CE

TECHNICAL CONSTRUCTION FILE
(TCF)

FILE NO：HANDA-2023A01
DATE：21.07.2023

PRODUCT NAME: Welding Rotator
MODEL: Model No.:HDTR-1000, HDTR-3000, ZT-5, ZT-10, ZT-20, ZT-30, ZT-40, ZT-50, ZT-60, ZT-100, KT-5, KT-10, KT-20, KT-40, KT-60, KT-80, KT-100

ACCORDING TO:

MACHINERY DIRECTIVE: 2006/42/EC
LOW VOLTAGE DIRECTIVE: 2014/35/EU
ELECTROMAGNETIC COMPATIBILITY DIRECTIVE: 2014/30/EU

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济南恒达机械有限公司 JINAN HANDA MACHINERY CO., LTD

Content

1.1 General description

Basically, this kind of machine belongs to simple machine and with low risk when using it. All possible risk have been analysis in the risk assessment report and been prevent by suitable ways.

In order to ensure the conformity for CE marking for these machines, some main European and/or International standards have been used to made assessment of conformity, they are：

BS EN ISO 12100:2010 SAFETY OF MACHINERY - GENERAL PRINCIPLES FOR DESIGN - RISK ASSESSMENT AND RISK REDUCTION
BS EN 60204-1:2018 SAFETY OF MACHINERY- ELECTRICAL EQUIPMENT OF MACHINES - PART 1: GENERAL REQUIREMENTS
BS EN 61000-6-2:2019 ELECTROMAGNETIC COMPATIBILITY (EMC) -- PART 6-2: GENERIC STANDARDS - IMMUNITY FOR INDUSTRIAL ENVIRONMENTS
BS EN 61000-6-4:2019 ELECTROMAGNETIC COMPATIBILITY (EMC) -- PART 6-4: GENERIC STANDARDS - EMISSION STANDARD FOR INDUSTRIAL ENVIRONMENTS

The test reports for these applicable standards in detail have been included in the relevant sub-clauses of this technical construction file.

1.2 Product Parameter

Model	HDTR-1000
Working area	500*600mm
Workpiece diameter	20-800mm
Power	120 W
Voltage	AC220V
Size	550*550*580mm
Weight	72kg

1.3 Quality control system

In order to ensure the conformity of the series production, the JINAN HANDA MACHINERY CO., LTD. has taken the related procedures mentioned below：

（1）Carry out the inspection for parts and components according to the TCF

Before the assemblies of the series production, the QC engineers of JINAN HANDA MACHINERY CO., LTD. has to check and inspect the technical specifications and intended functions of parts and components to ensure the correct use of them according to the contents of TCF and principle described in the related technical information.

（2）Carry out the inspection＆testing for the products before packing

Before packing the products, the QC engineers of JINAN HANDA MACHINERY CO., LTD. have to do the necessary inspection and testing to ensure the conformity of related requirements, in particularly, the testing and inspection of outer feature.

（3）Carry out the inspection for the packing

After finishing the necessary inspection and testing for the products, an inspection for the packing has to be done to ensure the necessary elements being included in this packing before shipment.

（4）Provision for the change of design

Any change of the products described in this TCF must be checked in detail and written down again in the TCF by the designer of JINAN HANDA MACHINERY CO., LTD. if the change may effects the related electrical or mechanical characteristics.

（5）Provision for the Quality Assurance

For the provisions of internal control measures to ensure the conformity of series production of the machines, JINAN HANDA MACHINERY CO., LTD. has built an internal quality control system in accordance with the international standard of ISO 9001.

1.4 List of applicable regulations and standards

Directive:

Machinery directive: 2006/42/EC
Low voltage directive: 2014/35/EU
Electromagnetic Compatibility Directive: 2014/30/EU

Standards:

BS EN ISO 12100:2010 SAFETY OF MACHINERY - GENERAL PRINCIPLES FOR DESIGN - RISK ASSESSMENT AND RISK REDUCTION
BS EN 60204-1:2018 SAFETY OF MACHINERY- ELECTRICAL EQUIPMENT OF MACHINES - PART 1: GENERAL REQUIREMENTS
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Part II：Assessment of conformity

2.1 Essential health and safety requirements relating to the design and construction of machinery

1.	Essential health and safety requirements	-	P
1.1	General remarks	-	P
1.1.1	Definitions	-	P
1.1.2	Principles of safety integration	-	P
	(a) Machinery must be designed and constructed so that it is fitted for its function, and can be operated, adjusted and maintained without putting persons at risk when these operations are carried out under the conditions foreseen but also taking into account any reasonably foreseeable misuse thereof. The aim of measures taken must be to eliminate any risk throughout the foreseeable lifetime of the machinery including the phases of transport, assembly, dismantling, disabling and scrapping.	These requirements have been taken into account during the design of this machine.	P
	(b) In selecting the most appropriate methods, the manufacturer or his authorised representative must apply the following principles, in the order given:	- These requirements have been taken into account during the design of this machine.	P
	— eliminate or reduce risks as far as possible(inherently safe machinery design and construction) —take the necessary protection measure in relation to risks that cannot be eliminated — inform users of the residual risks due to any shortcomings of the protective measures adopted, indicate whether any particular training is required and specify any need to provide personal protective equipment.		P
	(c) When designing and constructing machinery and when drafting the instructions, the manufacturer or his authorised representative must envisage not only the intended use of the machinery but also any reasonably foreseeable misuse thereof. The machinery must be designed and constructed in such a way as to prevent abnormal use if such use would engender a risk. Where appropriate, the instructions must draw the user's attention to ways — which experience has shown might occur — in which the machinery should not be used.	These requirements have been taken into account during the design of this machine.	P
	(d) Machinery must be designed and constructed to take account of the constraints to which the operator is subject as a result of the necessary or foreseeable use of personal protective equipment.	These requirements have been taken into account during the design of this machine.	P
	(e) Machinery must be supplied with all the special equipment and accessories essential to enable it to be adjusted, maintained and used safely.		P
1.1.3	Materials and products	-	
	The materials used to construct machinery or products used or created during its use must not endanger persons' safety or health. In particular, where fluids are used, machinery must be designed and constructed to prevent risks due to filling, use, recovery or draining.		P
1.1.4	Lighting	-	N.A

	Machinery must be supplied with integral lighting suitable for the operations concerned where the absence thereof is likely to cause a risk despite ambient lighting of normal intensity. Machinery must be designed and constructed so that there is no area of shadow likely to cause nuisance, that there is no irritating dazzle and that there are no dangerous stroboscopic effects on moving parts due to the lighting. Internal parts requiring frequent inspection and adjustment, and maintenance areas must be provided with appropriate lighting.		
1.1.5	Design of machinery to facilitate its handling	-	P
	Machinery or each component part thereof must:	-	P
	- be capable of being handle and transported safely	Enough measures have been taken to ensure the safe of the handling.	P
	- be packaged or designed so that it can be stored safely and without damage		P
	During the transportation of the machinery and/or its component parts, there must be no possibility of sudden movements or of hazards due to instability as long as the machinery and/or its component parts are handled in accordance with the instructions.		N.A
	Where the weight, size or shape of machinery or its various component parts prevents them from being moved by hand, the machinery or each components part must: - either be fitted with attachments for lifting gear, or - be designed so that it can be fitted with such attachments, or - be shaped in such a way that standard lifting gear can easily be attached		N.A
	Where machinery or one of its component parts is to be moved by hand, it must: - either be easily movable, or - be equipped for picking up and moving safely. Special arrangements must be made for the handling of tools and/or machinery parts which, even if lightweight, could be hazardous.		P
1.1.6	Ergonomics	-	P
	Under the intended conditions of use, the discomfort, fatigue and physical and psychological stress faced by the operator must be reduced to the minimum possible, taking into account ergonomic principles such as: — allowing for the variability of the operator's physical dimensions, strength and stamina, — providing enough space for movements of the parts of the operator's body, — avoiding a machine-determined work rate, — avoiding monitoring that requires lengthy concentration, — adapting the man/machinery interface to the foreseeable characteristics of the operators.		P
1.1.7	Operating positions	-	N.A
	The operating position must be designed and constructed in such a way as to avoid any risk due to		N.A

	exhaust gases and/or lack of oxygen. If the machinery is intended to be used in a hazardous environment presenting risks to the health and safety of the operator or if the machinery itself gives rise to a hazardous environment, adequate means must be provided to ensure that the operator has good working conditions and is protected against any foreseeable hazards. Where appropriate, the operating position must be fitted with an adequate cabin designed, constructed and/or equipped to fulfil the above requirements. The exit must allow rapid evacuation. Moreover, when applicable, an emergency exit must be provided in a direction which is different from the usual exit.		
1.1.8	Seating		N.A
	Where appropriate and where the working conditions so permit, work stations constituting an integral part of the machinery must be designed for the installation of seats. If the operator is intended to sit during operation and the operating position is an integral part of the machinery, the seat must be provided with the machinery. The operator's seat must enable him to maintain a stable position. Furthermore, the seat and its distance from the control devices must be capable of being adapted to the operator. If the machinery is subject to vibrations, the seat must be designed and constructed in such a way as to reduce the vibrations transmitted to the operator to the lowest level that is reasonably possible. The seat mountings must withstand all stresses to which they can be subjected. Where there is no floor beneath the feet of the operator, footrests covered with a slip-resistant material must be provided.		N.A
1.2	CONTROL SYSTEMS	-	P
1.2.1	Safety and reliability of control systems	-	P
	Control systems must be designed and constructed in such a way as to prevent hazardous situations from arising. Above all, they must be designed and constructed in such a way that:	The control system for this machine is safe	P
	— they can withstand the intended operating stresses and external influences, — a fault in the hardware or the software of the control system does not lead to hazardous situations, — errors in the control system logic do not lead to hazardous situations, — reasonably foreseeable human error during operation does not lead to hazardous situations.	The control system can withstand related effects during normal operation.	P
	Particular attention must be given to the following points:		P
	— the machinery must not start unexpectedly, — the parameters of the machinery must not change in an uncontrolled way, where such change may lead to hazardous situations, — the machinery must not be prevented from stopping if the stop command has already been given, — no moving part of the machinery or piece held by		P

	the machinery must fall or be ejected, — automatic or manual stopping of the moving parts, whatever they may be, must be unimpeded, — the protective devices must remain fully effective or give a stop command, — the safety-related parts of the control system must apply in a coherent way to the whole of an assembly of machinery and/or partly completed machinery.		
	For cable-less control, an automatic stop must be activated when correct control signals are not received, including loss of communication.		P
1.2.2	Control devices	-	P
	Control devices must be:	-	P
	— clearly visible and identifiable, using pictograms where appropriate, — positioned in such a way as to be safely operated without hesitation or loss of time and without ambiguity, — designed in such a way that the movement of the control device is consistent with its effect, — located outside the danger zones, except where necessary for certain control devices such as an emergency stop or a teach pendant, — positioned in such a way that their operation cannot cause additional risk, — designed or protected in such a way that the desired effect, where a hazard is involved, can only be achieved by a deliberate action, — made in such a way as to withstand foreseeable forces; particular attention must be paid to emergency stop devices liable to be subjected to considerable forces.	Visible markings are provided. Good design meets the requirements.	P
	Where a control device is designed and constructed to perform several different actions, namely where there is no one-to-one correspondence, the action to be performed must be clearly displayed and subject to confirmation, where necessary. Control devices must be so arranged that their layout, travel and resistance to operation are compatible with the action to be performed, taking account of ergonomic principles. Machinery must be fitted with indicators as required for safe operation. The operator must be able to read them from the control position. From each control position, the operator must be able to ensure that no-one is in the danger zones, or the control system must be designed and constructed in such a way that starting is prevented while someone is in the danger zone. If neither of these possibilities is applicable, before the machinery starts, an acoustic and/or visual warning signal must be given. The exposed persons must have time to leave the danger zone or prevent the machinery starting up. If necessary, means must be provided to ensure that the machinery can be controlled only from control positions located in one or more predetermined zones or locations. Where there is more than one control position, the control system must be designed in such a way that		P

	the use of one of them precludes the use of the others, except for stop controls and emergency stops. When machinery has two or more operating positions, each position must be provided with all the required control devices without the operators hindering or putting each other into a hazardous situation.		
1.2.3	Starting	-	
	It must be possible to start machinery only by voluntary actuation of a control provided for the purpose.	Devices preventing unintended starting have been provided.	P
	The same requirement applies:	-	P
	- when restarting the machinery after stoppage, whatever the cause - when effecting a significant change in the operating conditions		P
	However, the restarting of the machinery or a change in operating conditions may be effected by voluntary actuation of a device other than the control device provided for the purpose, on condition that this does not lead to a hazardous situation. For machinery functioning in automatic mode, the starting of the machinery, restarting after a stoppage, or a change in operating conditions may be possible without intervention, provided this does not lead to a hazardous situation. Where machinery has several starting control devices and the operators can therefore put each other in danger, additional devices must be fitted to rule out such risks. If safety requires that starting and/or stopping must be performed in a specific sequence, there must be devices which ensure that these operations are performed in the correct order.	Reset is necessary before restarting.	P
1.2.4	Stopping	-	P
1.2.4.1.	Normal stopping	-	P
	Machinery must be fitted with a control device whereby the machinery can be brought safely to a complete stop.	A normal stop control has been provided.	P
	Each workstation must be fitted with a control to stop some or all of the moving parts of the machinery, depending on the existing hazard, so that the machinery is rendered safe	A normal stop control has been provided.	P
	The machinery's stop control must have priority over the start controls	It has priority over the start control.	P
	Once the machinery or its dangerous parts have stopped, the energy supply to the actuators concerned must be cut off		P
1.2.4.2	Operational stop	-	P
	Where, for operational reasons, a stop control that does not cut off the energy supply to the actuators is required, the stop condition must be monitored and maintained.		P
1.2.4.3	Emergency stop	-	P
	Machinery must be fitted with one or more emergency stop devices to enable actual or impending danger to be averted.		P
	The following exceptions apply:		N.A

