- 230 V @ 50 Hz</li> <li>- 277 V @ 60 Hz</li> <li>- 220 V @ DC</li> </ul>		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

EN 60204-1			
Clause	Requirement - Test	Result - Remark	Verdict
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.		P
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.		P
	Where safety functions and/or protective measures cannot be applied for certain operations, manual control of such operations are by hold-to-run controls, together with enabling devices, as appropriate.		P
	In the case of machines requiring the use of more than one control station to initiate a start, each of these control stations shall have a separate manually actuated start control device. The conditions to initiate a start are: -all required conditions for machine operation 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).		P
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).		P
	Stop functions shall override related start functions		P
	Where more than one control station is provided, stop commands from any control station is effective when required by the risk assessment of the machine.		P
9.2.3.4	Emergency operations (emergency stop, emergency switching off)		P

EN 60204-1			
Clause	Requirement - Test	Result - Remark	Verdict
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.		P
	It shall not be possible to reenergize the machinery until all emergency switching off commands are reset.		P
9.2.3.4.2	The emergency stop does function either as a stop category 0 or as a stop category 1.		P
	-it shall override all other functions and operations in all modes -it shall stop the hazardous motion as quickly as practicable without creating other hazards -a reset shall not initiate a restart		P
9.2.3.4.3	Emergency switching off should be provided where: -Protection against direct contact is achieved only by placing out of reach or by obstacles (see 6.2.6) or -there is the possibility of other hazards or damage caused by electricity		P
	Emergency switching off is accomplished by electromechanical switching devices, effecting a stop category 0 of machine actuators connected to this incoming supply		P
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		P
	Another selection method can be used (for example an access code)		P

EN 60204-1			
Clause	Requirement - Test	Result - Remark	Verdict
	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		P
9.2.3.7	Hold-to-run controls shall require continuous actuation of the control device(s) to achieve operation		P
9.2.3.8	Two-hand controls shall be one of the following types and have the following features		N/A
	Type I: this type requires: -the provision of two control devices and their concurrent actuation by both hands; -continuous concurrent actuation during the hazardous situation; -machine operation shall cease upon the release		N/A
	Type II: a Type I control requiring the release of both control devices before machine operation can be reinitiated		N/A

EN 60204-1			
Clause	Requirement - Test	Result - Remark	Verdict
	Type III: a Type II control requiring concurrent actuation of the control devices as follows: -it shall be necessary to actuate the control devices within a certain time limit of each other, not exceeding 0.5 s -where this time limit is exceeded, both control devices shall be released before machine operation can be initiated		N/A
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		P
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/A
9.2.4.1	The CCS shall have functionality and a response time suitable for the application based on the risk assessment.		N/A
9.2.4.2	The ability of a CCS to control a machine shall be automatically monitored, either continuously or at suitable intervals.		N/A
	If the communication signal has degraded (e.g., reduced signal level, low battery power) a warning shall be given		N/A
	When the ability to control a machine has been lost, an automatic stop of the machine shall be initiated.		N/A
	Its restoration shall not restart the machine.		N/A
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/A

EN 60204-1			
Clause	Requirement - Test	Result - Remark	Verdict
	Cableless operator control station(s) shall only control the intended machine(s) and shall affect only the intended machine functions.		N/A
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/A
	-transfer of control shall require a deliberate manual action at the station having control		N/A
	-transfer shall only be possible if both stations are in the same mode		N/A
	-a transfer shall not change the mode of operation or function		N/A
	-on the station that has control, a visual indication shall indicate this		N/A
9.2.4.5	Portable cableless operator control stations shall be provided with means to prevent unauthorized use		N/A
	Each machine should have an indication when it is under cableless control		N/A
	When possible to be connected to several machines, means shall be provided on the portable device to select		N/A
	Selecting a machine shall not initiate control commands.		N/A
9.2.4.6	A deliberate disabling shall meet the requirements of 9.2.4.2.		N/A
	Where disabling without interrupting machine operation is necessary, appropriate means shall be provided to transfer control		N/A
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/A



EN 60204-1			
Clause	Requirement - Test	Result - Remark	Verdict
	Confusion between active and inactive emergency stop devices shall be avoided		N/A
9.2.4.8	Restarting of a cableless control shall not result in a reset of an emergency stop condition		N/A
	The instructions shall state that a reset shall only be performed when it can be seen that the reason has been cleared		N/A
9.3	Protective interlocks		N/A
9.3.1	The reclosing or resetting of an interlocking safeguard does not initiate hazardous machine operation		N/A
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/A
9.3.3	The correct operation of auxiliary functions shall be checked by appropriate devices		N/A
	Where the non-operation of a device can cause a hazard, appropriate interlocking shall be provided		N/A
9.3.4	Interlocks between different operations and for contrary motions shall be provided, if these operations can lead to hazardous situations		N/A
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/A
	For this purpose, a device operating exclusively as a function of time is not permitted		N/A
	Control circuits shall be so arranged that rotation of a motor shaft, for example manually, does not result in a hazardous situation		N/A

EN 60204-1			
Clause	Requirement - Test	Result - Remark	Verdict
9.3.6	Where it is necessary to suspend safety functions and/or protective measures, the control or operating mode selector shall simultaneously:		N/A
	-disable all other operating (control) modes		N/A
	-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/A
	-prevent any operation of hazardous functions by voluntary or involuntary action on the machine's sensors		N/A
	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/A
9.4	Control functions in the event of failure		P
9.4.1	The electrical control system(s) shall have an appropriate performance that has been determined from the risk assessment of the machine		P
	The requirements for safety-related control functions of IEC 62061 and/or ISO 13849-1, ISO 13849-2 shall apply		P
	Where memory retention is achieved for example, by battery power, measures shall be taken to prevent hazardous situations arising from failure, undervoltage or removal of the battery		P
	Means shall be provided to prevent unauthorized or inadvertent memory alteration by, for example, requiring the use of a key, access code or tool		P
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)		P
9.4.2.3	Provisions of partial or complete redundancy		P
9.4.2.4	Provision of diversity (see examples)		P

EN 60204-1			
Clause	Requirement - Test	Result - Remark	Verdict
9.4.2.5	Provision for functional tests		P
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		P
	The common conductor shall be connected to the protective bonding circuit at the point of supply.		P
	All control elements are to be inserted on the other side of the components		P
9.4.3.1.3	Method b) – Non-earthed control circuits fed by transformers shall either		N/A
	1) have 2-pole control switches that operate on both conductors; or		N/A
	2) be provided with a device that interrupts the circuit automatically in the event of an earth fault; or		N/A
	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/A
9.4.3.1.4	Method c) – Control circuits fed by transformer with an earthed centre-tap winding shall have overcurrent protective devices that break both the conductors		N/A
	The control switches shall be 2-pole types that operate on both conductors		N/A
9.4.3.1.5	Method d) – Control circuits not fed by a transformer are only allowed for machines with a maximum of one motor starter and/or maximum of two control devices, in accordance with 9.1.1		N/A
	Possible cases are:		—

EN 60204-1			
Clause	Requirement - Test	Result - Remark	Verdict
	1) directly connected to an earthed supply system (TN- or TT-system)		N/A
	If powered between two lines, multi-pole control switches are required		N/A
	2) directly connected to a supply system that is not earthed or is earthed through a high impedance (IT-system)		N/A
	A device shall be provided that interrupts the circuit automatically in the event of an earth fault		N/A
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/A
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/A

<b>10</b>	<b>OPERATOR INTERFACE AND MACHINE-MOUNTED CONTROL DEVICES</b>		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:		—

EN 60204-1			
Clause	Requirement - Test	Result - Remark	Verdict
	-they are within easy reach of the normal working position of the operator		N/A
	-the operator is not placed in a hazardous situation when operating them		N/A
10.1.3	The degree of protection (IP rating in accordance with IEC 60529) together with other appropriate measures shall provide protection against:		N/A
	– the effects of liquids, vapours, or gases found in the physical environment or used on the machine		N/A
	– the ingress of contaminants (for example swarf, dust, particulate matter)		N/A
	The operator interface control devices shall have a minimum degree of protection against contact with live parts of IPXXD (see IEC 60529)		N/A
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/A
	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/A
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/A
10.2	Actuators		P
10.2.1	Actuators shall be colour-coded as follows:		P
	The colours for START/ON actuators should be WHITE, GREY, BLACK or GREEN with a preference for WHITE. RED shall not be used		P
	The colour RED shall be used for emergency stop and emergency switching off actuators		P

EN 60204-1			
Clause	Requirement - Test	Result - Remark	Verdict
	If a background exists, it shall be coloured YELLOW		N/A
	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		P
	WHITE, GREY, or BLACK are the preferred colours for actuators that alternately act as START/ON and STOP/OFF actuators. The colours RED, YELLOW, or GREEN shall not be used		P
	The same is applicable for “hold-to-run” actuators		P
	Reset actuators shall be BLUE, WHITE, GREY, or BLACK. Where they also act as a STOP/OFF actuator, the colours WHITE, GREY, or BLACK are preferred with the main preference being for BLACK. GREEN shall not be used.		P
	The colour YELLOW is reserved for use in abnormal conditions		P
	Where the same colours are used for various functions, a supplementary means of coding shall be used for the identification		P
10.2.2	Recommended markings for actuators are given in table 2 and 3		P
10.3	Indicator lights and displays		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).		P
	Circuits used for visual or audible devices used to warn persons of an impending hazardous event shall be fitted with facilities to check the operability of these devices		P
10.3.2	Indicator lights should be colour-coded with respect to the condition (status) of the machine in accordance with Table 4.		P

EN 60204-1			
Clause	Requirement - Test	Result - Remark	Verdict
	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		P
	Where flashing lights or displays are used to provide higher priority information, additional acoustic warnings should be considered		N/A
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/A
	The colour RED for the emergency stop actuator shall not depend on the illumination of its light.		P
10.5	Devices having a rotational member, such as potentiometers and selector switches, shall have means of prevention of rotation of the stationary member. Friction alone isn't considered sufficient.		P
10.6	Actuators used to initiate a start function or the movement of machine elements shall be constructed and mounted so as to minimize inadvertent operation		P
10.7	Emergency stop devices		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
	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

EN 60204-1			
Clause	Requirement - Test	Result - Remark	Verdict
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		P
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
	The devices shall have direct opening action		P
10.8.3	Where the supply disconnecting device is to be locally operated for emergency switching off, it shall be readily accessible and shall meet the colour requirements of 10.2.1		P
10.9	Enabling control device		N/A

EN 60204-1			
Clause	Requirement - Test	Result - Remark	Verdict
	Enabling control devices shall be selected and arranged so as to minimize the possibility of defeating		N/A
	They shall be designed in accordance with ergonomic principles		N/A
	Functions of two-position types: -position 1: off-function of the switch (actuator is not operated); -position 2: enabling function (actuator is operated)		N/A
	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/A

<b>11</b>	<b>CONTROLGEAR: LOCATION, MOUNTING AND ENCLOSURES</b>		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)		P
	All controlgear are mounted so as to facilitate its operation and maintenance		P
	Necessary tools to adjust, maintain, or remove a device are supplied		P

EN 60204-1			
Clause	Requirement - Test	Result - Remark	Verdict
	Where access is required for regular maintenance or adjustment, the relevant devices shall be located between 0.4 m and 2.0 m above the servicing level		P
	Recommendation, that terminals be least 0.2 m above the servicing level and so placed that conductors and cables can be easily connected		P
	Only operating, indicating, measuring, and cooling devices are mounted on doors or on normally removable access covers of enclosures		N/A
	Where connected through plug-in arrangements, their association shall be made clear by type (shape), marking or reference designation		N/A
	Plug-in devices that are handled during normal operation shall be provided with non-interchangeable features		N/A
	Plug/socket combinations that are handled during normal operation are unobstructedly accessible.		N/A
	Test points for connection of test equipment shall be: <ul style="list-style-type: none"> <li>– mounted to provide unobstructed access</li> <li>– clearly identified to correspond with the documentation</li> <li>– adequately insulated</li> <li>– sufficiently spaced</li> </ul>		P
11.2.2	Physical separation or grouping		P
	Non-electrical parts and devices, not directly associated with the electrical equipment, shall not be located within enclosures containing controlgear		P
	Devices such as solenoid valves should be separated from the other electrical equipment (for example in a separate compartment)		P
	Control devices mounted in the same location and connected to the supply voltage, or to both supply and control voltages, should be grouped separately from those connected only to the control voltages		P

EN 60204-1			
Clause	Requirement - Test	Result - Remark	Verdict
	Terminals shall be separated into groups for: <ul style="list-style-type: none"> <li>– power circuits</li> <li>– associated control circuits</li> <li>– other control circuits, fed from external sources (for example for interlocking)</li> </ul>		P
	The clearances and creepage distances specified by the supplier shall be maintained, taking into account the external influences or conditions of the physical environment.		P
11.2.3	The temperature rise inside electrical equipment enclosures shall not exceed the ambient temperature specified by the component manufacturers		P
	Heat generating components (for example heat sinks, power resistors) are located so, that the temperature of each component in the vicinity remains within the permitted limit		P
11.3	Degrees of protection		N/A
	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/A
	Enclosures of controlgear provide a degree of protection of at least IP22 (see IEC 60529)		N/A
	Exception, where: <ul style="list-style-type: none"> <li>a) an electrical operating area provides an appropriate degree of protection</li> <li>b) removable collectors on conductor wire or conductor bar systems are used and the measures of 12.7.1 are applied</li> </ul>		N/A
11.4	Enclosures, doors and openings		P

EN 60204-1			
Clause	Requirement - Test	Result - Remark	Verdict
	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
	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°		P
	Joints or gaskets of doors, lids, etc. shall withstand the chemical effects of the aggressive liquids, vapours, or gases used on the machine.		P
	They shall: -be securely attached -not deteriorate due to removal or replacement of the door		P
	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.		P
	A suitable opening may be provided in the base of enclosures within the machine so that moisture due to condensation can drain away		P
	Openings for cable entries shall be easily re-opened on site		P
	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.		P

EN 60204-1			
Clause	Requirement - Test	Result - Remark	Verdict
	Holes in an enclosure for mounting shall not impair the required protection.		P
	Equipment that, in normal or abnormal operation, can attain a surface temperature sufficient to cause a risk of fire or harmful effect to an enclosure material shall: <ul style="list-style-type: none"> <li>– be located within an enclosure that will withstand, such temperatures; and</li> <li>– be located at a sufficient distance from adjacent equipment allowing safe dissipation of heat (see also 11.2.3); or</li> <li>– be otherwise screened by material that can withstand to the harmful effect.</li> </ul>		P
11.5	Access to electrical equipment		N/A
	Doors in gangways for access to electrical operating areas shall: <ul style="list-style-type: none"> <li>-be at least 0.7 m wide and 2.0 m high</li> <li>-open outwards</li> <li>-have a means (for example panic bolts) to allow opening from the inside without the use of a key or tool</li> </ul>		N/A
<b>12</b>	<b>CONDUCTORS AND CABLES</b>		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 <sup>2</sup> .	Copper	P
	The cross-sectional area of conductors should not be less than as shown in Table 5		P

EN 60204-1			
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/A
	Class 1 and class 2 conductors are primarily intended for use between rigid, non-moving parts where vibration is not likely to cause damage		P
	All conductors that are subject to frequent movement should have flexible stranding of class 5 or class 6.		P
12.3	Where the insulation of conductors and cables can constitute hazards due for example to the propagation of a fire or the emission of toxic or corrosive fumes adequate means are provided.  Special attention is given to the integrity of a circuit having a safety-related function		P
	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/A
	The insulation shall be such that it cannot be damaged in operation or during laying, especially for cables pulled into ducts.		P
12.4	Current-carrying capacity in normal service in accordance with table 6. Or in accordance with suppliers recommendation.		P
12.5	The voltage drop from the point of supply to the load in any power circuit cable shall not exceed 5 % of the nominal voltage under normal operating conditions.		P

EN 60204-1			
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.		P
12.6	Flexible cables		P
12.6.1	Flexible cables shall have Class 5 or Class 6 conductors		P
	Cables that are subjected to severe duties shall be of adequate construction to protect against: -abrasion due to mechanical handling and dragging across rough surfaces -kinking due to operation without guides -stress resulting from guide rollers and forced guiding, being wound and re-wound on cable drums		P
12.6.2	The tensile stress applied to copper conductors shall not exceed 15 N/mm <sup>2</sup> of cross-sectional area Or special measures are taken to withstand the applied stress		P
	For material other than copper the applied stress shall be within the cable manufacturer's specification		N/A
12.6.3	For cables of circular cross-sectional area installed on drums, the maximum current should be derated in accordance with Table 7		P
12.7	Conductor wires, conductor bars and slip-ring assemblies		P
12.7.1	During normal access to the machine, protection to conductor wires, conductor bars and slip-ring assemblies shall be achieved by the application of one of the following protective measures:		P
	-protection by partial insulation of live parts, or where this is not practicable		P
	-protection by enclosures or barriers of at least IP2X or IPXXB		N/A



EN 60204-1			
Clause	Requirement - Test	Result - Remark	Verdict
	Horizontal top surfaces of barriers or enclosures that are readily accessible shall provide a degree of protection of at least IP4X or IPXXD		N/A
	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/A
	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		P
12.7.2	Protective conductor circuit (PE) and the neutral conductor (N) each use a separate conductor wire, conductor bar or slip-ring		P
	The continuity of the protective conductor circuit using sliding contacts shall be ensured by taking appropriate measures (for example, duplication of the current collector, continuity monitoring)		P
12.7.3	Protective conductor current collectors shall have a shape or construction so that they are not interchangeable with the other current collectors. Such current collectors shall be of the sliding contact type		P
12.7.4	Removable current collectors with disconnecter function: The protective conductor circuit interrupts after and reconnects before any live conductor		P
12.7.5	Clearances in air between conductors and adjacent systems shall be suitable for at least a rated impulse voltage of an overvoltage category III in accordance with IEC 60664-1		P

EN 60204-1			
Clause	Requirement - Test	Result - Remark	Verdict
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/A
	-unprotected conductor wires, conductor bars, and slip-ring assemblies: 60 mm		N/A
	-enclosed conductor wires, insulated multipole conductor bars and insulated individual conductor bars: 30 mm		N/A
12.7.7	Conductor system divided into isolated sections: suitable design measures shall be employed to prevent the energization of adjacent sections by the current collectors themselves		P
12.7.8	Conductor wires, conductor bars and slip-ring assemblies in power circuits shall be grouped separately from those in control circuits		P
	They shall be capable of withstanding, without damage, the mechanical forces and thermal effects of short-circuit currents		P
	Removable covers cannot be opened by one person without the aid of a tool		P
	Where common metal enclosures are used, the individual sections shall be bonded together and connected to the protective bonding circuit		P
	Conductor bar ducts that can be subject to accumulation of liquid shall have drainage facilities		N/A