	— machinery in which an emergency stop device would not lessen the risk, either because it would not reduce the stopping time or because it would not enable the special measures required to deal with the risk to be taken,		
	—portable hand-held and/or hand-guided machinery.		
	The device must:		
	— have clearly identifiable, clearly visible and quickly accessible control devices,		
	—stop the hazardous process as quickly as possible, without creating additional risks,		
	— where necessary, trigger or permit the triggering of certain safeguard movements.		
	Once active operation of the emergency stop device has ceased following a stop command, that command must be sustained by engagement of the emergency stop device until that engagement is specifically overridden; it must not be possible to engage the device without triggering a stop command; it must be possible to disengage the device only by an appropriate operation, and disengaging the device must not restart the machinery but only permit restarting. The emergency stop function must be available and operational at all times, regardless of the operating mode. Emergency stop devices must be a back-up to other safeguarding measures and not a substitute for them.		
1.2.4.4	Assembly of machinery		P
	In the case of machinery or parts of machinery designed to work together, the machinery must be designed and constructed in such a way that the stop controls, including the emergency stop devices, can stop not only the machinery itself but also all related equipment, if its continued operation may be dangerous.		P
1.2.5	Selection of control or operating modes	-	P
	The control or operating mode selected must override all other control or operating modes, with the exception of the emergency stop. If machinery has been designed and constructed to allow its use in several control or operating modes requiring different protective measures and/or work procedures, it must be fitted with a mode selector which can be locked in each position. Each position of the selector must be clearly identifiable and must correspond to a single operating or control mode. The selector may be replaced by another selection method which restricts the use of certain functions of the machinery to certain categories of operator. If, for certain operations, the machinery must be able to operate with a guard displaced or removed and/or a protective device disabled, the control or operating mode selector must simultaneously: — disable all other control or operating modes, — permit operation of hazardous functions only by control devices requiring sustained action, — permit the operation of hazardous functions only in		P

	reduced risk conditions while preventing hazards from linked sequences, —prevent any operation of hazardous functions by voluntary or involuntary action on the machine's sensor. If these four conditions cannot be fulfilled simultaneously, the control or operating mode selector must activate other protective measures designed and constructed to ensure a safe intervention zone. In addition, the operator must be able to control operation of the parts he is working on from the adjustment point.		
1.2.6	Failure of the power supply	-	
	The interruption, re-establishment after an interruption or fluctuation in whatever manner of the power supply to the machinery must not lead to a dangerous situation	No any dangerous situation has been found.	P
	Particular attention must be given to the following points:	-	
	- the machinery must not start unexpectedly		P
	- the parameters of the machinery must not change in an uncontrolled way when such change can lead to hazardous situations,	All the parameters stay the same.	P
	- the machinery must not be prevented from stopping if the command has already been given,		P
	-no moving part of the machinery or piece held by the machinery must fall or be ejected,	No such hazards.	P
	-automatic or manual stopping of the moving parts, whatever they may be, must be unimpeded,		P
	— the protective devices must remain fully effective or give a stop command.		P
1.3	PROTECTION AGAINST MECHANICAL HAZARDS		P
1.3.1	Risk of loss of Stability	-	P
	Machinery and its components and fittings must be stable enough to avoid overturning, falling or uncontrolled movements during transportation, assembly, dismantling and any other action involving the machinery. If the shape of the machinery itself or its intended installation does not offer sufficient stability, appropriate means of anchorage must be incorporated and indicated in the instructions.	These requirements have been taken into account design. The whole equipment is stable enough.	P
1.3.2	Risk of break-up during operation	-	P
	The various parts of machinery and their linkages must be able to withstand the stress to which they are subject when used	All parts of the machine can withstand related stress when they are used.	P
	The durability of the materials used must be adequate for the nature of the workplace foreseen by the manufacturer, in particular as regards the phenomena of fatigue, aging, corrosion and abrasion	All materials used for this machine are appropriate for their intended use and have adequate life.	P
	The instructions must indicate the type and frequency of inspections and maintenance required for safety reasons. They must, where appropriate, indicate the parts subject to wear and the criteria for replacement.		P
	Where a risk of rupture or disintegration remains despite the measures taken, the parts concerned must be mounted, positioned and/or guarded in such a way that any fragments will be contained,		P

	preventing hazardous situations.		
	Both rigid and flexible pipes carrying fluids, particularly those under high pressure, must be able to withstand the foreseen internal and external stresses and must be firmly attached and/or protected to ensure that no risk is posed by a rupture.		N.A
	Where the material to be processed is fed to the tool automatically, the following conditions must be fulfilled to avoid risks to persons:	-	N/A
	- when the work piece comes into contact with the tool, the later must have attained its normal working conditions		N.A
	- when the tool starts and/or stops(intentionally or accidentally) the feed movement and the tool movement must be coordinated	.	N.A
1.3.3	Risked due to falling or ejected objects	-	P
	Precautions must be taken to prevent risks from falling or ejected object	The fuel will not be ejected.	P
1.3.4	Risks due to surfaces, edges or angles	-	P
	Insofar as their purpose allows, accessible parts of the machinery must have no sharp edges, no sharp angles, and no rough surfaces likely to cause injury		P
1.3.5	Risks related to combined machinery	-	P
	Where the machinery is intended to carry out several different operations with manual removal of the piece between each operation (combined machinery), it must be designed and constructed in such a way as to enable each element to be used separately without the other elements constituting a risk for exposed persons.		P
	For this purpose, it must be possible to start and stop separately and elements that are not protected		N.A
1.3.6	Risks relating to variations in operating conditions	-	P
	Where the machinery performs operations under different conditions of use, it must be designed and constructed in such a way that selection and adjustment of these conditions can be carried out safely and reliably.		P
1.3.7	Risks related to moving parts	-	
	The moving parts of machinery must be designed and constructed in such a way as to prevent risks of contact which could lead to accidents or must, where risks persist, be fitted with guards or protective devices. All necessary steps must be taken to prevent accidental blockage of moving parts involved in the work. In cases where, despite the precautions taken, a blockage is likely to occur, the necessary specific protective devices and tools must, when appropriate, be provided to enable the equipment to be safely unblocked. The instructions and, where possible, a sign on the machinery shall identify these specific protective devices and how they are to be used.		P
1.3.8	Choice of protection against risk related to moving parts		N.A

	Guards or protection devices used to protect against the risks related to moving parts must be selected on the basis of the type of risk The following guidelines must be used to help make the choice		N.A
1.3.8.1	Moving transmission parts	-	N.A
	Guards designed to protect exposed persons against the risks associated with moving transmission parts must be：	-	N.A
	— either fixed guards as referred to in section 1.4.2.1, or		N.A
	— interlocking movable guards as referred to in section 1.4.2.2. Interlocking movable guards should be used where frequent access is envisaged.		N.A
1.3.8.2	Moving parts involved in the process	-	N.A
	Guards or protective devices designed to protect persons against the hazards generated by moving parts involved in the process must be: — either fixed guards as referred to in section 1.4.2.1, or — interlocking movable guards as referred to in section 1.4.2.2, or — protective devices as referred to in section 1.4.3, or — a combination of the above. However, when certain moving parts directly involved in the process cannot be made completely inaccessible during operation owing to operations requiring operator intervention, such parts must be fitted with: — fixed guards or interlocking movable guards preventing access to those sections of the parts that are not used in the work, and — adjustable guards as referred to in section 1.4.2.3 restricting access to those sections of the moving parts where access is necessary.		N.A
1.3.9	Risks of uncontrolled movements	-	N.A
	When a part of the machinery has been stopped, any drift away from the stopping position, for whatever reason other than action on the control devices, must be prevented or must be such that it does not present a hazard.		
1.4	Required characteristics of guards and protection devices	-	N.A
1.4.1	General requirement	-	N.A
	Guards and protection devices must:	-	N.A
	-be of robust construction -be securely held in place, -not give rise to any additional hazard, -not be easy to by-pass or render non-operational, - be located at an adequate distance from the danger zone, -cause minimum obstruction to the view of the production process, and -enable essential work to be carried out on the installation and/or replacement of tools and for maintenance		N.A

	purposes by restricting access exclusively to the area where the work has to be done, if possible without the guard having to be removed or the protective device having to be disabled. In addition, guards must, where possible, protect against the ejection or falling of materials or objects and against emissions generated by the machinery.		
1.4.2	Special requirements for guards	-	N.A
1.4.2.1	Fixed guards	-	N.A
	Fixed guards must be fixed by systems that can be opened or removed only with tools. Their fixing systems must remain attached to the guards or to the machinery when the guards are removed. Where possible, guards must be incapable of remaining in place without their fixings.		N.A
1.4.2.2	Interlocking movable guards		N.A.
	Interlocking movable guards must: — as far as possible remain attached to the machinery when open, — be designed and constructed in such a way that they can be adjusted only by means of an intentional action. Interlocking movable guards must be associated with an interlocking device that: — prevents the start of hazardous machinery functions until they are closed and — gives a stop command whenever they are no longer closed. Where it is possible for an operator to reach the danger zone before the risk due to the hazardous machinery functions has ceased, movable guards must be associated with a guard locking device in addition to an interlocking device that: — prevents the start of hazardous machinery functions until the guard is closed and locked, and — keeps the guard closed and locked until the risk of injury from the hazardous machinery functions has ceased. Interlocking movable guards must be designed in such a way that the absence or failure of one of their components prevents starting or stops the hazardous machinery functions.		
1.4.2.3	Adjustable guards restricting access		N.A
	Adjustable guards restricting access to those areas of the moving parts strictly necessary for the work must be: — adjustable manually or automatically, depending on the type of work involved, and — readily adjustable without the use of tools.		
1.4.3	Special requirements for protection devices	-	N.A
	Protective devices must be designed and incorporated into the control system in such a way that:	-	N.A
	Protective devices must be designed and incorporated into the control system in such a way that: — moving parts cannot start up while they are within		N.A

	the operator's reach, — persons cannot reach moving parts while the parts are moving, and — the absence or failure of one of their components prevents starting or stops the moving parts. Protective devices must be adjustable only by means of an intentional action.		
1.5	Risk due to other hazards	-	P
1.5.1	Electricity supply	-	P
	Where machinery has an electricity supply it must be designed, constructed and equipped in a way that all hazards of an electrical nature are or can be prevented		
	The safety objectives set out in Directive 73/23/EEC shall apply to machinery. However, the obligations Concerning conformity assessment and the placing on the market and/or putting into service of machinery with regard to electrical hazards are governed solely by this Directive.		N.A
1.5.2	Static electricity	-	P
	Machinery must be designed and constructed to prevent or limit the build-up of potentially dangerous electrostatic charges and/or be fitted with a discharging system.		P
1.5.3	Energy supply other than electricity	-	N.A
	Where machinery is powered by source of energy other than electricity, it must be so designed, constructed and equipped as to avoid all potential risks associated with such sources of energy.		N.A
1.5.4	Error of fitting	-	N.A
	Errors likely to be made when fitting or refitting certain parts which could be a source of risk must be made impossible by the design and construction of such parts or, failing this, by information given on the parts themselves and/or their housings. The same information must be given on moving parts and/or their housings where the direction of movement needs to be known in order to avoid a risk.		N.A
	Where necessary, the instructions must give further information on these risks.		N.A
	Where a faulty connection can be the source of risk, incorrect connections must be made impossible by Design or, failing this, by information given on the elements to be connected and, where appropriate, on the means of connection.		N.A
1.5.5	Extreme temperatures	-	N.A
	Steps must be taken to eliminate any risk of injury arising from contact with or proximity to machinery parts or materials at high or very low temperatures. The necessary steps must also be taken to avoid or protect against the risk of hot or very cold material being ejected.		N.A
1.5.6	Fire	-	N.A
	Machinery must be designed and constructed in such a way as to avoid any risk of fire or overheating posed by the machinery itself or by gases, liquids, dust, vapours or other substances produced or used by the machinery.		N.A
1.5.7	Explosion	-	N.A