EN 60204-1			
Clause	Requirement - Test	Result - Remark	Verdict
<b>13</b>	<b>WIRING PRACTICES</b>		P
13.1	Connections and routing		P
13.1.1	All connections shall be secured against accidental loosening	All connections can 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	The means of connection is suitable.	P
	No connection of two or more conductors to one terminal, unless the terminal is designed for it	No terminal has been connected with three or more conductors.	P
	No soldered connections to terminals unless they are suitable for it		P
	Terminals on terminal blocks are plainly marked or labelled corresponding with the diagrams	All of them have been marked corresponding to markings on the diagrams.	P
	Installations of flexible conduits and cables are such that liquids drain away from the fittings	Liquids can drain away from the fittings.	P
	Retaining means for conductor strand and shields provided (no soldering for that purpose)	By appropriate terminals.	P
	Identification tags shall be legible, permanent, and appropriate for the physical environment	They are legible, permanent, and appropriate for the physical environment.	P
	Terminal blocks mounted and wired so that the wiring does not cross over the terminals	No conductor crosses over the terminals.	P
13.1.2	Conductors and cables shall be run from terminal to terminal without splices or joints		P
	Connections using plug/socket combinations with suitable protection against accidental disconnection are not considered to be splices or joints for the purpose of this subclause		P
	Exceptions are possible as described		N/A

EN 60204-1			
Clause	Requirement - Test	Result - Remark	Verdict
	Terminations of cables shall be adequately supported to prevent mechanical stresses at the terminations of the conductors		P
	Protective conductor shall be placed close to the associated live conductors in order to decrease the impedance of the loop		P
13.1.3	Conductors for circuits that operate at different voltages are separated by suitable barriers, or are insulated for the highest voltage that occurs within the same duct		P
13.1.4	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		P
	Single-core cables armoured with steel wire or steel tape should not be used for AC circuits		P
13.2	The cable between the pick-up and the pick-up converter of an inductive power supply system shall be:		P
	-as short as practicable		P
	-adequately protected against mechanical damage		P
13.2.1	Each conductor shall be identifiable at each termination in accordance with the technical documentation		P
13.2.2	When identification of the protective conductor is by colour alone, the bicolour combination GREEN-AND-YELLOW shall be used throughout the length of the conductor		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

EN 60204-1			
Clause	Requirement - Test	Result - Remark	Verdict
	Exception: Protective bonding conductors may be marked with the letters PB and/or the symbol IEC 60417-5021		N/A
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
	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.		P

EN 60204-1			
Clause	Requirement - Test	Result - Remark	Verdict
13.4.2	<p>Conductors and their connections external to the electrical equipment shall be placed in suitable ducts (see cl.13.5)</p> <p>Exceptions:</p> <ul style="list-style-type: none"> <li>-Cables with special suitable protection.</li> <li>-Position switches or proximity switches supplied with a dedicated cable which is sufficiently short</li> </ul>		P
13.4.3	<p>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>		P
	<p>The bending radius of the cable shall be at least 10 times the diameter of the cable</p>		P
	<p>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>		P
	<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>		P
	<p>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</p>		P
	<p>Flexible conduit shall not be used for connections subject to rapid or frequent movements except when specifically designed for that purpose</p>		P
13.4.4	<p>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</p>		P
13.4.5	<p>Plug/socket combinations</p>		N/A



EN 60204-1			
Clause	Requirement - Test	Result - Remark	Verdict
	Components or devices inside an enclosure, terminated by fixed plug/socket combinations (no flexible cable), or components connected to a bus system by a plug/socket combination, are excluded		N/A
	Where the plug/socket contains a contact for the protective bonding circuit, it shall have a first make last break contact (see also 8.2.4).		N/A
	Plug/socket combinations intended to be connected or disconnected during load conditions shall have sufficient load-breaking capacity		N/A
	Where the plug/socket combination is rated at 30 A, or greater, it shall be interlocked		N/A
	Plug/socket combinations that are rated at more than 16 A shall have a retaining means to prevent unintended or accidental disconnection.		N/A
	Where an unintended or accidental disconnection of plug/socket combinations can cause a hazardous situation, they shall have a retaining means.		N/A

EN 60204-1			
Clause	Requirement - Test	Result - Remark	Verdict
	<p>The installation of plug/socket combinations shall fulfil the following requirements as applicable:</p> <ul style="list-style-type: none"> <li>a) The component which remains live after disconnection shall have a degree of protection of at least IP2X or IPXXB</li> <li>b) Metallic housings of plug/socket combinations shall be connected to the protective bonding circuit</li> <li>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</li> <li>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</li> <li>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.</li> </ul>		N/A
13.4.6	Where it is necessary that wiring be disconnected for shipment, terminals or plug/socket combinations shall be provided at the sectional points.		N/A
13.4.7	When spare conductors are provided, they shall be connected to spare terminals or isolated to prevent contact with live parts		P
13.5	Ducts, connection boxes and other boxes		P
	Ducts shall provide a degree of protection (see IEC 60529) suitable for the application		P
	No sharp edges, flash, burrs, rough surfaces, or threads with which the insulation of the conductors can come into contact		P

EN 60204-1			
Clause	Requirement - Test	Result - Remark	Verdict
	Where human passage is required, least 2 m above the working surface		N/A
	Where cable trays are only partially covered, the cables used shall be of a type suitable for installation on open cable trays.		N/A
13.5.2	Rigid metal conduit and fittings shall be of galvanized steel or of a corrosion-resistant material		P
	Fittings shall be compatible with the conduit and should be threaded		P
	Conduit bends shall be properly made		P
13.5.3	A flexible metal conduit shall consist of a flexible metal tubing or woven wire armour		P
13.5.4	Flexible non-metallic conduit shall be resistant to kinking		P
13.5.5	Cable trunking systems external to enclosures shall be rigidly supported and clear of all moving and of sources of contamination		P
	Where furnished in sections, the joints shall fit tightly but need not be gasketed		P
	The only openings permitted shall be those required for wiring or for drainage		P
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



EN 60204-1			
Clause	Requirement - Test	Result - Remark	Verdict
	They shall not have opened but unused knockouts nor any other openings		P
13.5.8	Motor connection boxes shall enclose only connections to the motor and motor-mounted devices (e.g. brakes, temperature sensors		N/A

<b>14</b>	<b>ELECTRIC MOTORS AND ASSOCIATED EQUIPMENT</b>		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.		P
	Proper cooling shall be ensured and the temperature rise shall remain within the limits of the insulation class (see IEC 60034-1)		P
	There shall be no opening between the motor compartment and any other compartment that does not meet the motor compartment requirements		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

EN 60204-1			
Clause	Requirement - Test	Result - Remark	Verdict
<b>15</b>	<b>SOCKET-OUTLETS AND LIGHTING</b>		N/A
15.1	For socket-outlets intended for accessory equipment, the following apply:		N/A
	- they should conform to IEC 60309-1. Where not practicable, they should be clearly marked with the voltage and current ratings		N/A
	- the continuity of the protective bonding circuit to the socket-outlet shall be ensured		N/A
	- all unearthed conductors connected to the socket-outlet shall be protected against overcurrent and, when required, overload		N/A
	- 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/A
	- 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/A
	-socket-outlets with a rating not exceeding 20 A shall be provided with an RCD not exceeding 30 mA		N/A
15.2	Local lighting of the machine and of the equipment		N/A
15.2.1	The ON/OFF switch shall not be incorporated in the lampholder or in the flexible connecting cord		N/A
	Stroboscopic effects from lights shall be avoided		N/A
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		N/A
	Lighting circuits shall be supplied from one of the following sources:		N/A
	- a dedicated isolating transformer connected to the supply disconnecting device. Overcurrent protection shall be provided in the secondary circuit		N/A

EN 60204-1			
Clause	Requirement - Test	Result - Remark	Verdict
	– a dedicated isolating transformer connected before the supply disconnecting device. This is permitted for maintenance lighting in control enclosures only. Overcurrent protection shall be provided in the secondary circuit		N/A
	– a circuit of the electrical equipment of the machine for lighting, with dedicated overcurrent protection		N/A
	– 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/A
	– 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/A
	– power supply units, for DC supply to LED light sources, fitted with isolating transformers		N/A
	Exception: where fixed lighting is out of reach of operators during normal operations, the provisions of this 15.2.2 do not apply		N/A
15.2.3	Local lighting circuits shall be protected in accordance with 7.2.6		N/A
15.2.4	Adjustable lighting fittings shall be suitable for the physical environment		N/A
	The lampholders shall be:		N/A
	– in accordance with the relevant IEC standard		N/A
	– constructed with an insulating material protecting the lamp cap so as to prevent unintentional contact		N/A
	Reflectors shall be supported by a bracket and not by the lampholder		N/A

EN 60204-1			
Clause	Requirement - Test	Result - Remark	Verdict
	Exception: where fixed lighting is out of reach of operators during normal operations, the provisions of this 15.2.4 do not apply		N/A

<b>16</b>	<b>MARKING, WARNING SIGNS AND REFERENCE DESIGNATIONS</b>		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)		P
16.2.2	Where the risk assessment shows the need to warn against the possibility of hazardous surface temperatures, the graphical symbol ISO 7010-W017 shall be used 		P
16.3	Control devices and visual indicators, shall be clearly and durably marked with regard to their functions		P

EN 60204-1			
Clause	Requirement - Test	Result - Remark	Verdict
16.4	<p>The following information shall be legibly and durably marked - plainly visible after installation on enclosures that receive incoming power supplies:</p> <ul style="list-style-type: none"> <li>• name or trade mark of supplier</li> <li>• certification mark or other marking where applicable</li> <li>• type designation or model, where applicable</li> <li>• serial number where applicable</li> <li>• main document number (see IEC 62023) where applicable</li> <li>• rated voltage, number of phases and frequency (if AC), and full-load current for each incoming supply</li> </ul> <p>It is recommended that this information is provided adjacent to the main incoming supply(ies)</p>		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		P
<b>17</b>	<b>TECHNICAL DOCUMENTATION</b>		P
17.1	The information necessary for identification, transport, installation, use, maintenance, decommissioning and disposal of the electrical equipment shall be supplied		P
	Annex I should be considered as guidance for the preparation of information and documents		P
17.2	Information related to the electrical equipment		P
	The following shall be supplied:		—
	a) where more than one document is provided, a main document for the electrical equipment as a whole, listing the complementary documents		P
	b) identification of the electrical equipment		P

EN 60204-1			
Clause	Requirement - Test	Result - Remark	Verdict
	<p>c) information on installation and mounting including:</p> <ul style="list-style-type: none"><li>• a description of installation and mounting, and its connection to the electrical and other supplies</li><li>• short-circuit current rating for each incoming power supply</li><li>• rated voltage, number of phases and frequency (if AC.), type of distribution system (TT, TN, IT) and full-load current for each incoming supply</li><li>• any additional electrical supply(ies) requirements (for example maximum supply source impedance, leakage current) for each incoming supply</li><li>• space required for servicing</li><li>• installation requirements regarding cooling</li><li>• environmental limitations (for example lighting, vibration, EMC environment, atmospheric contaminants)</li><li>• functional limitations (for example peak starting currents and permitted voltage drops)</li><li>• precautions to be taken for the installation regarding electromagnetic compatibility</li></ul>		P
	<p>d) an instruction for the connection of conductive-parts in the vicinity of the machine to the protective bonding circuit:</p> <ul style="list-style-type: none"><li>• metallic pipes</li><li>• fences</li><li>• ladders</li><li>• handrails</li></ul>		P
	<p>e) information on the functioning and operation as applicable:</p> <ul style="list-style-type: none"><li>• an overview of the structure of the electrical equipment</li><li>• procedures for programming or configuring</li><li>• procedures for restarting after an unexpected stop</li><li>• a sequence of operation</li></ul>		P

EN 60204-1			
Clause	Requirement - Test	Result - Remark	Verdict
	<p>f) information on maintenance, as appropriate:</p> <ul style="list-style-type: none"><li>• frequency and method of functional testing</li><li>• instructions for safe maintenance and where necessary suspend a safety function and/or protective measure (see 9.3.6)</li><li>• guidance on the adjustment, repair, and frequency and method of preventive maintenance</li><li>• details of the interconnections subject to replacement</li><li>• required special devices or tools;</li><li>• spare parts;</li><li>• possible residual risks, indication of particular training and specification of personal protective equipment</li><li>• instructions to restrict availability of keys or too(s) to skilled or instructed persons</li><li>• settings (DIP-switches, programmable parameter values, etc);</li><li>• information for validation of safety related control functions after repair or modification, and for periodic testing where necessary;</li></ul>		P
	<p>g) information on handling, transportation and storage</p>		P
	<p>h) information for proper disassembly and handling of components</p>		P

EN 60204-1			
Clause	Requirement - Test	Result - Remark	Verdict
18	<b>VERIFICATION</b>		P
18.1	<p>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):</p> <p>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)</p>		—
	The results of the verification shall be documented		P
18.2	Verification of conditions for protection by automatic disconnection of supply		P
18.2.1	<p>Test 1 verifies the continuity of the protective bonding circuit.</p> <p>Test 2 verifies the conditions for protection by automatic disconnection of the supply in TN systems</p> <p>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</p> <p>For TT systems, see Clause A.2</p> <p>For IT systems, see IEC 60364-6</p>		P
	Where RCDs are used in the electrical equipment, their function shall be verified in accordance with the manufacturer's instructions. The test procedure and test interval shall be specified in the maintenance instructions		N/A
18.2.2	Test 1: Verification of the continuity of the protective bonding circuit		—

EN 60204-1			
Clause	Requirement - Test	Result - Remark	Verdict
	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		P
	The resistance measured shall be in the expected range	Measured: 0.044Ω Limit:0.1Ω	P
18.2.3	Test 2: Fault loop impedance verification and suitability of the associated overcurrent protective device		P
	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/A
	The conditions for the protection by automatic disconnection of supply in accordance with 6.3.3 and Annex A shall be verified by both		P
	a) verification of the fault loop impedance by - calculation, or - measurement in accordance with A.4, and		P
	b) confirmation that the setting and characteristics of the associated overcurrent protective device are in accordance with the requirements of Annex A, and		P
	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/A
18.2.4	Application of the test methods for TN-systems		P
	When Test 2 of 18.2.3 is carried out by measurement, it shall always be preceded by Test 1 of 18.2.2		P
	The tests that are necessary for machines of different status are specified in Table 9		P



EN 60204-1			
Clause	Requirement - Test	Result - Remark	Verdict
18.3	Insulation resistance tests (optional)		P
	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	Measured: L1-L2-L3: >100 MΩ Limit:1 MΩ	P
	If the electrical equipment of the machine contains surge protection devices which are likely to operate during the test, it is permitted to either: – disconnect these devices, or – reduce the test voltage to a value lower than the voltage protection level of the surge protection devices		N/A
18.4	Voltage tests (optional)		P
	The test voltage shall be at a nominal frequency of 50 Hz or 60 Hz. 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. The test voltage shall be applied between the power circuit conductors and the protective bonding circuit for at least 1 s.	Measured: L1-L2-L3: 1000V/30s Result: No breakdown	P
	Components and devices that are not rated to withstand the test voltage and surge protection devices shall be disconnected		P
18.5	Protection against residual voltages		P
	Where appropriate, tests shall be performed to ensure compliance with 6.2.4		P
18.6	Functional tests		P
	The functions of electrical equipment shall be tested		P
18.7	Retesting		N/A
	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

EN 60204-1			
Clause	Requirement - Test	Result - Remark	Verdict
<b>A</b>	<b>ANNEX A (NORMATIVE) FAULT PROTECTION BY AUTOMATIC DISCONNECTION OF SUPPLY</b>		<b>P</b>
A.1	Fault protection for machines supplied from TN-systems		P
A.1.1	Fault protection shall be provided by an overcurrent protective device within a sufficiently short disconnecting time.		P
	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		P
	For Class 1 hand-held equipment or portable equipment table A.1 specifies the maximum disconnecting times		N/A
A.1.2	Conditions for protection by overcurrent protective devices fulfilled		P
A.1.3	Condition for protection by reducing the touch voltage below 50 V fulfilled		P
A.1.4	Verification of conditions for protection by automatic disconnection of the supply (A.1.2) by		P
	-verification of the characteristics of the associated protective device and		P
	-measurement of the fault loop impedance ( $Z_s$ )		N/A
	Exception: Verification of the continuity of the protective conductors may replace the measurement where appropriate		N/A
A.2	Fault protection for machines supplied from TT-systems		N/A
	Expand if applicable		N/A
<b>B</b>	<b>ANNEX B (INFORMATIVE) ENQUIRY FORM FOR THE ELECTRICAL EQUIPMENT OF MACHINES</b>		<b>P</b>
	The use of this form can facilitate an exchange of information between the user and supplier		P

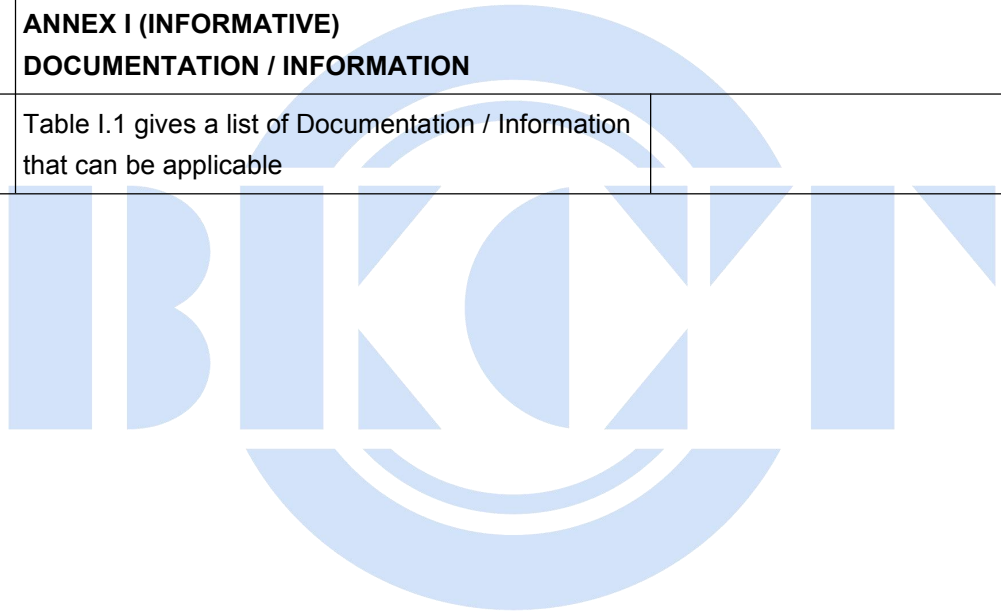


EN 60204-1			
Clause	Requirement - Test	Result - Remark	Verdict
<b>C</b>	<b>ANNEX C (INFORMATIVE)</b> <b>EXAMPLES OF MACHINES COVERED BY THIS PART OF IEC 60204</b>		<b>P</b>
	Non exhaustive list of examples This standard does not apply to machines within the scope of the IEC 60335 series		P
<b>D</b>	<b>ANNEX D (INFORMATIVE)</b> <b>CURRENT-CARRYING CAPACITY AND OVERCURRENT PROTECTION OF CONDUCTORS AND CABLES</b>		N/A
D.2.1	Correction factors for PVC conductors at higher temperatures		N/A
D.2.2	Methods of installation		N/A
D.2.3	Grouping and derating factors		N/A
D.4	Guidance for overcurrent protection of conductors		N/A
<b>E</b>	<b>ANNEX E (INFORMATIVE)</b> <b>EXPLANATION OF EMERGENCY OPERATION FUNCTIONS</b>		<b>P</b>
	Description of emergency stop, start, switching off, switching on		P
<b>F</b>	<b>ANNEX F (INFORMATIVE)</b> <b>GUIDE FOR THE USE OF THIS PART OF IEC 60204</b>		<b>P</b>
	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
<b>G</b>	<b>ANNEX G (INFORMATIVE)</b> <b>COMPARISON OF TYPICAL CONDUCTOR CROSS-SECTIONAL AREAS</b>		<b>P</b>
	Comparison of the American Wire Gauge (AWG), square millimetres, square inches, and circular mil		P