	Machinery must be designed and constructed in such a way as to avoid any risk of explosion posed by the machinery itself or by gases, liquids, dust, vapours or other substances produced or used by the machinery. Machinery must comply, as far as the risk of explosion due to its use in a potentially explosive atmosphere is concerned, with the provisions of the specific Community Directives.		N.A
1.5.8	Noise	-	P
	Machinery must be designed and constructed in such a way that risks resulting from the emission of airborne noise are reduced to the lowest level, taking account of technical progress and the availability of means of reducing noise, in particular at source. The level of noise emission may be assessed with reference to comparative emission data for similar machinery.		P
1.5.9	Vibration	-	P
	Machinery must be designed and constructed in such a way that risks resulting from vibrations produced by the machinery are reduced to the lowest level, taking account of technical progress and the availability of means of reducing vibration, in particular at source. The level of vibration emission may be assessed with reference to comparative emission data for similar machinery.	Vibrations of this machine will not create any risk.	P
1.5.10	Radiation	-	P
	Undesirable radiation emissions from the machinery must be eliminated or be reduced to levels that do not have adverse effects on persons. Any functional ionising radiation emissions must be limited to the lowest level which is sufficient for the proper functioning of the machinery during setting, operation and cleaning. Where a risk exists, the necessary protective measures must be taken. Any functional non-ionising radiation emissions during setting, operation and cleaning must be limited to levels that do not have adverse effects on persons.		P
1.5.11	External radiation	-	N.A
	Machinery must be designed and constructed in such a way that external radiation does not interfere with its operation.		N.A
1.5.12	Laser radiation		N.A
	Where laser equipment is used, the following should be taken into account: — laser equipment on machinery must be designed and constructed in such a way as to prevent any accidental radiation, — laser equipment on machinery must be protected in such a way that effective radiation, radiation produced by reflection or diffusion and secondary radiation do not damage health, —optical equipment for the observation or adjustment of laser equipment on machinery must be such that no health risk is created by laser radiation.		N.A
1.5.13	Emissions of hazardous materials and substances	-	P
	Machinery must be designed and constructed in such a way that risks of inhalation, ingestion, contact with the skin, eyes and mucous membranes and		P

	penetration through the skin of hazardous materials and substances which it produces can be avoided. Where a hazard cannot be eliminated, the machinery must be so equipped that hazardous materials and substances can be contained, evacuated, precipitated by water spraying, filtered or treated by another equally effective method. Where the process is not totally enclosed during normal operation of the machinery, the devices for containment and/or evacuation must be situated in such a way as to have the maximum effect.		
1.5.14	Risk of being trapped in a machine Machinery must be designed, constructed or fitted with a means of preventing a person from being enclosed within it or, if that is impossible, with a means of summoning help.		N.A
1.5.15	Risk of slipping, tripping or falling		N.A
	Parts of the machinery where persons are liable to move about or stand must be designed and constructed in such a way as to prevent persons slipping, tripping or falling on or off these parts. Where appropriate, these parts must be fitted with handholds that are fixed relative to the user and that enable them to maintain their stability.		N.A
1.5.16	Lightning		N.A
	Machinery in need of protection against the effects of lightning while being used must be fitted with a system for conducting the resultant electrical charge to earth.		N.A
1.6	Maintenance	-	P
1.6.1	Machinery maintenance	-	P
	Adjustment and maintenance points must be located outside danger zones. It must be possible to carry out adjustment, maintenance, repair, cleaning and servicing operations while machinery is at a standstill. If one or more of the above conditions cannot be satisfied for technical reasons, measures must be taken to ensure that these operations can be carried out safely (see section 1.2.5). In the case of automated machinery and, where necessary, other machinery, a connecting device for mounting diagnostic fault-finding equipment must be provided. Automated machinery components which have to be changed frequently must be capable of being removed and replaced easily and safely. Access to the components must enable these tasks to be carried out with the necessary technical means in accordance with a specified operating method.	The design and construction of this machine are in conformity with this requirement.	P
1.6.2	Access to operating position and servicing points		P
	Machinery must be designed and constructed in such a way as to allow access in safety to all areas where intervention is necessary during operation, adjustment and maintenance of the machinery.		P
1.6.3	Isolation of energy sources	-	N.A
	Machinery must be fitted with means to isolate it from all energy sources. Such isolators must be clearly identified. They must be capable of being locked if reconnection could endanger persons. Isolators must		

	also be capable of being locked where an operator is unable, from any of the points to which he has access, to check that the energy is still cut off. In the case of machinery capable of being plugged into an electricity supply, removal of the plug is sufficient, provided that the operator can check from any of the points to which he has access that the plug remains removed. After the energy is cut off, it must be possible to dissipate normally any energy remaining or stored in the circuits of the machinery without risk to persons. As an exception to the requirement laid down in the previous paragraphs, certain circuits may remain connected to their energy sources in order, for example, to hold parts, to protect information, to light interiors, etc. In this case, special steps must be taken to ensure operator safety.		
1.6.4	Operator intervention	-	
	Machinery must be so designed, constructed and equipped that the need for operator intervention is limited. If operator intervention cannot be avoided, it must be possible to carry it out easily and safely.	The design and construction of this machine are in conformity with these requirements.	P
1.6.5	Cleaning of internal parts	-	
	The machinery must be designed and constructed in such a way that it is possible to clean internal parts which have contained dangerous substances or preparations without entering them; any necessary unblocking must also be possible from the outside. If it is impossible to avoid entering the machinery, it must be designed and constructed in such a way as to allow cleaning to take place safely.		P
1.7	Information	-	P
1.7.0	Information and warnings on the machinery	-	P
	Information and warnings on the machinery should preferably be provided in the form of readily understandable symbols or pictograms. Any written or verbal information and warnings must be expressed in an official Community language or languages, which may be determined in accordance with the Treaty by the Member State in which the machinery is placed on the market and/or put into service and may be accompanied, on request, by versions in any other official Community language or languages understood by the operators.	The information is identified clearly and can be easily under understood.	P
1.7.1.1	Information and information devices		P
	The information needed to control machinery must be provided in a form that is unambiguous and easily understood. It must not be excessive to the extent of overloading the operator. Visual display units or any other interactive means of communication between the operator and the machine must be easily understood and easy to use.		P
1.7.1.2	Warning devices	-	
	Where the health and safety of persons may be endangered by a fault in the operation of unsupervised machinery, the machinery must be equipped in such a way as to give an appropriate acoustic or light signal as a warning.	The warning devices comply with ergonomic principles.	P

	Where machinery is equipped with warning devices these must be unambiguous and easily perceived. The operator must have facilities to check the operation of such warning devices at all times. The requirements of the specific Community Directives concerning colours and safety signals must be complied with.		
1.7.2	Warning of residual risks	-	P
	Where risks remain despite the inherent safe design measures, safeguarding and complementary protective measures adopted, the necessary warnings, including warning devices, must be provided.		P
1.7.3	Marking of machinery	-	P
	All machinery must be marked visibly, legibly and indelibly with the following minimum particular：	-	P
	— the business name and full address of the manufacturer and, where applicable, his authorised representative, — designation of the machinery, — the CE Marking (see Annex III), — designation of series or type, — serial number, if any, — the year of construction, that is the year in which the manufacturing process is completed.		P
	It is prohibited to pre-date or post-date the machinery when affixing the CE marking. Furthermore, machinery designed and constructed for use in a potentially explosive atmosphere must be marked accordingly. Machinery must also bear full information relevant to its type and essential for safe use. Such information is subject to the requirements set out in section 1.7.1. Where a machine part must be handled during use with lifting equipment, its mass must be indicated legibly, indelibly and unambiguously.		P
1.7.4	Instruction	-	P
	All machinery must be accompanied by instructions in the official Community language or languages of the Member State in which it is placed on the market and/or put into service. The instructions accompanying the machinery must be either ‘Original instructions’ or a ‘Translation of the original instructions’, in which case the translation must be accompanied by the original instructions. By way of exception, the maintenance instructions intended for use by specialised personnel mandated by the manufacturer or his authorised representative may be supplied in only one Community language which the specialised personnel understand. The instructions must be drafted in accordance with the principles set out below.		P
1.7.4.1	General principles for the drafting of instructions	-	P
	(a) The instructions must be drafted in one or more official Community languages. The words ‘Original instructions’ must appear on the language version(s) verified by the manufacturer or his authorised representative. (b) Where no ‘Original instructions’ exist in the official	All related information have been provided within the instruction manual	P

	language(s) of the country where the machinery is to be used, a translation into that/those language(s) must be provided by the manufacturer or his authorized representative or by the person bringing the machinery into the language area in question. The translations must bear the words 'Translation of the original instructions'. (c) The contents of the instructions must cover not only the intended use of the machinery but also take into account any reasonably foreseeable misuse thereof. (d) In the case of machinery intended for use by non-professional operators, the wording and layout of the instructions for use must take into account the level of general education and acumen that can reasonably be expected from such operators.		
1.7.4.2	Contents of the instructions	All related information has been provided within the instruction manual.	P
	Each instruction manual must contain, where applicable, at least the following information: (a) the business name and full address of the manufacturer and of his authorized representative; (b) the designation of the machinery as marked on the machinery itself, except for the serial number (see section 1.7.3); (c) the EC declaration of conformity, or a document setting out the contents of the EC declaration of conformity, showing the particulars of the machinery, not necessarily including the serial number and the signature; (d) a general description of the machinery; (e) the drawings, diagrams, descriptions and explanations necessary for the use, maintenance and repair of the machinery and for checking its correct functioning; (f) a description of the workstation(s) likely to be occupied by operators; (g) a description of the intended use of the machinery; (h) warnings concerning ways in which the machinery must not be used that experience has shown might occur; (i) assembly, installation and connection instructions, including drawings, diagrams and the means of attachment and the designation of the chassis or installation on which the machinery is to be mounted; (j) instructions relating to installation and assembly for reducing noise or vibration; (k) instructions for the putting into service and use of the machinery and, if necessary, instructions for the training of operators; (l) information about the residual risks that remain despite the inherent safe design measures, safeguarding and complementary protective measures adopted; (m) instructions on the protective measures to be taken by the user, including, where appropriate, the personal protective equipment to be provided; (n) the essential characteristics of tools which may be fitted to the machinery;	All related information has been provided within the instruction manual.	P

	(o) the conditions in which the machinery meets the requirement of stability during use, transportation, assembly, dismantling when out of service, testing or foreseeable breakdowns; (p) instructions with a view to ensuring that transport, handling and storage operations can be made safely, giving the mass of the machinery and of its various parts where these are regularly to be transported separately; (q) the operating method to be followed in the event of accident or breakdown; if a blockage is likely to occur, the operating method to be followed so as to enable the equipment to be safely unblocked; (r) the description of the adjustment and maintenance operations that should be carried out by the user and the preventive maintenance measures that should be observed; (s) instructions designed to enable adjustment and maintenance to be carried out safely, including the protective measures that should be taken during these operations; (t) the specifications of the spare parts to be used, when these affect the health and safety of operators; (u) the following information on airborne noise emissions: — the A-weighted emission sound pressure level at workstations, where this exceeds 70 dB(A); where this level does not exceed 70 dB(A), this fact must be indicated, — the peak C-weighted instantaneous sound pressure value at workstations, where this exceeds 63 Pa (130 dB in relation to 20 μPa), — the A-weighted sound power level emitted by the machinery, where the A-weighted emission sound pressure level at workstations exceeds 80 dB(A). These values must be either those actually measured for the machinery in question or those established on the basis of measurements taken for technically comparable machinery which is representative of the machinery to be produced. In the case of very large machinery, instead of the A-weighted sound power level, the A-weighted emission sound pressure levels at specified positions around the machinery may be indicated. Where the harmonized standards are not applied, sound levels must be measured using the most appropriate method for the machinery. Whenever sound emission values are indicated the uncertainties surrounding these values must be specified. The operating conditions of the machinery during measurement and the measuring methods used must be described. Where the workstation(s) are undefined or cannot be defined, A-weighted sound pressure levels must be measured at a distance of 1 metre from the surface of the machinery and at a height of 1,6 metres from the floor or access platform. The position and value of the maximum sound pressure must be indicated. Where specific Community Directives lay down other		

	requirements for the measurement of sound pressure levels or sound power levels, those Directives must be applied and the corresponding provisions of this section shall not apply; (v) where machinery is likely to emit non-ionising radiation which may cause harm to persons, in particular persons with active or non-active implantable medical devices, information concerning the radiation emitted for the operator and exposed persons.		
1.7.4.3	Sales literature		P
	Sales literature describing the machinery must not contradict the instructions as regards health and safety aspects. Sales literature describing the performance characteristics of machinery must contain the same information on emissions as is contained in the instructions.		P
2	Supplementary essential health and safety requirements for certain categories of machinery	Not applicable.	N.A
3	Supplementary essential health and safety requirements to offset hazards due to the mobility of machinery		N.A
4	Supplementary essential health and safety requirements to offset hazards due to lifting operations	Not applicable.	N.A
5	Supplementary essential health and safety requirements for machinery intended for underground work	Not applicable.	N.A
6	Supplementary essential health and safety requirements for machinery presenting particular hazards due to the lifting of persons	Not applicable.	N.A

2.2 Risk assessment

This risk assessment report is based on the methods in the EN ISO12100 standards, and the 4 factors S-A-G-W have been used for evaluating the level of risks.