EN 60204-1			
Clause	Requirement - Test	Result - Remark	Verdict
H	<b>ANNEX H (INFORMATIVE) MEASURES TO REDUCE THE EFFECTS OF ELECTROMAGNETIC INFLUENCES</b>		<b>P</b>
	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	<b>ANNEX I (INFORMATIVE) DOCUMENTATION / INFORMATION</b>		<b>P</b>
	Table I.1 gives a list of Documentation / Information that can be applicable		P



EN 60825-1			
Clause	Requirement + Test	Result - Remark	Verdict
<b>4</b>	<b>CLASSIFICATION PRINCIPLES</b>		
4.3	Classification rules		---
4.3 a	Radiation of a single wavelength		P
4.3 b	Radiation of multiple wavelengths		N/A
	1) Laser product emits at two or more wavelengths shown as additive in Table 1		N/A
	2) Laser product emits at two or more wavelengths not shown as additive in Table 1		N/A
4.3 c	Radiation from extended sources (see 5.4.3)		N/A
4.3 d	Non-uniform, non-circular or multiple apparent source		N/A
4.3 e	Time bases		---
	1) 0,25 s		P
	2) 100 s		N/A
	3) 30000 s		N/A
4.3 f	Repetitively pulsed or modulated lasers		P
	1) Any single pulse		P
	2) Average power for pulse trains		N/A
	3) Pulse duration $t \leq T_i$ : Number of pulses N and C5 :		N/A
	3) Pulse duration $t > T_i$ : Number of pulses N and C5 :		N/A
4.4	Laser products designed to function as conventional lamps.		N/A
	$\alpha$ measured at 200 mm distance from closest point of human access ( $\alpha > 5$ mrad).		N/A
	Un-weighted radiance L measured at 200 mm distance (comparison with $L_T = 1 \text{ MWm}^{-2}\text{s}^{-1}/\alpha$ ) under reasonably foreseeable single fault conditions.		N/A



EN 60825-1			
Clause	Requirement + Test	Result - Remark	Verdict
	Evaluation of emission according to IEC 62471 series (optional): Standard applied (IEC 62471 series)..... : Risk Group..... : Labelling..... : Classification of product based on accessible laser radiation (if no laser radiation accessible: Class 1).		N/A

5	DETERMINATION OF THE ACCESSIBLE EMISSION LEVEL and PRODUCT CLASSIFICATION		
5.1	Tests		---
	Compliance under reasonably foreseeable single fault conditions.		P
5.3	Determination of the class of the laser product ... : For Class 1C: vertical safety standard applied with requirements for Class 1C.		---
5.4	Measurement geometry		---
5.4.1	General		---
5.4.2	Default (simplified) evaluation		P
	Conditions applied .....		P
	Aperture diameter .....		P
	Reference point :.....		P
	Measurement distance .....		P
	(for each condition)		
5.4.3	Evaluation condition for extended sources		N/A
	Conditions applied .....		N/A
	Most restrictive position .....		N/A
	(distance from reference point)		
	Angular subtense of the apparent source $\alpha$ and $C_6$ : (for each condition)		N/A



EN 60825-1			
Clause	Requirement + Test	Result - Remark	Verdict
5.4.3 a	Aperture diameters (for each condition)..... :		N/A
5.4.3 b	Angle of acceptance (for each condition).....:		N/A

6	ENGINEERING SPECIFICATIONS		
6.2	Protective housing		---
6.2.1	General		---
	Protective housing prevents access to energy levels in excess of the AEL for Class 1.		N/A
	Protective housing prevents access to energy levels equivalent to Class 4 and withstands exposures under reasonably foreseeable single fault conditions.		N/A
	Maintenance of Class 1, 1C, 1M, 2, 2M, or 3R (access to emissions of Class 3B or 4 is prevented).		N/A
	Maintenance of Class 3B product (access to emission of Class 4 is prevented).		N/A
6.2.2	Service	Product does not intend to be serviced by dealers or distributors. When the product needs to be serviced, the product is returned to factory and serviced by trained factory staff.	N/A
6.2.3	Removable laser system (laser system complies with requirements of Clauses 6 and 7).		N/A
6.3	Access panels and safety interlocks		---
6.3.1	Panel is intended to be removed during operation (or maintenance) and would give access to higher energy levels (see Table 13).		N/A
	Accessible emission (after removal of the panel) corresponds to product Class (designated by "X" in Table 13)		N/A



EN 60825-1			
Clause	Requirement + Test	Result - Remark	Verdict
	Emission through the opening if interlocked panel of Class 1, 1C, 1M, 2, or 2M is removed (Emission < AEL of Class 1M or 2M).		N/A
	Emission through the opening if interlocked panel of Class 3R, 3B, or 4 is removed (Emission < AEL of Class 3R).		N/A
	Requirements regarding reasonably foreseeable single fault condition.		N/A
6.3.2	Override mechanism		N/A
	Behaviour of override in operation when the panel is replaced.		N/A
	Visible or audible warning for override mode.		N/A
6.4	Remote interlock connector		N/A
6.5	Manual reset		N/A
6.6	Key control		N/A
6.7	Laser radiation emission warning		---
6.7.1	Laser product is a 3R ( $\lambda < 400 \text{ nm}$ ; $\lambda > 700 \text{ nm}$ ), 1C, 3B or 4 laser systems.		P
6.7.2	Audible or visible warning.		P
	Warning is failsafe or redundant.		P
	Viewing of the visible warning does not require exposure to emissions > AEL for Class 1M and 2M.....		N/A
6.7.3	Operational control and laser aperture are provided with a warning device when they are separated more than 2 m from warning device.		P
6.7.4	Visible indication of output aperture if laser emission may be distributed through more than one output.		P
6.7.5	Switch for handheld Class 3R device must be depressed for emission (in lieu of emission indicator).		N/A
6.8	Beam stop or attenuator		N/A

EN 60825-1			
Clause	Requirement + Test	Result - Remark	Verdict
6.9	Controls		N/A
6.10	Viewing optics		N/A
	a) Human access to laser radiation in excess of Class 1M prevented when the shutter is opened or attenuation varied.		N/A
	b) Opening of the shutter or variation of the attenuation prevented when exposure to laser radiation in excess of Class 1M is possible.		N/A
6.11	Scanning safeguard		N/A
6.12	Safeguard for Class 1C products		N/A
	a) Human access to laser radiation in excess of AEL for Class 1 measured under Condition 3 is prevented.		N/A
	b) Human access to laser radiation in excess of AEL for Class 3B measured through 3,5 mm aperture at 5 mm distance from applicator is prevented.		N/A
6.13	Walk-in access		N/A
	a) Means provided so that any person inside the housing can prevent activation of Class 3B or 4 laser hazards.		N/A
	b) A warning device provides adequate warning of emission to any person within the housing.		N/A
	c) Where "walk-in" access during operation is intended or reasonably foreseeable, emission of laser radiation that is equivalent to Class 3B or 4 while someone is present inside the enclosure of Class 1, Class 2 or Class 3R product is prevented by engineering means.		N/A
6.14	Environmental conditions		---
	- climatic conditions		P
	- vibration and shock		P
6.15	Protection against other hazards		---
6.15.1	Non-optical hazards (product safety standard)		N/A



EN 60825-1			
Clause	Requirement + Test	Result - Remark	Verdict
	- electrical hazards;		N/A
	- excessive temperature;		N/A
	- spread of fire from the equipment;		N/A
	- sound and ultrasonics;		N/A
	- harmful substances;		N/A
	- explosion;		N/A
6.15.2	Collateral radiation		N/A
6.16	Power limiting circuit		P

<b>7</b>	<b>LABELLING</b>		
7.1	General		---
	Labels durable, permanently affixed		P
	Labels clearly visible		P
	Reading of labels is possible without exposure to laser radiation in excess of AEL for Class 1.		N/A
	Colour combination		N/A
	Labelling impractical due to the size or design of the product.		N/A
	Warning label – Hazard symbol (Figure 3)		P
7.2 - 7.7	Text on explanatory label or pictogram (laser class, warning text)		P
7.8	Aperture label		P
7.9	Radiation output and standards information		---
	Max output of laser radiation .....		P
	Pulse duration .....		P
	Emitted wavelength(s) .....		P
	Name and publication date of the standard.....		P
7.10	Labels for access panels		---



EN 60825-1			
Clause	Requirement + Test	Result - Remark	Verdict
7.10.1 a) – f)	Labels for panels - warning wording used .....		N/A
7.10.2	Labels for safety interlocked panels - Warning wording used .....		N/A
7.11	Warning for invisible laser radiation .....		P
7.12	Warning for visible laser radiation .....		N/A
7.13	Warning for potential hazard to the skin or anterior parts of the eye - warning wording used.....		N/A

8	OTHER INFORMATIONAL REQUIREMENTS		
8.1	Information for the user		---
	a) adequate instructions for assembly, maintenance and safe use and description of the classification limitations, if appropriate.		P
	b) additional warning for Class 1M and 2M		N/A
	c) laser beam parameters for radiation above the AEL of Class 1		---
	•Wavelength .....		N/A
	•Beam divergence .....		N/A
	•Pulse pattern .....		N/A
	(pulse duration, repetition rate, ...)		
	•Maximum power or energy output .....		N/A
	d) safety instruction for embedded laser products and other incorporated laser products.		N/A
	e) MPE and NOHD for Class 3B and 4 laser products; For collimated beam Class 1M and 2M lasers the extended NOHD (ENOHD).		P
	f) information for the selection of eye protection.		N/A
	g) reproduction of all required labels and warnings.		P

EN 60825-1			
Clause	Requirement + Test	Result - Remark	Verdict
	h) location of laser apertures		P
	i) list of controls, adjustments of procedures for operation and maintenance - and warning statement.		P
	j) information (compatibility requirements) about laser energy source if not incorporated.		N/A
	k) additional warning for Class 1, 1M, 2, 2M, and 3R regarding skin or corneal burns.		N/A
	l) Information for Class 1C products (e.g. warning that repeated application may pose a risk).		N/A
8.2	Purchasing and service information		P
	a) safety classification of each laser product stated in all descriptive material (e.g. brochures).		P
	b) adequate instructions for servicing available: <ul style="list-style-type: none"> <li>•warnings and precautions regarding exposure of laser emission above Class 1</li> <li>•maintenance schedule</li> <li>•list of controls and procedures that could increase accessible emissions</li> <li>•description of displaceable parts</li> <li>•protective procedures for service personnel</li> <li>•reproduction of labels and hazard warnings</li> </ul>		N/A

9 ADDITIONAL REQUIREMENTS FOR SPECIFIC LASER PRODUCTS			
9.1	Applicable other parts of the standard series IEC 60825		---
	IEC 60825-2 (Safety of optical communication systems)		N/A
	IEC 60825-4 (Laser guards)		N/A
	IEC 60825-12 (Safety of free space optical communication systems used for transmission of information)		N/A

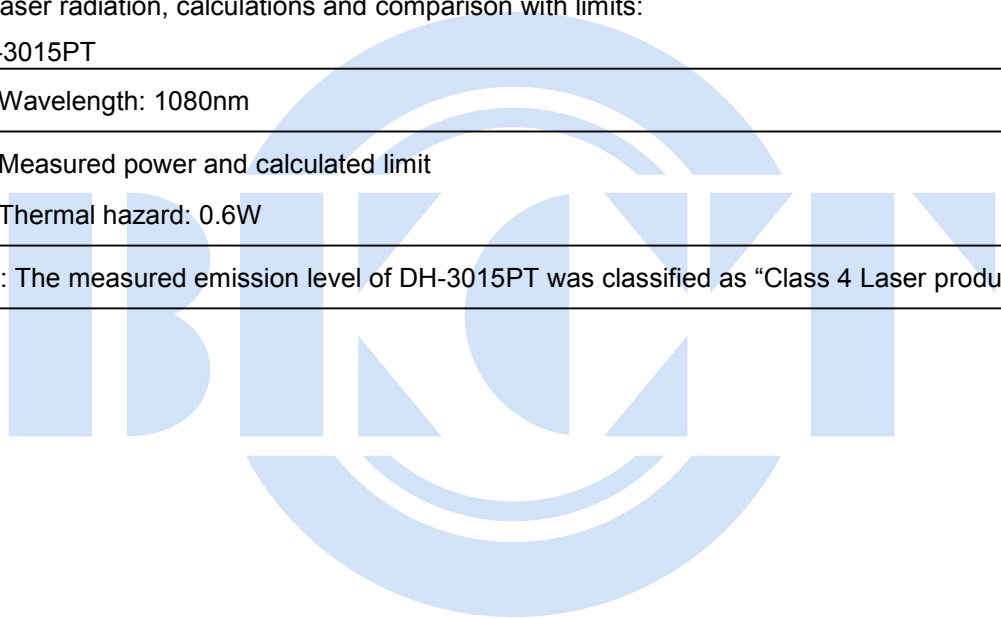


EN 60825-1			
Clause	Requirement + Test	Result - Remark	Verdict
9.2	Medical laser products: Class 3B and Class 4 medical laser products comply with IEC 60601-2-22		N/A
9.3	Laser processing machines: Comply with IEC/ISO 11553 series.		N/A
9.4	Electric toys: Comply with IEC 62115		N/A
9.5	Consumer electronic products: Comply with IEC 60950 (IT-equipment) or IEC 60065 (AV equipment)		N/A





EN 60825-1			
	MEASUREMENT EQUIPMENT		P
	Type of equipment :	Optical Power Meter	—
	Manufacturer :	Yokogawa	—
	Type designation :	Laser Projector	—
	Others:	Last cal. date: 2024-05-10 Next cal. date: 2025-05-09	—
Measured laser radiation, calculations and comparison with limits: Model: DH-3015PT			
1.	Wavelength: 1080nm		—
2.	Measured power and calculated limit Thermal hazard: 0.6W		—
Conclusion: The measured emission level of DH-3015PT was classified as "Class 4 Laser product".			



EN ISO 11553-1			
Clause	Requirement + Test	Result - Remark	Verdict
<b>4</b>	<b>Hazards generated by laser radiation</b>		P
4.1	General		P
	A number of different hazards can emanate from a laser processing machine. This document is (exclusively) addressed to the specific hazards resulting from laser radiation arising in laser processing machines.		P
	Secondary hazards, which are caused by laser beam/material interaction, such as the generation of hazardous substances (fumes, vapours, gases), fire/explosion risks or the generation of secondary radiation, e.g. UV-radiation or ionizing radiation, are not considered in this document.		P
	Other hazards which can emanate from a laser processing machine are given in Annex A.		N/A
	Particular hazards are also covered by harmonized standards (examples):		N/A
	For noise reduction and noise measurement methods for laser processing machines and hand-held processing devices and associated auxiliary equipment (accuracy grade2) see ISO11553-3:2013, AnnexA.		N/A
	For assessment and reduction of risks arising from radiation (laser and ionizing radiation excluded) emitted by machinery see EN 12198- 1 to EN 12198-3.		N/A
	For the evaluation of the emission of airborne hazardous substances, generated during laser material processing (such as particulate and gaseous substances; e.g. fumes, vapours, gases) see EN 1093 (all parts).		N/A
	For reduction of risks to health resulting from hazardous substances emitted by machinery see ISO 14123- 1 and ISO 14123-2.		N/A
4.2	Laser radiation hazards/sources of laser radiation emission		P

EN ISO 11553-1			
Clause	Requirement + Test	Result - Remark	Verdict
	Laser radiation hazards can originate from a direct laser beam or a reflected/scattered laser beam. The normal use as well as malfunctions/reasonably foreseeable fault conditions have to be considered.		P
	a)aperture of an embedded laser source,		N/A
	b)beam delivery system within a laser processing machine,		N/A
	c)laser beam emitted from the processing head (to the workpiece),		P
	d)laser beam emitted from a scanning unit (to the workpiece).		N/A
	Possible emission sources of a reflected beam are: elements (with reflective surface) within the beam delivery system of the laser processing machine, the workpiece holder (if the workpiece is missing), elements in the processing zone, elements inside the housing of a machine (e.g. handling system, suction pipes, parts of guards), the workpiece, processed by the laser processing machine.		P
	The optical properties (e.g. surface roughness and reflectivity) of the material exposed to the laser beam decisively determine the kind of reflection (direct/specular reflection or scattered reflection) and thus the risk level. This has impact on both the foreseeable exposure limit (FEL) at the inner surface of a machine enclosure/guard or the resulting irradiance or the radiant exposure at a machine workplace or at a certain distance to the machine.		P
	Inadequate design or malfunctions of laser components and machinery equipment can also be the reason for laser radiation hazards/emission (or a misguided laser beam):		-

EN ISO 11553-1			
Clause	Requirement + Test	Result - Remark	Verdict
	<p>damaged optical fibre cable,</p> <p>damaged passive optical elements (e.g. mirrors,lenses),</p> <p>misaligned beam path (inadequate optical elements, incorrectly positioned),</p> <p>not properly working active beam guiding and shaping elements,</p> <p>not properly working handling system or robot positioning of the laser processing head,gaps in the enclosure/guard of a laser processing machine, through which laser radiation can propagate,</p> <p>damage of protective enclosure/guards/screens.</p>		P
	<p>Inadequate design of safety functions, and safety related parts of control systems (SRP/CS) respectively, for the safe isolation or deactivation of the laser beam (e.g. by shutters, relays controlling power supply to the laser) can cause severe laser radiation risks. In the following, safety functions are exemplarily given:</p>		-
	<p>emergency stop;</p> <p>opening of maintenance covers or doors for workpiece input and output with access to laser radiation;</p> <p>opening of doors to enter laser cabins with access to the laser hazard area;</p> <p>disassembling (manually) of fibre connectors with access to the direct laser beam;</p> <p>active control of guards and windows with regard to damage by laser radiation.</p>		P
4.3	<p>Laser radiation hazards induced by external effects (interferences)</p>		N/A