S：Severity of possible harm

-S1：Slight（normally reversible）
-S2：Serious（normally irreversible）
-S3：Cause a few men die
-S4：Calamity or cause many men die

A：Frequency any duration of exposure

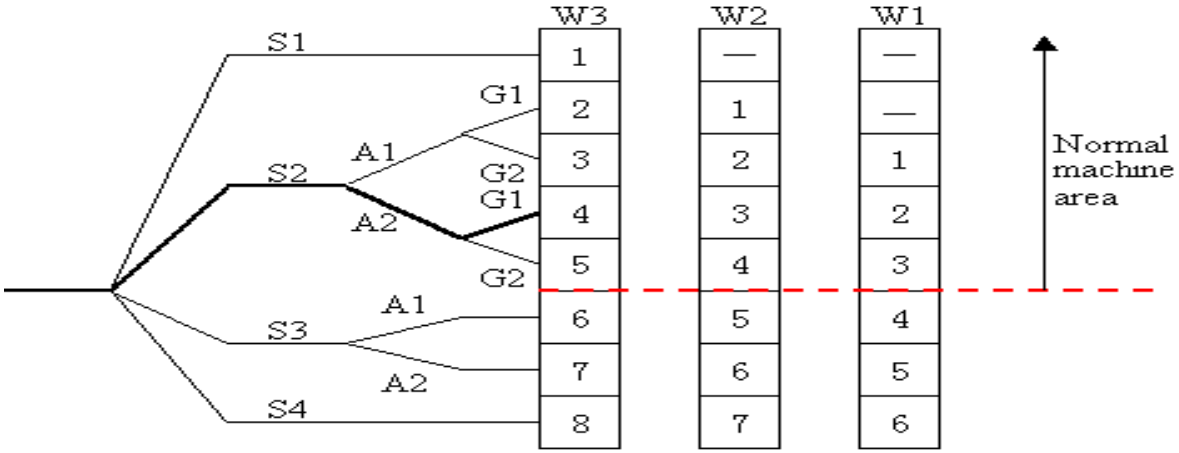
-A1：Seldom to very often
-A2：Frequent to continuous

G：Possibilities of avoidance

-G1：Possible
-G2：Impossible

W：Probability of occurrence of harm

-W1：Low
-W2：Medium
-W3：High



Solutions for the level of hazards

1：Protected by warning sign

2：Protected by guard and warning sign

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

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

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

No.	Hazards source	Hazards occuring	S	A	G	W	Level	Control means	S	A	G	W	Level
Harzards, hazardous situations and hazardous events													
1	**Mechanical hazards 机械危险**	/	/	/	/	/	/	/	/	/	/	/	/
1.0	Mechanical hazards due to machine parts or work pieces e.g.: a) shape b) relative location c) mass and stability (potential energy of elements which may move under the effect of gravity kinetic energy of gravity) d) mass and velocity (kinetic energy of gravity) e) inadequacy of mechanical strength	working	S2	A1	G2	W2	2	1.Design 2. Add warning sign	S1	A1	G1	W1	1
	Mechanical hazards due to accumulation of energy inside the machinery e.g. f) elastic elements (springs) g) liquids and gases under pressure h) the effect of vacuum	N/A											
1.1	Crushing	N/A											
1.2	Shearing	N/A											
1.3	Cutting or severing	N/A											
1.4	Entanglement	working	S2	A1	G1	W3	2	1.Design, 2. Add warning sign	S1	A1	G1	W1	1
1.5	Drawing-in or trapping	N/A											

No.	Hazards source	Hazards occuring	S	A	G	W	Level	Control means	S	A	G	W	Level
1.6	Impact	N/A											
1.7	Stabbing or puncture	N/A											
1.8	Friction or abrasion	N/A											
1.9	High pressure fluid injection or ejection	N/A											
2	**Electrical hazards 电气危险**	/	/	/	/	/	/	/	/	/	/	/	/
2.1	Contact of persons with live parts	working	S2	A1	G1	W3	2	1.Design, 2. Add warning sign	S1	A1	G1	W1	1
2.2	Contact with parts which have become live under faulty conditions	working	S2	A1	G1	W3	2	1.Design, 2. Add warning sign	S1	A1	G1	W1	1
2.3	Approach to live part under high voltage	working	S2	A1	G1	W3	2	1.Design, 2. Add warning sign	S1	A1	G1	W1	1
2.4	Electrostatic phenomena	N/A											
2.5	Thermal radiation or other phenomena such as projection of molten particles and chemical effects from short-circuits, overloads etc.	working	S2	A1	G1	W3	2	1.Design, 2. Add warning sign	S1	A1	G1	W1	1
3	**Thermal hazards 热危险**	/	/	/	/	/	/	/	/	/	/	/	/
3.1	Burns ,scalds and other injuries by a possible contact of persons with objects or materials with an extreme high or low temperature, by flames or explosions and also by the radiation of heat sources	working	S2	A1	G1	W3	2	1.Design, 2. Add warning sign	S1	A1	G1	W1	1
3.2	Damage to health by hot or cold working environment	N/A											

No.	Hazards source	Hazards occuring	S	A	G	W	Level	Control means	S	A	G	W	Level
4	**Hazards generated by noise 噪声危害**	/	/	/	/	/	/	/	/	/	/	/	/
4.1	Hearing loss (deafness), other physiological disorders	working	S2	A1	G1	W3	2	1.Design, 2. Add warning sign	S1	A1	G1	W1	1
4.2	Interference with speech communication, acoustic signals, etc.	N/A											
5	**Hazards generated by vibration 振动危险**	/	/	/	/	/	/	/	/	/	/	/	/
5.1	Use of hand-held machines resulting in a variety of neurological and vascular disorder	N/A											
5.2	Whole body vibration, particular when combined with poor postures	N/A											
6	**Hazards generated by radiation 辐射危险**	/	/	/	/	/	/	/	/	/	/	/	/
6.1	Low frequency, radio frequency radiation, microwaves	N/A											
6.2	Infrared, visible and ultraviolet light	N/A											-
6.3	X and gamma rays	N/A											
6.4	Alpha, beta rays, electron or ion beams, neutrons	N/A											
6.5	Lasers	N/A											
7	**Hazards generated by materials and substances processed or used by the machinery 机器的材料或加工产品材料的危害**	/	/	/	/	/	/	/	/	/	/	/	/

No.	Hazards source	Hazards occuring	S	A	G	W	Level	Control means	S	A	G	W	Level
7.1	Hazards from contact with or inhalation of harmful fluids, gases, mists, fumes and dusts	N/A											
7.2	Fire and explosion hazard	N/A											
7.3	Biological and micro-biological (viral or bacterial) hazards	N/A											
8	**Hazards generated by neglecting ergonomic principles in machine design as 不符合人体工学的危害**	/	/	/	/	/	/	/	/	/	/	/	/
8.1	Unhealthy postures or excessive effort	N/A											
8.2	Inadequate consideration of hand-arm or foot-leg anatomy	N/A											
8.3	Neglected use of personal protection equipment	N/A											
8.4	Inadequate local lighting	N/A											
8.5	Mental overload or under load, stress	N/A											
8.6	Human error, human behavior	N/A											
8.7	Inadequate design, location or identification of manual controls	N/A											
8.8	Inadequate design or location of visual display units	N/A											
9	**Combination of hazards 综合危害**	N/A											

No.	Hazards source	Hazards occuring	S	A	G	W	Level	Control means	S	A	G	W	Level
10	**Unexpected start-up, unexpected overrun/over-speed(or any similar malfunction) from:非正常启动或过载（飞车）危害**	/	/	/	/	/	/	/	/	/	/	/	/
10.1	Failure/disorder of the control system	working	S2	A2	G1	W2	3	1.Optimize design	S1	A1	G1	W1	1
10.2	Restoration of energy supply after an interruption	N/A											
10.3	External influences on electrical equipment	N/A											
10.4	Other external influences (gravity, wind, etc.)	N/A											
10.5	Errors in the software	N/A											
10.6	Errors made by the operator (due to mismatch of machinery with human characteristics and abilities, see 8.6)	N/A											
11	**Impossibility of stopping the machine in the best possible conditions**	N/A											
12	**Variations in the rotational speed of tools**	N/A											
13	**Failure of the power supply**	N/A											
14	**Failure of the control circuit**	N/A											
15	**Errors of fitting**	N/A											
16	**Break-up during operation**	N/A											

No.	Hazards source	Hazards occuring	S	A	G	W	Level	Control means	S	A	G	W	Level
17	Falling or ejected objects or fluids	N/A											
18	Loss of stability / overturning of machinery	N/A											
19	Slip, trip and fall of persons (related to machinery)	N/A											
Additional hazards hazardous situations and hazards events due to mobility													
20	Relating to the travelling function	N/A											
21	Linked to the work position (including driving station) on the machine	N/A											
22	Due to the control system	N/A											
24	Due to the power source and to the transmission of power	N/A											
25	From/to third persons	N/A											
26	Insufficient instructions for the driver/operator	N/A											
Additional hazards, hazardous situations and hazardous events due to lifting													
27	Mechanical hazards and hazardous events	N/A											
28	From lightning	N/A											
29	Hazards generated by neglecting ergonomic principles	N/A											
Additional hazards, hazardous situations and hazardous events due to underground work													

No.	Hazards source	Hazards occuring	S	A	G	W	Level	Control means	S	A	G	W	Level
30	**Mechanical hazards and hazardous events due to:**	N/A											
31	**Restricted movement of persons**	N/A											
32	**Fire and explosion**	N/A											
33	**Emission of dust, gases etc.**	N/A						1.					
Additional hazards, hazardous situations and hazardous events due to the lifting or moving of persons													
34	**Mechanical hazards and hazardous events due to:**	N/A											
35	**Falling of person from person carrier**	N/A											
36	**Falling or overturning of person carrier**	N/A											
37	**Human error, human behavior**	N/A											

Part III ： Test report

TEST REPORT

Report No.: HA2307-116

Jinan Handa Machinery Co., Ltd.

Workshop 4-B-4 Zhongdianjian Energy Industrial Park, No. 5577 North Gongye Road, Jinan City, Shandong Province, China.

TEST REPORT

2006/42/EC
MACHINERY DIRECTIVE, ANNEX I ESSENTIAL HEALTH AND SAFETY REQUIREMENTS
BS EN ISO 12100:2010
SAFETY OF MACHINERY - GENERAL PRINCIPLES FOR DESIGN - RISK ASSESSMENT AND RISK REDUCTION
BS EN 60204-1:2018
SAFETY OF MACHINERY- ELECTRICAL EQUIPMENT OF MACHINES - PART 1: GENERAL REQUIREMENTS

Report reference No......:	HA2307-116
Applicant's Name.....:	Jinan Handa Machinery Co., Ltd.
Address.....:	Workshop 4-B-4 Zhongdianjian Energy Industrial Park, No. 5577 North Gongye Road, Jinan City, Shandong Province, China.
Manufacturer.....:	Same as applicant
Address.....:	
Trademark.....:	/
Product description.....:	Welding Rotator
Model and/or type reference.....:	HDTR-1000, HDTR-3000, ZT-5, ZT-10, ZT-20, ZT-30, ZT-40, ZT-50, ZT-60, ZT-100, KT-5, KT-10, KT-20, KT-40, KT-60, KT-80, KT-100
Electrical ratings.....:	220~230V 50/60Hz
Test specification	
Standard.....:	BS EN ISO 12100:2010 BS EN 60204-1:2018
Test procedure.....:	MD & LVD
Result.....:	Requirement passed
Non-standard test method.....:	N.A
Tested by (printed name and signature).....:	Jiang Ping
Approved by (printed name and signature).....:	Chen Jian
Date of issue.....:	17.07.2023

济南焊达机械有限公司 JINAN HANDA MACHINERY CO., LTD

Test case verdicts

Test item does not apply to the test object……..: N.A (Not Applicable)

Test item does meet the requirement……..: P(Pass)

Test item does meet the requirement……..: F(Fail)

Testing

General product information:

General remarks:

The test result presented in this report relate only to the object(s) tested.

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

"(see Annex #)" refers to additional information appended to the report.

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

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

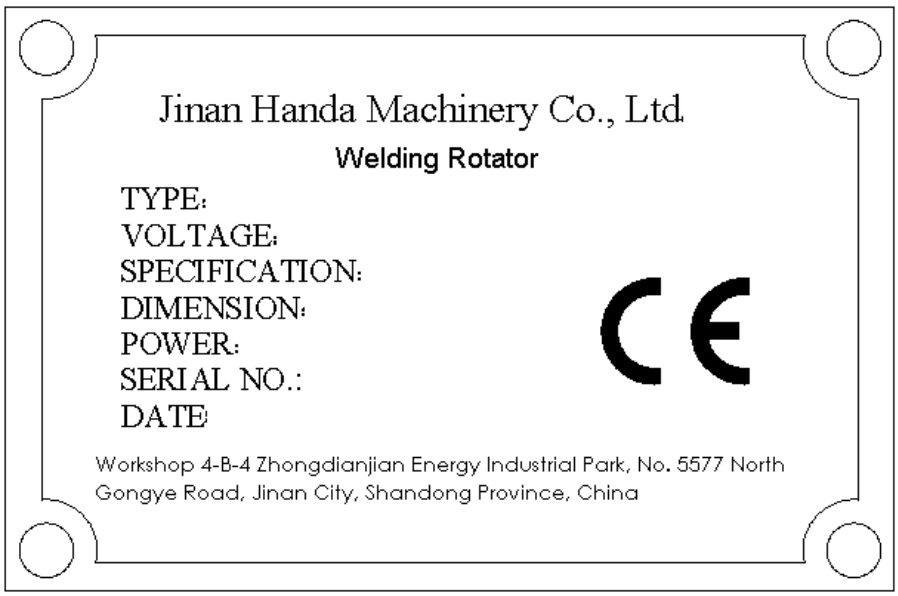
The report including:

2006/42/EC Machinery Directive, Annex I Essential Health and Safety Requirements

BS EN ISO 12100:2010

BS EN 60204-1:2018

Nameplate



Checklist: 2006/42/EC Machinery Directive, Annex I Essential Health and Safety Requirements					
No.	Requirements	OK	No	N.A	remarks
1	Essential health and safety requirements				
1.1	General remarks				
1.1.2	Principles of safety integration				
	(a) Machinery must be designed and constructed so that it is fitted for its function, and can be operated, adjusted and maintained without putting persons at risk when these operations are carried out under the conditions foreseen but also taking into account any reasonably foreseeable misuse thereof.	X			EN ISO 12100
	The aim of measures taken must be to eliminate any risk throughout the foreseeable lifetime of the machinery including the phases of transport, assembly, dismantling, disabling and scrapping.	X			EN ISO 12100
	(b) Following principles applied				
	- elimination and reduction of risks as far as possible (inherently safe machinery design and construction),	X			EN ISO 12100, 4
	- the necessary protection measures are taken in relation to risks that cannot be eliminated,	X			EN ISO 12100, 6.3
	- information for users of the residual risks due to any shortcomings of the protection measures adopted, indication whether any particular training is required and specification of any need to provide personal protection equipment.	X			EN ISO 12100, 6.4
	(c) When designing and constructing machinery and when drafting the instructions, the manufacturer or his authorised representative must envisage not only the intended use of the machinery but also any reasonably foreseeable misuse thereof.	X			EN ISO 12100, 6.2 & 6.4
	The machinery must be designed and constructed in such a way as to prevent abnormal use if such use would engender a risk. Where appropriate, the instructions must draw the user's attention to ways — which experience has shown might occur — in which the machinery should not be used.	X			EN ISO 12100, 6.2 & 6.4
	(d) Machinery must be designed and constructed to take account of the constraints to which the operator is subject as a result of the necessary or foreseeable use of personal protective equipment.	X			EN ISO 12100, 6.2
	(e) Machinery must be supplied with all the special equipment and accessories essential to enable it to be adjusted, maintained and used safely.	X			EN ISO 12100, 6.2
1.1.3	Materials and products				

Checklist: 2006/42/EC Machinery Directive, Annex I Essential Health and Safety Requirements					
No.	Requirements	OK	No	N.A	remarks
	The materials used to construct machinery or products used or created during its use must not endanger persons' safety or health.	X			EN ISO 12100, 6.2, 6.3
	In particular, where fluids are used, machinery must be designed and constructed to prevent risks due to filling, use, recovery or draining.	X			EN ISO 12100,6.2
1.1.4	Lighting				
	Machinery must be supplied with integral lighting suitable for the operations concerned where the absence thereof is likely to cause a risk despite ambient lighting of normal intensity.			X	EN ISO 12100, 6.2 No integral lighting
	Machinery must be designed and constructed so that there is no area of shadow likely to cause nuisance, that there is no irritating dazzle and that there are no dangerous stroboscopic effects on moving parts due to the lighting.			X	EN ISO 12100, 6.3
	Internal parts requiring frequent inspection and adjustment, and maintenance areas must be provided with appropriate lighting.			X	EN ISO 12100, 6.2 No integral lighting
1.1.5	Design of machinery to facilitate its handling				
	Machinery, or each component part thereof, must:				
	— be capable of being handled and transported safely,	X			EN ISO 12100, 6.2 & 6.4
	— be packaged or designed so that it can be stored safely and without damage.	X			See above
	During the transportation of the machinery and/or its component parts, there must be no possibility of sudden movements or of hazards due to instability as long as the machinery and/or its component parts are handled in accordance with the instructions.	X			EN ISO 12100, 6.3 & 6.4
	Where the weight, size or shape of machinery or its various component parts prevents them from being moved by hand, the machinery or each component part must:				
	— either be fitted with attachments for lifting gear, or	X			EN ISO 12100, 6.3 & 6.4
	— be designed so that it can be fitted with such attachments, or			X	
	— be shaped in such a way that standard lifting gear can easily be attached.			X	See above
	Where machinery or one of its component parts is to be moved by hand, it must:				

Checklist: 2006/42/EC Machinery Directive, Annex I Essential Health and Safety Requirements					
No.	Requirements	OK	No	N.A	remarks
	— either be easily moveable, or			X	Not moved by hand
	— be equipped for picking up and moving safely.			X	See above
	Special arrangements must be made for the handling of tools and/or machinery parts which, even if lightweight, could be hazardous.			X	EN ISO 12100,6.2
1.1.6	Ergonomics				
	Under the intended conditions of use, the discomfort, fatigue and physical and psychological stress faced by the operator must be reduced to the minimum possible, taking into account ergonomic principles such as:				
	— allowing for the variability of the operator's physical dimensions, strength and stamina,	X			EN ISO 12100, 6.2 & 6.3
	— providing enough space for movements of the parts of the operator's body,	X			EN ISO 12100, 6.2 & 6.3
	— avoiding a machine-determined work rate,	X			EN ISO 12100, 6.2 & 6.3
	— avoiding monitoring that requires lengthy concentration,	X			EN ISO 12100, 6.2 & 6.3
	— adapting the man/machinery interface to the foreseeable characteristics of the operators.	X			EN ISO 12100, 6.2 & 6.3
1.1.7	Operating positions				
	The operating position must be designed and constructed in such a way as to avoid any risk due to exhaust gases and/or lack of oxygen.			X	No exhaust gases and/or lack of oxygen
	If the machinery is intended to be used in a hazardous environment presenting risks to the health and safety of the operator or if the machinery itself gives rise to a hazardous environment, adequate means must be provided to ensure that the operator has good working conditions and is protected against any foreseeable hazards.			X	
	Where appropriate, the operating position must be fitted with an adequate cabin designed, constructed and/or equipped to fulfil the above requirements.			X	See above
	The exit must allow rapid evacuation. Moreover, when applicable, an emergency exit must be provided in a direction which is different from the usual exit.			X	See above
1.1.8	Seating				
	Where appropriate and where the working conditions so permit, work stations constituting an integral part of the machinery must be designed for the installation of			X	No seats

	seats.				
	If the operator is intended to sit during operation and the operating position is an integral part of the machinery, the seat must be provided with the machinery.			X	See above
	The operator's seat must enable him to maintain a stable position. Furthermore, the seat and its distance from the control devices must be capable of being adapted to the operator.			X	See above
	If the machinery is subject to vibrations, the seat must be designed and constructed in such a way as to reduce the vibrations transmitted to the operator to the lowest level that is reasonably possible.			X	See above
	The seat mountings must withstand all stresses to which they can be subjected. Where there is no floor beneath the feet of the operator, footrests covered with a slip-resistant material must be provided.			X	See above
1.2	Control Systems	To be evaluated at installation			
1.2.1	Safety and reliability of control systems				
	Control systems must be designed and constructed in such a way as to prevent hazardous situations from arising. Above all, they must be designed and constructed in such a way that:				
	— they can withstand the intended operating stresses and external influences,			X	EN ISO 12100, 6.2; EN 60204-1, 9 to 12
	— a fault in the hardware or the software of the control system does not lead to hazardous situations,			X	EN ISO 12100, 6.2
	— errors in the control system logic do not lead to hazardous situations,			X	See above
	— reasonably foreseeable human error during operation does not lead to hazardous situations.			X	EN ISO 12100, 6.2 & 6.3
	Particular attention must be given to the following points:				
	— the machinery must not start unexpectedly,			X	EN ISO 12100, 6.2; EN 60204-1:2006, 9.2
	— the parameters of the machinery must not change in an uncontrolled way, where such change may lead to hazardous situations,			X	See above
	— the machinery must not be prevented from stopping if the stop command has already been given,			X	See above
	— no moving part of the machinery or piece held by			X	See above

	the machinery must fall or be ejected,				
	— automatic or manual stopping of the moving parts, whatever they may be, must be unimpeded,			X	See above
	— the protective devices must remain fully effective or give a stop command,			X	See above
	— the safety-related parts of the control system must apply in a coherent way to the whole of an assembly of machinery and/or partly completed machinery.			X	See above
	For cable-less control, an automatic stop must be activated when correct control signals are not received, including loss of communication.			X	See above
1.2.2	Control devices	Provided by user			
	Control devices must be:				
	— clearly visible and identifiable, using pictograms where appropriate,			X	EN ISO 12100, 6.2; EN 60204-1, 9 to 12
	— positioned in such a way as to be safely operated without hesitation or loss of time and without ambiguity,			X	See above
	— designed in such a way that the movement of the control device is consistent with its effect,			X	See above
	— located outside the danger zones, except where necessary for certain control devices such as an emergency stop or a teach pendant,			X	See above
	— positioned in such a way that their operation cannot cause additional risk,			X	See above
	— designed or protected in such a way that the desired effect, where a hazard is involved, can only be achieved by a deliberate action,			X	See above
	— made in such a way as to withstand foreseeable forces; particular attention must be paid to emergency stop devices liable to be subjected to considerable forces.			X	See above
	Where a control device is designed and constructed to perform several different actions, namely where there is no one-to-one correspondence, the action to be performed must be clearly displayed and subject to confirmation, where necessary.			X	See above
	Control devices must be so arranged that their layout, travel and resistance to operation are compatible with the action to be performed, taking account of ergonomic principles.			X	See above
	Machinery must be fitted with indicators as required			X	See above

	for safe operation. The operator must be able to read them from the control position.				
	From each control position, the operator must be able to ensure that no-one is in the danger zones, or the control system must be designed and constructed in such a way that starting is prevented while someone is in the danger zone.			X	See above
	If neither of these possibilities is applicable, before the machinery starts, an acoustic and/or visual warning signal must be given. The exposed persons must have time to leave the danger zone or prevent the machinery starting up.			X	See above
	If necessary, means must be provided to ensure that the machinery can be controlled only from control positions located in one or more predetermined zones or locations.			X	See above
	Where there is more than one control position, the control system must be designed in such a way that the use of one of them precludes the use of the others, except for stop controls and emergency stops.			X	See above
	When machinery has two or more operating positions, each position must be provided with all the required control devices without the operators hindering or putting each other into a hazardous situation.			X	See above
1.2.3	Starting				
	It must be possible to start machinery only by voluntary actuation of a control device provided for the purpose.			X	EN ISO 12100, 6.2; EN 60204-1:2006, 7.5
	The same requirement applies:				
	— when restarting the machinery after a stoppage, whatever the cause,			X	EN ISO 12100, 6.2
	— when effecting a significant change in the operating conditions.			X	EN ISO 12100, 6.2
	However, the restarting of the machinery or a change in operating conditions may be effected by voluntary actuation of a device other than the control device provided for the purpose, on condition that this does not lead to a hazardous situation.			X	EN ISO 12100, 6.2; EN 60204-1:2006, 7.5
	For machinery functioning in automatic mode, the starting of the machinery, restarting after a stoppage, or a change in operating conditions may be possible without intervention, provided this does not lead to a			X	EN ISO 12100, 6.2

	hazardous situation.				
	Where machinery has several starting control devices and the operators can therefore put each other in danger, additional devices must be fitted to rule out such risks.			X	EN ISO 12100, 6.2
	If safety requires that starting and/or stopping must be performed in a specific sequence, there must be devices which ensure that these operations are performed in the correct order.			X	EN ISO 12100, 6.2; EN 60204-1:2006, 7.5
1.2.4	Stopping				
1.2.4.1	Normal stop				
	Machinery must be fitted with a control device whereby the machinery can be brought safely to a complete stop.			X	EN ISO 12100, 6.2; EN 60204-1, 9 to 12
	Each workstation must be fitted with a control device to stop some or all of the functions of the machinery, depending on the existing hazards, so that the machinery is rendered safe.			X	See above
	The machinery's stop control must have priority over the start controls.			X	See above
	Once the machinery or its hazardous functions have stopped, the energy supply to the actuators concerned must be cut off.			X	See above
1.2.4.2	Operational stop				
	Where, for operational reasons, a stop control that does not cut off the energy supply to the actuators is required, the stop condition must be monitored and maintained.			X	EN ISO 12100, 6.2; EN 60204-1, 9 to 12
1.2.4.3	Emergency stop				
	Machinery must be fitted with one or more emergency stop devices to enable actual or impending danger to be averted.			X	EN ISO 12100, 6.2; EN 60204-1, 9 to 12
	The following exceptions apply:				
	— machinery in which an emergency stop device would not lessen the risk, either because it would not reduce the stopping time or because it would not enable the special measures required to deal with the risk to be taken,			X	See above
	— portable hand-held and/or hand-guided machinery.			X	See above
	The device must:				
	— have clearly identifiable, clearly visible and quickly			X	EN ISO 12100, 6.2;

	accessible control devices,				EN 60204-1, 9 to 12
	— stop the hazardous process as quickly as possible, without creating additional risks,			X	See above
	— where necessary, trigger or permit the triggering of certain safeguard movements.			X	See above
	Once active operation of the emergency stop device has ceased following a stop command,				
	— that command must be sustained by engagement of the emergency stop device until that engagement is specifically overridden;			X	See above
	— it must not be possible to engage the device without triggering a stop command;			X	See above
	— it must be possible to disengage the device only by an appropriate operation, and disengaging the device must not restart the machinery but only permit restarting.			X	See above
	The emergency stop function must be available and operational at all times, regardless of the operating mode.			X	See above
	Emergency stop devices must be a back-up to other safeguarding measures and not a substitute for them.			X	See above
1.2.4.4	Assembly of machinery				
	In the case of machinery or parts of machinery designed to work together, the machinery must be designed and constructed in such a way that the stop controls, including the emergency stop devices, can stop not only the machinery itself but also all related equipment, if its continued operation may be dangerous.			X	EN ISO 12100, 6.2; EN 60204-1, 9 to 12
1.2.5	Selection of control or operating modes				
	The control or operating mode selected must override all other control or operating modes, with the exception of the emergency stop.			X	EN ISO 12100, 6.2; EN 60204-1, 9.2.4
	If machinery has been designed and constructed to allow its use in several control or operating modes requiring different protective measures and/or work procedures, it must be fitted with a mode selector which can be locked in each position.			X	See above
	Each position of the selector must be clearly identifiable and must correspond to a single operating or control mode.			X	See above
	The selector may be replaced by another selection			X	See above

	method which restricts the use of certain functions of the machinery to certain categories of operator.				
	If, for certain operations, the machinery must be able to operate with a guard displaced or removed and/or a protective device disabled, the control or operating mode selector must simultaneously:				
	— disable all other control or operating modes,			X	See above
	— permit operation of hazardous functions only by control devices requiring sustained action,			X	See above
	— permit the operation of hazardous functions only in reduced risk conditions while preventing hazards from linked sequences,			X	See above
	— prevent any operation of hazardous functions by voluntary or involuntary action on the machine's sensors.			X	See above
	If these four conditions cannot be fulfilled simultaneously, the control or operating mode selector must activate other protective measures designed and constructed to ensure a safe intervention zone.			X	See above
	In addition, the operator must be able to control operation of the parts he is working on from the adjustment point.			X	See above
1.2.6	Failure of the power supply				
	The interruption, the re-establishment after an interruption or the fluctuation in whatever manner of the power supply to the machinery must not lead to dangerous situations.			X	EN ISO 12100, 6.2
	Particular attention must be given to the following points:				
	— the machinery must not start unexpectedly,			X	See above
	— the parameters of the machinery must not change in an uncontrolled way when such change can lead to hazardous situations,			X	See above
	— the machinery must not be prevented from stopping if the command has already been given,			X	See above
	— no moving part of the machinery or piece held by the machinery must fall or be ejected,			X	See above
	— automatic or manual stopping of the moving parts, whatever they may be, must be unimpeded,			X	See above
	— the protective devices must remain fully effective or give a stop command.			X	See above

Checklist: 2006/42/EC Machinery Directive, Annex I Essential Health and Safety Requirements					
No.	Requirements	OK	No	N.A	remarks
1.3	Protection against mechanical hazards				
1.3.1	Loss of stability				
	Machinery and its components and fittings must be stable enough to avoid overturning, falling or uncontrolled movements during transportation, assembly, dismantling and any other action involving the machinery.	X			EN ISO 12100, 6.2 & 6.3
	If the shape of the machinery itself or its intended installation does not offer sufficient stability, appropriate means of anchorage must be incorporated and indicated in the instructions.	X			See above
1.3.2	Risk of break-up during operation				
	The various parts of machinery and their linkages must be able to withstand the stresses to which they are subject when used.	X			EN ISO 12100, 6.2 & 6.3
	The durability of the materials used must be adequate for the nature of the working environment foreseen by the manufacturer or his authorised representative, in particular as regards the phenomena of fatigue, ageing, corrosion and abrasion.	X			See above
	The instructions must indicate the type and frequency of inspections and maintenance required for safety reasons. They must, where appropriate, indicate the parts subject to wear and the criteria for replacement.	X			EN ISO 12100, 6.2 & 6.3
	Where a risk of rupture or disintegration remains despite the measures taken, the parts concerned must be mounted, positioned and/or guarded in such a way that any fragments will be contained, preventing hazardous situations.	X			EN ISO 12100, 6.2 & 6.3
	Both rigid and flexible pipes carrying fluids, particularly those under high pressure, must be able to withstand the foreseen internal and external stresses and must be firmly attached and/or protected to ensure that no risk is posed by a rupture.			X	
	Where the material to be processed is fed to the tool automatically, the following conditions must be fulfilled to avoid risks to persons:				
	— when the workpiece comes into contact with the tool, the latter must have attained its normal working condition,			X	EN ISO 12100, 6.2 & 6.3
	— when the tool starts and/or stops (intentionally or accidentally), the feed movement and the tool			X	See above

	movement must be coordinated.				
1.3.3	Risks due to falling or ejected objects				
	Precautions must be taken to prevent risks from falling or ejected objects.	X			EN ISO 12100,6.3
1.3.4	Risks due to surfaces, edges or angles				
	Insofar as their purpose allows, accessible parts of the machinery must have no sharp edges, no sharp angles and no rough surfaces likely to cause injury.	X			EN ISO 12100, 6.2 & 6.3
1.3.5	Risks related to combined machinery				
	Where the machinery is intended to carry out several different operations with manual removal of the piece between each operation (combined machinery), it must be designed and constructed in such a way as to enable each element to be used separately without the other elements constituting a risk for exposed persons.			X	EN ISO 12100, 6.2
	For this purpose, it must be possible to start and stop separately any elements that are not protected.			X	See above
1.3.6	Risks related to variations in operating conditions				
	Where the machinery performs operations under different conditions of use, it must be designed and constructed in such a way that selection and adjustment of these conditions can be carried out safely and reliably.	X			EN ISO 12100, 6.2、6.3、6.4
1.3.7	Risks related to moving parts				
	The moving parts of machinery must be designed and constructed in such a way as to prevent risks of contact which could lead to accidents or must, where risks persist, be fitted with guards or protective devices.	X			EN ISO 12100, 6.2、6.3
	All necessary steps must be taken to prevent accidental blockage of moving parts involved in the work. In cases where, despite the precautions taken, a blockage is likely to occur, the necessary specific protective devices and tools must, when appropriate, be provided to enable the equipment to be safely unblocked.	X			EN ISO 12100, 6.4
	The instructions and, where possible, a sign on the machinery shall identify these specific protective devices and how they are to be used.	X			EN ISO 12100, 6.4
1.3.8	Choice of protection against risks arising from moving parts				

Checklist: 2006/42/EC Machinery Directive, Annex I Essential Health and Safety Requirements					
No.	Requirements	OK	No	N.A	remarks
	Guards or protective devices designed to protect against risks arising from moving parts must be selected on the basis of the type of risk. The following guidelines must be used to help to make the choice.	X			EN ISO 12100, 6.3
1.3.8.1	Moving transmission parts				
	Guards designed to protect persons against the hazards generated by moving transmission parts must be:				
	— either fixed guards as referred to in section 1.4.2.1, or	X			EN ISO 12100, 6.3
	— interlocking movable guards as referred to in section 1.4.2.2.			X	EN ISO 12100, 6.3
	Interlocking movable guards should be used where frequent access is envisaged.			X	See above
1.3.8.2	Moving parts involved in the process				
	Guards or protective devices designed to protect persons against the hazards generated by moving parts involved in the process must be:				
	— either fixed guards as referred to in section 1.4.2.1, or	X			EN ISO 12100, 6.3;
	— interlocking movable guards as referred to in section 1.4.2.2, or			X	EN ISO 12100, 6.3
	— protective devices as referred to in section 1.4.3, or			X	EN ISO 12100, 6.3
	— a combination of the above.			X	See above
	However, when certain moving parts directly involved in the process cannot be made completely inaccessible during operation owing to operations requiring operator intervention, such parts must be fitted with:				
	— fixed guards or interlocking movable guards preventing access to those sections of the parts that are not used in the work, and	X			EN ISO 12100, 6.3;
	— adjustable guards as referred to in section 1.4.2.3 restricting access to those sections of the moving parts where access is necessary.			X	EN ISO 12100, 6.3
1.3.9	Risks of uncontrolled movements				
	When a part of the machinery has been stopped, any drift away from the stopping position, for whatever reason other than action on the control devices, must be prevented or must be such that it does not present a hazard.			X	EN 60204-1:2006, 9.2.5.1, 9.2.5.5
1.4	Required characteristics of guard and protection				

	devices				
1.4.1	General requirement				
	Guards and protective devices must:				
	— be of robust construction,	X			EN ISO 12100, 6.3
	— be securely held in place,	X			See above
	— not give rise to any additional hazard,	X			See above
	— not be easy to by-pass or render non-operational,	X			See above
	— be located at an adequate distance from the danger zone,	X			See above
	— cause minimum obstruction to the view of the production process, and	X			See above
	— enable essential work to be carried out on the installation and/or replacement of tools and for maintenance purposes by restricting access exclusively to the area where the work has to be done, if possible without the guard having to be removed or the protective device having to be disabled.	X			See above
	In addition, guards must, where possible, protect against the ejection or falling of materials or objects and against emissions generated by the machinery.	X			See above
1.4.2	Special requirements for guards				
1.4.2.1	Fixed guards				
	Fixed guards must be fixed by systems that can be opened or removed only with tools.	X			EN ISO 12100, 6.3
	Their fixing systems must remain attached to the guards or to the machinery when the guards are removed.	X			See above
	Where possible, guards must be incapable of remaining in place without their fixings.	X			See above
1.4.2.2	Interlocking moveable guards				
	Interlocking movable guards must:				
	— as far as possible remain attached to the machinery when open,			X	EN ISO 12100, 6.3 a); No moveable guards for moving transmission parts (see 1.3.8)
	— be designed and constructed in such a way that they can be adjusted only by means of an intentional action.			X	See above
	Interlocking movable guards must be associated with an interlocking device that:				
	— prevents the start of hazardous machinery			X	See above

	functions until they are closed and				
	— gives a stop command whenever they are no longer closed.			X	See above
	Where it is possible for an operator to reach the danger zone before the risk due to the hazardous machinery functions has ceased, movable guards must be associated with a guard locking device in addition to an interlocking device that:				
	— prevents the start of hazardous machinery functions until the guard is closed and locked, and			X	EN ISO 12100, 6.3 b); (see 1.3.8)
	— keeps the guard closed and locked until the risk of injury from the hazardous machinery functions has ceased.			X	See above
	Interlocking movable guards must be designed in such a way that the absence or failure of one of their components prevents starting or stops the hazardous machinery functions.			X	See above
1.4.2.3	Adjustable guards restricting access				
	Adjustable guards restricting access to those areas of the moving parts strictly necessary for the work must be:				
	— adjustable manually or automatically, depending on the type of work involved, and			X	EN ISO 12100, 6.3; No adjustable guards
	— readily adjustable without the use of tools.			X	See above
1.4.3	Special requirements for protection devices				
	Protective devices must be designed and incorporated into the control system in such a way that:				
	— moving parts cannot start up while they are within the operator's reach,			X	EN ISO 12100, 6.3
	— persons cannot reach moving parts while the parts are moving, and			X	See above
	— the absence or failure of one of their components prevents starting or stops the moving parts.			X	See above
	Protective devices must be adjustable only by means of an intentional action.			X	See above
1.5	Risks due to other hazards				
1.5.1	Electricity supply				
	Where machinery has an electricity supply, it must be designed, constructed and equipped in such a way that all hazards of an electrical nature are or can be prevented.	X			EN ISO 12100, 6.2; EN 60204-1:2006, 6

Checklist: 2006/42/EC Machinery Directive, Annex I Essential Health and Safety Requirements					
No.	Requirements	OK	No	N.A	remarks
	The safety objectives set out in Directive 2006/95/EC shall apply to machinery. However, the obligations concerning conformity assessment and the placing on the market and/or putting into service of machinery with regard to electrical hazards are governed solely by this Directive.	X			See above
1.5.2	Static electricity				
	Machinery must be designed and constructed to prevent or limit the build-up of potentially dangerous electrostatic charges and/or be fitted with a discharging system.	X			EN ISO 12100, 6.3; EN 60204-1:2006, 4.4.2; EN 61000-6 series
1.5.3	Energy supply other than electricity				
	Where machinery is powered by source of energy other than electricity, it must be so designed, constructed and equipped as to avoid all potential risks associated with such sources of energy.			X	EN 983:1996; EN ISO 12100, 6.3
1.5.4	Errors of fitting				
	Errors likely to be made when fitting or refitting certain parts which could be a source of risk must be made impossible by the design and construction of such parts or, failing this, by information given on the parts themselves and/or their housings.	X			EN ISO 12100, 6.4
	The same information must be given on moving parts and/or their housings where the direction of movement needs to be known in order to avoid a risk.	X			See above
	Where necessary, the instructions must give further information on these risks.	X			See above
	Where a faulty connection can be the source of risk, incorrect connections must be made impossible by design or, failing this, by information given on the elements to be connected and, where appropriate, on the means of connection.	X			See above
1.5.5	Extreme temperatures				
	Steps must be taken to eliminate any risk of injury arising from contact with or proximity to machinery parts or materials at high or very low temperatures.	X			EN ISO 12100 6.2 6.3 6.4 b); EN 563; Operator accessible parts < 65oC
	The necessary steps must also be taken to avoid or protect against the risk of hot or very cold material being ejected.	X			EN ISO 12100 6.2 6.3 6.4
1.5.6	Fire				
	Machinery must be designed and constructed in such	X			EN ISO 12100 6.3

	a way as to avoid any risk of fire or overheating posed by the machinery itself or by gases, liquids, dust, vapours or other substances produced or used by the machinery.				6.4
1.5.7	Explosion				
	Machinery must be designed and constructed in such a way as to avoid any risk of explosion posed by the machinery itself or by gases, liquids, dust, vapours or other substances produced or used by the machinery.			X	EN ISO 12100 6.2 6.3 6.4 b); EN 50020; No explosion likely
	Machinery must comply, as far as the risk of explosion due to its use in a potentially explosive atmosphere is concerned, with the provisions of the specific Community Directives.			X	94/9/EC - ATEX
1.5.8	Noise				
	Machinery is so designed and constructed that risks resulting from the emission of airborne noise are reduced to the lowest level taking account of technical progress and the availability of means of reducing noise, in particular at source.	X			EN ISO 12100 6.2 6.3 6.4 c); < 80 dB(A) (see 1.1.1 e)
1.5.9	Vibrations				
	Machinery must be designed and constructed in such a way that risks resulting from vibrations produced by the machinery are reduced to the lowest level, taking account of technical progress and the availability of means of reducing vibration, in particular at source.	X			EN ISO 12100 6.2 6.3 6.4 (EN 1299) & 6.5.1 c);
	The level of vibration emission may be assessed with reference to comparative emission data for similar machinery.	X			See above
1.5.10	Radiation				
	Undesirable radiation emissions from the machinery must be eliminated or be reduced to levels that do not have adverse effects on persons.			X	EN ISO 12100 6.2 6.3 6.4 c);
	Any functional ionising radiation emissions must be limited to the lowest level which is sufficient for the proper functioning of the machinery during setting, operation and cleaning. Where a risk exists, the necessary protective measures must be taken.			X	See above
	Any functional non-ionising radiation emissions during setting, operation and cleaning must be limited to levels that do not have adverse effects on persons.			X	See above
1.5.11	External radiation				
	Machinery must be designed and constructed in such			X	See 1.5.10