EN ISO 11553-1			
Clause	Requirement + Test	Result - Remark	Verdict
	Power conditions and the environment in which the laser processing machine operates may cause the machine to malfunction, thus giving rise to hazardous conditions related to laser radiation and/or making it necessary for someone to intervene within hazard zones.		N/A
	Environmental interferences include		N/A
	temperature,		N/A
	humidity,		N/A
	external shock/vibration,		N/A
	vapours, dust or gases from the environment,		N/A
	electromagnetic/radio frequency interference,		N/A
	source voltage interruption/fluctuation, and		N/A
	insufficient hardware/software compatibility and integrity of machine parts.		N/A
4.4	Characteristics of laser radiation		P
	The hazards related to laser radiation depend on the characteristics of the radiation.		P
	For a hazard analysis and a risk assessment, the laser radiation emitted from a laser processing machine is characterized by including but not limited to the following:		-
	wavelength;		P
	operating mode (cw, pulsed);		P
	beam profile (mode, energy distribution);		P
	beam quality codes: BPP, M2, K;		P
	polarization;		P
	foreseeable exposure limit (FEL) at the inner side of an enclosure/guard;		P
	irradiance/radiant exposure at a machine workplace or specified distance to the laser machine;		P



EN ISO 11553-1			
Clause	Requirement + Test	Result - Remark	Verdict
	maximum exposure time.		P

<b>5</b>	<b>Safety requirements and measures</b>		<b>P</b>
5.1	General requirements		P
	The extent to which hazards are covered is indicated in the Scope.		P
	Manufacturers shall ensure the safety of laser processing machines by		P
	a)hazard identification and risk assessment,		P
	b)implementation of safety measures to minimize risks by laser radiation,		P
	c)verification of the safety measures, and		P
	d)provision of appropriate information for the user.		P
	Based on the risk assessment (see 5.2), appropriate safety measures against laser radiation shall be incorporated into the laser processing machine by design and manufacture.		P
5.2	Risk assessment with regard to laser radiation hazards		P
	The accessibility to hazardous laser radiation decisively depends on the status of a laser machine. Therefore, a risk assessment with regard to laser radiation hazards shall be performed:		P
	for the whole life cycle of the machine, as applicable, (for examples see ISO 12100:2010);		P
	for all operating modes (The operating modes described in Clause 3 are only examples. The operating modes of the machine incl. terminology and content should be defined by the risk assessment of the manufacturer.);		P
	after each modification of the machine by the person or organization responsible for the modification; and		P

EN ISO 11553-1			
Clause	Requirement + Test	Result - Remark	Verdict
	for each reasonably foreseeable misuse/operation not included by the intended use.		P
	A risk assessment includes but is not limited to:		P
	a)hazards caused by the direct or reflected laser beam;		P
	b)hazard zones, particularly those associated with		P
	1)the laser or the laser system,		P
	2)the laser beam path/beam delivery system,		P
	3)the process zone,		P
	4)the laser hazard area, and		P
	5)the area in which laser radiation can dazzle people;		P-
	c)"interferences" listed in 4.3.		P
	The results of the risk assessment shall be duly documented. See ISO 12100:2010 for principles for risk assessment.		P
5.3	Implementation of risk reduction measures		P
5.3.1	General		P
	Safety measures against laser radiation hazards shall be incorporated in the machine by design and manufacture as specified in 5.3.2 to 5.3.4. Safety measures against laser hazards shall follow the priority principle according to ISO 12100:2010.		P
5.3.2	Safety measures against laser radiation hazards in dependence of the locations		P
5.3.2.1	Safety measures at locations with unrestricted and uncontrolled access		P
	For laser processing machines operating in locations with unrestricted and uncontrolled access, the possibility of people being exposed to hazardous levels of laser radiation exceeding the accessible emission limit (AEL) for Class 1 according to IEC 60825-1:2014 shall be eliminated during all operating modes (production and any other operating mode).		P



EN ISO 11553-1			
Clause	Requirement + Test	Result - Remark	Verdict
	To satisfy these requirements, the following conditions shall be met:		-
	Unauthorized human access to a hazard zone shall be prevented solely by engineering safety measures as stipulated in IEC 60825- 1:2014 and ISO 12100:2010.		P
	Guarding shall be applied to protect against laser radiation.		P
	SRP/CS shall be used to safely isolate the laser radiation, the requirements of ISO 13849- 1:2015 shall be met.		P
5.3.2.2	Safety measures at locations with restricted access		P
	For laser processing machines operating in locations with restricted access, predominantly engineering safety measures specified in IEC 60825- 1:2014 and ISO 12100:2010 shall be taken to prevent human access to a laser hazard area (NOHA).		P
	To satisfy these requirements, the following conditions shall be met:		---
	a)Engineering safety measures for guarding and for shielding of laser radiation shall reduce the irradiance below the MPE of eye and skin. SRP/CS for the safe isolation of the laser radiation shall comply with ISO 13849- 1:2015.		P
	b)In addition to engineering measures organizational measures might be necessary (e.g. for operating mode "service") to prevent human access to hazardous laser radiation. Exposure above the MPE shall be eliminated by additional use of administrative/organizational safety measures.		P

EN ISO 11553-1			
Clause	Requirement + Test	Result - Remark	Verdict
	Organizational safety measures shall be carried out with secondary priority in accordance with ISO 12100:2010 and IEC 60825- 1:2014. The anufactures shall inform the user, how to carry out the organizational measures in order to avoid risks (exceed MPE) by laser radiation.		P
	If the laser hazard area is shielded or partially shielded by laser guards the manufacturer shall inform the user how to determine the FEL and provide adequate laser guards (with sufficient PEL according to IEC 60825- 1:2014).		N/A
	If the laser safety is provided by distance the manufacturer shall inform the user how to determine the NOHA. The manufacturer shall inform the user, how to install barriers (e.g. with barrier tapes) at the respective Nominal Ocular Hazard Distances. He shall provide information how to implement the organisational measures in training/education and safety instructions.		N/A
5.3.2.3	Safety measures at locations with controlled access		P
	For laser processing machines operating in locations with controlled access, the possibility of people being exposed to levels of laser radiation exceeding the maximum permissible exposure (MPE <sub>eye</sub> and MPE <sub>skin</sub> ) shall be eliminated.		P
	To satisfy this requirement, the following conditions shall be met in addition to all safety measures related to operating modes, where 5.3.3.2 to 5.3.3.5 apply.		P
	a)Unauthorized human access to the laser hazard zone shall be prevented predominantly by engineering safety measures as specified in IEC 60825- 1:2014 and ISO 12100:2010. The manufacturer shall specify the kind of authorization control enabling/preventing access to the laser hazard zone (e.g. door with key, password/transponder).		P



EN ISO 11553-1			
Clause	Requirement + Test	Result - Remark	Verdict
	b)If authorized access (e.g. by key or password/transponder) is necessary for laser processing machines operating in locations with controlled access (e.g. for service mode, see also 5.3.3.4) the manufacturer shall provide information on how to work safely in a laser hazard area (see IEC 60825- 1:2014).		P
	Exposure above the MPE in the controlled area shall be eliminated by use of engineering and administrative controls, including Personal Protective Equipment (PPE). The manufacturer shall provide the following information to the user:		N/A
	Engineering measures: Emergency stop in the laser hazard area.		P
	Organizational measures: The qualification of personnel authorized to access the laser hazard zone, which means level of training and education of the personnel and on safety instructions given to the personnel.		P
5.3.3	Safety measures against laser radiation hazards		P
5.3.3.1	Design requirements for safety measures		P
	For all laser processing machines, without regard to restricted or controlled access, the following shall apply.		P
	a)The laser machine shall be equipped with protective devices to ensure a safe isolation of the laser beam (e.g. by a safety shutter or deactivation by shutting off the power to the pumping diodes).		P
	b)If human presence in a hazard zone is unavoidable while the machine is functioning (e.g. during service), the machine shall be equipped with an enabling switch of machine motion, laser beam direction and laser beam isolation. See 5.3.3.5.		P



EN ISO 11553-1			
Clause	Requirement + Test	Result - Remark	Verdict
	c)The design of protective devices, such as switches, shutters, beam dissipation devices and deterring/impeding devices, shall meet the requirements specified in IEC 60825- 1:2014 and ISO 12100:2010. A single protective device may be used to provide simultaneous protection against more than one hazard.		P
	d)Protective housings (enclosures) are not subject to IEC 60825- 4:2006, Annex D, but shall otherwise conform to IEC 60825- 4:2006 or IEC 60825- 1:2014. Laser guards (not part of a protective housing) shall comply with requirements specified in IEC 60825- 4:2006, Annex D.		P
	e)If active guards (e.g. equipped with sensors) are used within the enclosure or guarding the component shall be integrated in the safety control (SRP/CS) of the laser processing machine. Requirements on active guards are specified in IEC 60825- 4:2006, Annex D. The manufacturer shall indicate the achieved PL (according to ISO 13849- 1:2015) or SIL (according to IEC 62061:2005) and the system reaction time for isolating the laser beam and shall ensure that the passive laser resistance (time) of guard/windows is sufficient (longer) than the system reaction time.		N/A
	f)The beam delivery system or parts of a beam delivery system shall comply with the requirements specified in IEC 60825- 4:2006, Annex G.		P
	g)Whenever and wherever there are multiple laser sources [e.g. from a back-up laser, energy share multiplex (beam split) or time share multiplex (beam switch)] the safety controls for each respective work station, process zone or laser hazard zone shall be automatically connected or associated with each respective laser source, such that when that station's interlocks or emergency stops or other protective device sensors are activated, no hazardous laser energy can be directed to that station or zone.		N/A