	a way that external radiation does not interfere with its operation.				
1.5.12	Laser radiation				
	Where laser equipment is used, the following should be taken into account:			X	See 1.5.10
	— laser equipment on machinery must be designed and constructed in such a way as to prevent any accidental radiation,			X	See above
	— laser equipment on machinery must be protected in such a way that effective radiation, radiation produced by reflection or diffusion and secondary radiation do not damage health,			X	See above
	— optical equipment for the observation or adjustment of laser equipment on machinery must be such that no health risk is created by laser radiation.			X	See above
1.5.13	Emission of hazardous materials and substances				
	Machinery must be designed and constructed in such a way that risks of inhalation, ingestion, contact with the skin, eyes and mucous membranes and penetration through the skin of hazardous materials and substances which it produces can be avoided.	X			EN ISO 12100 6.2 6.3 6.4
	Where a hazard cannot be eliminated, the machinery must be so equipped that hazardous materials and substances can be contained, evacuated, precipitated by water spraying, filtered or treated by another equally effective method.	X			See above
	Where the process is not totally enclosed during normal operation of the machinery, the devices for containment and/or evacuation must be situated in such a way as to have the maximum effect.	X			See above
1.5.14	Risk of being trapped in a machine				
	Machinery must be designed, constructed or fitted with a means of preventing a person from being enclosed within it or, if that is impossible, with a means of summoning help.			X	EN ISO 12100, 6.3
1.5.15	Risk of slipping, tripping or falling				
	Parts of the machinery where persons are liable to move about or stand must be designed and constructed in such a way as to prevent persons slipping, tripping or falling on or off these parts.			X	EN ISO 12100, 6.3
	Where appropriate, these parts must be fitted with handholds that are fixed relative to the user and that			X	See above

Checklist: 2006/42/EC Machinery Directive, Annex I Essential Health and Safety Requirements					
No.	Requirements	OK	No	N.A	remarks
	enable them to maintain their stability.				
1.5.16	Lightning				
	Machinery in need of protection against the effects of lightning while being used must be fitted with a system for conducting the resultant electrical charge to earth.			X	See above
1.6	Maintenance				
1.6.1	Machinery maintenance				
	Adjustment and maintenance points must be located outside danger zones. It must be possible to carry out adjustment, maintenance, repair, cleaning and servicing operations while machinery is at a standstill.	X			EN ISO 12100, 6.2、6.3、 6.4
	If one or more of the above conditions cannot be satisfied for technical reasons, measures must be taken to ensure that these operations can be carried out safely (see section 1.2.5).			X	See above
	In the case of automated machinery and, where necessary, other machinery, a connecting device for mounting diagnostic fault-finding equipment must be provided.			X	EN ISO 12100, 6.2 & 6.3 e)
	Automated machinery components which have to be changed frequently must be capable of being removed and replaced easily and safely.			X	EN ISO 12100, 6.2、6.3、6.4
	Access to the components must enable these tasks to be carried out with the necessary technical means in accordance with a specified operating method.			X	See above
1.6.2	Access to operating position and serving points				
	Machinery must be designed and constructed in such a way as to allow access in safety to all areas where intervention is necessary during operation, adjustment and maintenance of the machinery.	X			EN ISO 12100, 6.2 & 6.3
1.6.3	Isolation of energy sources	Supplied by user			
	Machinery must be fitted with means to isolate it from all energy sources. Such isolators must be clearly identified.			X	EN ISO 12100, 6.2、6.3、6.4; EN 60204-1:2006, 17.4
	They must be capable of being locked if reconnection could endanger persons. Isolators must also be capable of being locked where an operator is unable, from any of the points to which he has access, to check that the energy is still cut off.			X	See above
	In the case of machinery capable of being plugged into an electricity supply, removal of the plug is			X	See above

	sufficient, provided that the operator can check from any of the points to which he has access that the plug remains removed.				
	After the energy is cut off, it must be possible to dissipate normally any energy remaining or stored in the circuits of the machinery without risk to persons.			X	See above
	As an exception to the requirement laid down in the previous paragraphs, certain circuits may remain connected to their energy sources in order, for example, to hold parts, to protect information, to light interiors, etc. In this case, special steps must be taken to ensure operator safety.			X	See above
1.6.4	Operator intervention				
	Machinery must be so designed, constructed and equipped that the need for operator intervention is limited.	X			EN ISO 12100, 6.2 & 6.3
	If operator intervention cannot be avoided, it must be possible to carry it out easily and safely.	X			See above
1.6.5	Cleaning of internal parts				
	The machinery must be designed and constructed in such a way that it is possible to clean internal parts which have contained dangerous substances or preparations without entering them; any necessary unblocking must also be possible from the outside.	X			EN ISO 12100, 6.3 & 6.4
	If it is impossible to avoid entering the machinery, it must be designed and constructed in such a way as to allow cleaning to take place safely.			X	Machinery is small
1.7	Indicators				
1.7.1	Information and warnings on the machinery				
	Information and warnings on the machinery should preferably be provided in the form of readily understandable symbols or pictograms.	X			EN ISO 12100 6.4; EN 60204-1:2006, 16; EN 809:1998, 7, prEN 13386:1998, 7
	Any written or verbal information and warnings must be expressed in an official Community language or languages, which may be determined in accordance with the Treaty by the Member State in which the machinery is placed on the market and/or put into service and may be accompanied, on request, by versions in any other official Community language or languages understood by the operators.	X			English
1.7.1.1	Information and information devices				

Checklist: 2006/42/EC Machinery Directive, Annex I Essential Health and Safety Requirements					
No.	Requirements	OK	No	N.A	remarks
	The information needed to control machinery must be provided in a form that is unambiguous and easily understood. It must not be excessive to the extent of overloading the operator.	X			EN ISO 12100, 6.2 & 6.3 ， 6.4
	Visual display units or any other interactive means of communication between the operator and the machine must be easily understood and easy to use.	X			See above
1.7.1.2	Warning devices				
	Where the health and safety of persons may be endangered by a fault in the operation of unsupervised machinery, the machinery must be equipped in such a way as to give an appropriate acoustic or light signal as a warning.			X	EN ISO 12100, 6.2 & 6.3 6.4
	Where machinery is equipped with warning devices these must be unambiguous and easily perceived. The operator must have facilities to check the operation of such warning devices at all times.			X	See above
	The requirements of the specific Community Directives concerning colours and safety signals must be complied with.			X	See above
1.7.2	Warning of residual risks				
	Where risks remain despite the inherent safe design measures, safeguarding and complementary protective measures adopted, the necessary warnings, including warning devices, must be provided.	X			EN ISO 12100, 6.4 c); EN 60204-1:2006, 16.2
1.7.3	Marking of machinery				
	All machinery must be marked visibly, legibly and indelibly with the following minimum particulars:				
	— the business name and full address of the manufacturer and, where applicable, his authorised representative,	X			EN ISO 12100, 6.4 EN 60204-1:2006, 16.4
	— designation of the machinery,			X	Type designation marked
	— the CE Marking (see Annex III),	X			EN ISO 12100, 6.4
	— designation of series or type,	X			EN ISO 12100, 6.4
	— serial number, if any,	X			EN ISO 12100, 6.4
	— the year of construction, that is the year in which the manufacturing process is completed.	X			EN ISO 12100, 6.4
	It is prohibited to pre-date or post-date the machinery when affixing the CE marking.	X			EN ISO 12100, 6.4
	Furthermore, machinery designed and constructed for			X	EN ISO 12100, 6.4

	use in a potentially explosive atmosphere must be marked accordingly.				
	Machinery must also bear full information relevant to its type and essential for safe use. Such information is subject to the requirements set out in section 1.7.1.	X			EN ISO 12100, 6.4
	Where a machine part must be handled during use with lifting equipment, its mass must be indicated legibly, indelibly and unambiguously.	X			EN ISO 12100, 6.4
1.7.4	Instructions				
	All machinery must be accompanied by instructions in the official Community language or languages of the Member State in which it is placed on the market and/or put into service.	X			EN ISO 12100, 6.4
	The instructions accompanying the machinery must be either ‘Original instructions’ or a ‘Translation of the original instructions’, in which case the translation must be accompanied by the original instructions.	X			EN ISO 12100, 6.4
	By way of exception, the maintenance instructions intended for use by specialised personnel mandated by the manufacturer or his authorised representative may be supplied in only one Community language which the specialised personnel understand.	X			EN ISO 12100, 6.4
	The instructions must be drafted in accordance with the principles set out below.	X			See below
1.7.4.1	General principles for the drafting of instructions				
	(a) The instructions must be drafted in one or more official Community languages. The words ‘Original instructions’ must appear on the language version(s) verified by the manufacturer or his authorised representative.	X			EN ISO 12100, 6.4
	(b) Where no ‘Original instructions’ exist in the official language(s) of the country where the machinery is to be used, a translation into that/those language(s) must be provided by the manufacturer or his authorised representative or by the person bringing the machinery into the language area in question. The translations must bear the words ‘Translation of the original instructions’.	X			EN ISO 12100, 6.4
	(c) The contents of the instructions must cover not only the intended use of the machinery but also take into account any reasonably foreseeable misuse thereof.	X			EN ISO 12100, 6.4

Checklist: 2006/42/EC Machinery Directive, Annex I Essential Health and Safety Requirements					
No.	Requirements	OK	No	N.A	remarks
	(d) In the case of machinery intended for use by non-professional operators, the wording and layout of the instructions for use must take into account the level of general education and acumen that can reasonably be expected from such operators.	X			EN ISO 12100, 6.4
1.7.4.2	Contents of the instructions				
	Each instruction manual must contain, where applicable, at least the following information:				
	(a) the business name and full address of the manufacturer and of his authorised representative;	X			EN ISO 12100, 6.4 EN 60204-1:2006, 17.2
	(b) the designation of the machinery as marked on the machinery itself, except for the serial number (see section 1.7.3);	X			EN ISO 12100, 6.4 EN 60204-1:2006, 17.2
	(c) the EC declaration of conformity, or a document setting out the contents of the EC declaration of conformity, showing the particulars of the machinery, not necessarily including the serial number and the signature;	X			Complied
	(d) a general description of the machinery;	X			EN ISO 12100, 6.4; EN 60204-1:2006, 17.2
	(e) the drawings, diagrams, descriptions and explanations necessary for the use, maintenance and repair of the machinery and for checking its correct functioning;	X			See above
	(f) a description of the workstation(s) likely to be occupied by operators;	X			See above
	(g) a description of the intended use of the machinery;	X			See above
	(h) warnings concerning ways in which the machinery must not be used that experience has shown might occur;	X			EN ISO 12100, 6.4; EN 60204-1:2006, 17.4 to 17.8
	(i) assembly, installation and connection instructions, including drawings, diagrams and the means of attachment and the designation of the chassis or installation on which the machinery is to be mounted;	X			EN ISO 12100, 6.4; EN 60204-1:2006, 17.4 to 17.8
	(j) instructions relating to installation and assembly for reducing noise or vibration;	X			EN ISO 12100, 6.4
	(k) instructions for the putting into service and use of the machinery and, if necessary, instructions for the training of operators;	X			EN ISO 12100, 6.4; EN 60204-1:2006, 17.2
	(l) information about the residual risks that remain despite the inherent safe design measures, safeguarding and complementary protective	X			See above

	measures adopted;				
	(m) instructions on the protective measures to be taken by the user, including, where appropriate, the personal protective equipment to be provided;	X			See above
	(n) the essential characteristics of tools which may be fitted to the machinery;	X			See above
	(o) the conditions in which the machinery meets the requirement of stability during use, transportation, assembly, dismantling when out of service, testing or foreseeable breakdowns;	X			See above
	(p) instructions with a view to ensuring that transport, handling and storage operations can be made safely, giving the mass of the machinery and of its various parts where these are regularly to be transported separately;	X			See above
	(q) the operating method to be followed in the event of accident or breakdown; if a blockage is likely to occur, the operating method to be followed so as to enable the equipment to be safely unblocked;	X			See above
	(r) the description of the adjustment and maintenance operations that should be carried out by the user and the preventive maintenance measures that should be observed;	X			See above
	(s) instructions designed to enable adjustment and maintenance to be carried out safely, including the protective measures that should be taken during these operations;	X			See above
	(t) the specifications of the spare parts to be used, when these affect the health and safety of operators;	X			See above
	(u) the following information on airborne noise emissions:				
	— the A-weighted emission sound pressure level at workstations, where this exceeds 70 dB(A); where this level does not exceed 70 dB(A), this fact must be indicated,	X			EN ISO 12100, 6.4; < 80 dB(A) (see 1.1.1 e)
	— the peak C-weighted instantaneous sound pressure value at workstations, where this exceeds 63 Pa (130 dB in relation to 20 μPa),			X	See above
	— the A-weighted sound power level emitted by the machinery, where the A-weighted emission sound pressure level at workstations exceeds 80 dB(A).	X			See above