EN ISO 11553-1			
Clause	Requirement + Test	Result - Remark	Verdict
5.3.3.2	Protection against laser radiation hazards during production		P
	The principal hazard zone is usually the process zone but the hazard zone shall be defined as a result of the risk assessment. The risk assessment shall indicate which type of guarding (local protection or peripheral protection) is to be used. The applicable type of guarding depends on the design of the machine and the guards respectively (see also IEC 60825-4:2006, Annex F: Guideline for assessing the suitability of laser guards).		P
	Local protection is a method of guarding to reduce laser radiation and associated optical radiation to a safe level based on a risk assessment (e.g. by means of a nozzle or a small guard fitted close to the beamfocus at the workpiece) without totally enclosing the workpiece, the workpiece support and/or machine motion system.		P
5.3.3.3	Protection against laser radiation hazards during setting mode (teaching, path programming and programme verification without processing)		P
	During setting mode, human access to laser radiation exceeding the AEL for Class 1 shall be prevented except for laser radiation emitted in the wavelength range of 400 nm to 700 nm when human access to laser radiation shall not exceed the AEL for Class 3R.		P
5.3.3.4	Protection against laser radiation hazards during service mode		P
	During service mode, human access to laser radiation exceeding the AEL for Class 1 is sometimes unavoidable. Machines shall therefore be designed, and appropriate safety measures provided, with respect to the following four situations (listed in order of preference):		P



EN ISO 11553-1			
Clause	Requirement + Test	Result - Remark	Verdict
	a)servicing takes place outside the laser hazard area (according to IEC 60825- 1:2014); no further protection is necessary.		P
	b)servicing takes place in a laser hazard area to which access is controlled in the same manner as during production; protective measures in c) apply.		P
	c)servicing takes place in a laser hazard area (e.g. with open guards that are normally closed during production) but accessible laser radiation does not exceed the AEL for Class 1.		P
	Exposure above AEL for class 1 shall be predominantly prevented by engineering safety measures described in IEC 60825- 1:2014, e.g. protective equipment to detect the presence of persons e. g. opto-electronic protective devices (Laserscanner). If parts are integrated in a safety control, requirements specified in ISO 13849- 1:2015 and/or ISO 62061:2005 shall be met.		P
	Administrative safety measures (lock-out/tagout: LOTO), e.g. to lock-out (e.g. with a padlock) a laser cabin door so that the door/interlock is open and therefore exposure above AEL for class 1 is prevented by SRP/CS, shall be used as subordinated measure.		P
	d)servicing takes place in hazard zones, for example because opening of guards (normally closed during production) is necessary. In this case accessible laser radiation exceeds the AEL for Class 1. If servicing takes place in the laser hazard area the requirements of 5.3.2.3 shall be met.		P
	The manufacturer shall indicate the effective class of accessible laser radiation as indicated by the AEL when in the service mode and recommended safety procedures for each of these situations.		P
5.3.3.5	Protection against laser radiation hazard by operating mode selector switch		N/A



EN ISO 11553-1			
Clause	Requirement + Test	Result - Remark	Verdict
	The operating mode selector switch enables the selection of machine functions characterized by different risk levels with regard to laser radiation hazards; e.g. normal use/automatic mode vs. service mode.		N/A
	On the basis of the risk assessment the manufacturer shall define requirements on the operating mode selector switch and the authorization control for the operating mode selector switch.		N/A
	If the mode selection can give rise to unsafe operation of the machine (e.g. by unauthorized or wrong selection of service mode resulting in hazardous accessible emission level (AEL) of laser radiation), the operating mode selector switch shall be lockable and integrated in the safety control of the machine. The requirements on the operating mode selector switch (here PLr) shall be determined in accordance with ISO 13849- 1:2015 and ISO 12100:2010.		N/A
5.3.4	Engineering control measures		P
	In the following, engineering control measures with regard to design and controls are listed:		P
	The manufacturer shall follow general principles for design, risk assessment and risk reduction for laser processing machines explained in ISO 12100:2010.		P
	The general requirements for the safety of the electrical equipment of laser processing machines described in IEC 60204- 1:2016 shall be observed.		P
	The start/stop controls of a laser processing machine shall comply with the requirements specified in ISO 60204- 1:2016 and ISO 13849- 1:2015.		P
	The emergency stop controls shall be designed according to the requirements specified in ISO 13850:2012 and IEC 60204- 1:2016.		P



EN ISO 11553-1			
Clause	Requirement + Test	Result - Remark	Verdict
	Safety related parts of control systems of laser processing machines shall comply with the requirements given in IEC 60825- 1:2014, IEC 60204- 1:2016, ISO 13849- 1:2015, or ISO 2061:2005.A risk assessment shall be performed according to ISO 12100:2010.		P
	This risk estimation for damage to sight leads at least to a required Performance Level PLr = c or in a Safety Integrity Level SIL = 1. If the accessible irradiance or the radiant exposure exceeds ten times the AEL of laser class 1 as defined in IEC 60825- 1:2014, then a Performance Level PLr = d is required.		P
	Provisions for the safe isolation of the laser beam shall be designed in compliance with IEC 60825- 1:2014, 4.3 (reasonably foreseeable single fault condition for normal operation).		P
6	Verification of the safety requirements and risk reduction measures		P
	The manufacturer shall verify the following.		-
	The verification of the safety requirements and risk reduction measures for the laser processing machine and the validation of the design and the function of the laser processing machine shall be carried out in accordance with relevant standards, see Table 2.		P
	The risk assessment shall be verified to ensure that all reasonably foreseeable hazards and reasonably foreseeable fault conditions are identified and, if necessary, corrective measures have been taken.		P
	The verification and validation of the safety requirements and risk reduction measures includes following measures, but are not limited to		P
	a)visual inspection,		P
	b)practical inspection/functional tests,		P



EN ISO 11553-1			
Clause	Requirement + Test	Result - Remark	Verdict
	c)measurements,		P
	d)observation during operation,		P
	e)Verification of application-specific schematics, circuits layouts and design document,		P
	f)Verification of safety-related application specific hardware and software or software documentation (SRP/CS),		P
	g)Verification of the risk assessment, (incl. evaluations, calculations),		P
	h)Verification of the detailed description, the layout drawings and mounting description,		P
	i)Verification of specification values and information to user.		P
7	Information for use		P
	The manufacturer shall follow the requirements of ISO 12100:2010, 6.4, preparing the chapter "information for use".		P
	The manufacturer should consider IEC/IEEE 82079- 1:2019.		P
	The information for use (manual) of the laser machine shall at least include the following laser radiation hazards related issues.		P
	The manufacturer shall:		-
	define the normal use of the machine and all other operating modes intended for the laser processing machine.		P



EN ISO 11553-1			
Clause	Requirement + Test	Result - Remark	Verdict
	describe the residual risks or the hazards related to laser radiation respectively for all phases of machine life and for every applicable operating mode and shall indicate the level of accessible laser radiation or the laser class (according to IEC 60825- 1:2014) respectively.		P
	advise users of known potential laser radiation hazards by providing a prominently placed warning statement in the user instructions and/or operator's manual.		P
	include information on laser safety requirements for all operating modes, including if applicable for the setting mode, the manual intervention mode and service mode. This information shall include general notes on		P
	technical protective measures,		P
	organizational protective measures,		P
	personal protective measures, or personal protective equipment, respectively,		P
	if necessary, specify requirements on the required protective equipment and refer to respective standards; e.g.		P
	technical and organizational laser protective measures: IEC 60825- 1:2014,		P
	laser guards: IEC 60825- 4:2006,		N/A
	SRP/CS for safe isolation of the laser radiation: ISO 13849- 1:2015, ISO 13849- 2:2012 (and/or IEC 62061:2005),		N/A
	laser protective eyewear: EN 207:2017.		N/A
	provide sufficient and adequate information how to operate the laser processing machine in other operating modes than the normal use without being exposed to laser hazards; especially if safety equipment is removed or overridden instructions for the use of adequate protective measures including personal protective equipment shall be given.		P



EN ISO 11553-1			
Clause	Requirement + Test	Result - Remark	Verdict
	define which authorization measures (to enter the laser hazard area) are comprised and have to be followed if access to hazardous laser radiation can be possible.		P
	if necessary, define the level of qualification of personnel (related to laser safety), gained by training and education and instructions, which is required to select specified operating modes and/or which is required according to the accessible laser radiation or the location (see Table 1), in which the laser processing machine is operated.		P

8	Laser processing machines shall be labelled regarding laser radiation hazards as following:		P
	a)Each laser processing machine shall be equipped with labelling in accordance with ISO 3864 (all parts).		-
	Safety signs (prohibition/warning/mandatory signs);		P
	Colours, sizes and print styles of the labels shall comply with the design principles for product safety labels according to ISO 3864 (all parts);		P
	Laser radiation labels shall be as described in IEC 60825- 1:2014.		P
	b)The location of labels shall satisfy the following requirement:		-
	the size and location of the labels shall be such as to make the appropriate labels legible from outside the hazard zones without exposing anyone to any of the laser hazards listed in Clause 4.		P
	if different operation modes make different sets of safety signs necessary (e.g. for normal use and service), it shall clearly be indicated for which operating mode which set of safety signs is applicable.		N/A

<b>Annex A</b>	<b>Potential hazards</b>		<b>P</b>
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**Attachment 1:**  
Photo-documentation

Photo 1



\*\*\*\*\* END OF REPORT \*\*\*\*\*