	These values must be either those actually measured for the machinery in question or those established on the basis of measurements taken for technically comparable machinery which is representative of the machinery to be produced.	X			EN ISO 12100, 6.4 c)
	In the case of very large machinery, instead of the A-weighted sound power level, the A-weighted emission sound pressure levels at specified positions around the machinery may be indicated.			X	Fixed type of liquid pumps
	Where the harmonised standards are not applied, sound levels must be measured using the most appropriate method for the machinery. Whenever sound emission values are indicated the uncertainties surrounding these values must be specified. The operating conditions of the machinery during measurement and the measuring methods used must be described.	X			See above
	Where the workstation(s) are undefined or cannot be defined, A-weighted sound pressure levels must be measured at a distance of 1 metre from the surface of the machinery and at a height of 1,6 metres from the floor or access platform. The position and value of the maximum sound pressure must be indicated.	X			See above
	Where specific Community Directives lay down other requirements for the measurement of sound pressure levels or sound power levels, those Directives must be applied and the corresponding provisions of this section shall not apply;			X	2000/14/EC Noise directive for movable outdoor equipment
	(v) where machinery is likely to emit non-ionising radiation which may cause harm to persons, in particular persons with active or non-active implantable medical devices, information concerning the radiation emitted for the operator and exposed persons.			X	None
1.7.4.3.	Sales literature				
	Sales literature describing the machinery must not contradict the instructions as regards health and safety aspects. Sales literature describing the performance characteristics of machinery must contain the same information on emissions as is contained in the instructions.	X			EN ISO 12100, 6.4
2	Supplementary essential health and safety			X	

Checklist: 2006/42/EC Machinery Directive, Annex I Essential Health and Safety Requirements					
No.	Requirements	OK	No	N.A	remarks
	requirements for certain categories of machinery				
2.1	Foodstuffs machinery and machinery for cosmetics or pharmaceutical products			X	
2.2	Portable hand-held and/or hand-guided machinery			X	
2.3	Machinery for working wood and material with similar physical characteristics			X	
3	Supplementary essential health and safety requirements to offset hazards due to the mobility of machinery			X	
4	Supplementary essential health and safety requirements to offset hazards due to lifting operations			X	
5	Supplementary essential health and safety requirements for machinery intended for underground work			X	
6	Supplementary essential health and safety requirements for machinery presenting particular hazards due to the lifting of persons			X	

EN ISO 12100:2010			
Clause	Requirement-Test	Result-Remark	Verdict
4	Strategy for risk assessment and risk reduction		P
	To implement risk assessment and risk reduction the designer shall take the following actions, in the order given (see Figure 1):		P
	a) determine the limits of the machinery, which include the intended use and any reasonably foreseeable misuse thereof;		P
	b) identify the hazards and associated hazardous situations;		P
	c) estimate the risk for each identified hazard and hazardous situation;		P
	d) evaluate the risk and take decisions about the need for risk reduction;		P
	e) eliminate the hazard or reduce the risk associated with the hazard by means of protective measures.		P
	Actions a) to d) are related to risk assessment and e) to risk reduction.		P
	Risk assessment is a series of logical steps to enable, in a systematic way, the analysis and evaluation of the risks associated with machinery.		P
	Risk assessment is followed, whenever necessary, by risk reduction. Iteration of this process can be necessary to eliminate hazards as far as practicable and to adequately reduce risks by the implementation of protective measures.		P
	It is assumed that, when present on machinery, a hazard will sooner or later lead to harm if no protective measure or measures have been implemented. Examples of hazards are given in Annex B.		P
	Protective measures are the combination of the measures implemented by the designer and the user in accordance with Figure 2. Measures which can be incorporated at the design stage are preferable to those implemented by the user and usually prove more effective.		P
	The objective to be met is the greatest practicable risk reduction, taking into account the four below factors. The strategy defined in this clause is represented by the flowchart in Figure 1. The process itself is iterative and several successive applications can be necessary to reduce the risk, making the best use of available technology. In carrying out this process, it is necessary to take into account these four factors, in the following order of preference:		P
	– the safety of the machine during all the phases of its life cycle;		P
	– the ability of the machine to perform its function;		P

	– the usability of the machine;		P
	– the manufacturing, operational and dismantling costs of the machine.		P
	NOTE 1 The ideal application of these principles requires knowledge of the use of the machine,the accident history and health records, available risk reduction techniques, and the legal framework in which the machine is to be used.		P
	NOTE 2 A machine design which is acceptable at a particular time could be no longer justifiable when technological development allows the design of an equivalent machine with lower risk.		P
5	Risk assessment		P
5.1	General Risk assessment comprises (see Figure 1) – risk analysis, comprising 1) determination of the limits of the machinery (see 5.3), 2) hazard identification (5.4 and Annex B), and 3) risk estimation (see 5.5), and – risk evaluation (see 5.6). Risk analysis provides information required for the risk evaluation, which in turn allows judgments to be made about whether or not risk reduction is required. These judgments shall be supported by a qualitative or, where appropriate, quantitative estimate of the risk associated with the hazards present on the machinery.		P
5.2	Information for risk assessment The information for risk assessment should include the following. a) Related to machinery description: 1) user specifications; 2) anticipated machinery specifications, including i) a description of the various phases of the whole life cycle of the machinery, ii) design drawings or other means of establishing the nature of the machinery, and iii) required energy sources and how they are supplied; 3) documentation on previous designs of similar machinery, if relevant; 4) information for use of the machinery, as available. b) Related to regulations, standards and other applicable documents: 1) applicable regulations; 2) relevant standards; 3) relevant technical specifications; 4) relevant safety data sheets.		P

	c) Related to experience of use: 1) any accident, incident or malfunction history of the actual or similar machinery; 2) the history of damage to health resulting, for example, from emissions (noise, vibration, dust, fumes, etc.), chemicals used or materials processed by the machinery; 3) the experience of users of similar machines and, whenever practicable, an exchange of information with the potential users. d) Relevant ergonomic principles. The information shall be updated as the design develops or when modifications to the machine are required. Comparisons between similar hazardous situations associated with different types of machinery are often possible, provided that sufficient information about hazards and accident circumstances in those situations is available. For quantitative analysis, data from databases, handbooks, laboratories or manufacturers' specifications may be used, provided that there is confidence in the suitability of the data. Uncertainty associated with these data shall be indicated in the documentation (see Clause 7).		
5.3	Determination of limits of machinery		P
5.3.1	General Risk assessment begins with the determination of the limits of the machinery, taking into account all the phases of the machinery life. This means that the characteristics and performances of the machine or a series of machines in an integrated process, and the related people, environment and products, should be identified in terms of the limits of machinery as given in 5.3.2 to 5.3.5.		P
5.3.2	Use limits Use limits include the intended use and the reasonably foreseeable misuse. Aspects to be taken into account include the following: a) the different machine operating modes and different intervention procedures for the users, including interventions required by malfunctions of the machine; b) the use of the machinery (for example, industrial, non-industrial and domestic) by persons identified by sex, age, dominant hand usage, or limiting physical abilities (visual or hearing impairment, size, strength, etc.); c) the anticipated levels of training, experience or ability of users including 1) operators, 2) maintenance personnel or technicians,		P

	3) trainees and apprentices, and 4) the general public; d) exposure of other persons to the hazards associated with the machinery where it can be reasonably foreseen: 1) persons likely to have a good awareness of the specific hazards, such as operators of adjacent machinery; 2) persons with little awareness of the specific hazards but likely to have a good awareness of site safety procedures, authorized routes, etc., such as administration staff; 3) persons likely to have very little awareness of the machine hazards or the site safety procedures, such as visitors or members of the general public, including children.		
5.3.3	Space limits Aspects of space limits to be taken into account include a) the range of movement, b) space requirements for persons interacting with the machine, such as during operation and maintenance, c) human interaction such as the operator–machine interface, and d) the machine–power supply interface		P
5.3.4	Time limits Aspects of time limits to be taken into account include a) the life limit of the machinery and/or of some of its components (tooling, parts that can wear, electromechanical components, etc.), taking into account its intended use and reasonably foreseeable misuse, and b) recommended service intervals.		P
5.3.5	Other limits Examples of other limits include a) properties of the material(s) to be processed, b) housekeeping — the level of cleanliness required, and c) environmental — the recommended minimum and maximum temperatures, whether the machine can be operated indoors or outdoors, in dry or wet weather, in direct sunlight, tolerance to dust and wet, etc.		P
5.4	Hazard identification After determination of the limits of the machinery, the essential step in any risk assessment of the machinery is the systematic identification of reasonably foreseeable hazards (permanent hazards and those which can appear unexpectedly), hazardous situations and/or hazardous events during all phases of the machine life cycle, i.e.: – transport, assembly and installation; – commissioning;		P

	– use; – dismantling, disabling and scrapping. Only when hazards have been identified can steps be taken to eliminate them or to reduce risks. To accomplish this hazard identification, it is necessary to identify the operations to be performed by the machinery and the tasks to be performed by persons who interact with it, taking into account the different parts, mechanisms or functions of the machine, the materials to be processed, if any, and the environment in which the machine can be used. The designer shall identify hazards taking into account the following. a) Human interaction during the whole life cycle of the machine Task identification should consider all tasks associated with every phase of the machine life cycle as given above. Task identification should also take into account, but not be limited to, the following task categories: – setting; – testing; – teaching/programming; – process/tool changeover; – start-up; – all modes of operation; – feeding the machine; – removal of product from machine; – stopping the machine; – stopping the machine in case of emergency; – recovery of operation from jam or blockage; – restart after unscheduled stop; – fault-finding/trouble-shooting (operator intervention); – cleaning and housekeeping; – preventive maintenance; – corrective maintenance. All reasonably foreseeable hazards, hazardous situations or hazardous events associated with the various tasks shall then be identified. Annex B gives examples of hazards, hazardous situations and hazardous events to assist in this process. Several methods are available for the systematic identification of hazards. See also ISO/TR 14121-2. In addition, reasonably foreseeable hazards, hazardous situations or hazardous events not directly related to tasks shall be identified. b) Possible states of the machine These are as follows:		

	1) the machine performs the intended function (the machine operates normally); 2) the machine does not perform the intended function (i.e. it malfunctions) due to a variety of reasons, including – variation of a property or of a dimension of the processed material or of the work piece, – failure of one or more of its component parts or services, – external disturbances (for example, shocks, vibration, electromagnetic interference), – design error or deficiency (for example, software errors), – disturbance of its power supply, and – surrounding conditions (for example, damaged floor surfaces). c) Unintended behaviour of the operator or reasonably foreseeable misuse of the machine Examples include – loss of control of the machine by the operator (especially for hand-held or mobile machines), – reflex behaviour of a person in case of malfunction, incident or failure during the use of the machine, – behaviour resulting from lack of concentration or carelessness, – behaviour resulting from taking the “line of least resistance” in carrying out a task, – behaviour resulting from pressures to keep the machine running in all circumstances, and – behaviour of certain persons (for example, children, disabled persons).		
5.5	Risk estimation		P
5.5.1	General After hazard identification, risk estimation shall be carried out for each hazardous situation by determining the elements of risk given in 5.5.2. When determining these elements, it is necessary to take into account the aspects given in 5.5.3. If standardized (or other suitable) measurement methods exist for an emission, they should be used, in conjunction with existing machinery or prototypes, to determine emission values and comparative emission data. This makes it possible for the designer to – estimate the risk associated with the emissions, – evaluate the effectiveness of the protective measures implemented at the design stage, – provide potential buyers with quantitative information on emissions in the technical documentation, and		P

	– provide users with quantitative information on emissions in the information for use. Hazards other than emissions that are described by measurable parameters can be dealt with in a similar manner.		
5.5.2	Elements of risk		P
5.5.2.1	General The risk associated with a particular hazardous situation depends on the following elements: a) the severity of harm; b) the probability of occurrence of that harm, which is a function of 1) the exposure of person(s) to the hazard, 2) the occurrence of a hazardous event, and 3) the technical and human possibilities to avoid or limit the harm. The elements of risk are shown in Figure 3. Additional details are given in 5.5.2.2, 5.5.2.3 and 5.5.3.		P
5.5.2.2	Severity of harm The severity can be estimated by taking into account the following: a) the severity of injuries or damage to health, for example, – slight, – serious, – death. b) the extent of harm, for example, to – one person, – several persons. When carrying out a risk assessment, the risk from the most likely severity of the harm that is likely to occur from each identified hazard shall be considered, but the highest foreseeable severity shall also be taken into account, even if the probability of such an occurrence is not high.		P
5.5.2.3	Probability of occurrence of harm		P
5.5.2.3.1	Exposure of persons to the hazard The exposure of a person to the hazard influences the probability of the occurrence of harm. Factors to be taken into account when estimating the exposure are, among others, a) the need for access to the hazard zone (for normal operation, correction of malfunction, maintenance or repair, etc.), b) the nature of access (for example, manual feeding of materials), c) the time spent in the hazard zone, d) the number of persons requiring access, and e) the frequency of access.		P
5.5.2.3.2	Occurrence of a hazardous event		P

	The occurrence of a hazardous event influences the probability of occurrence of harm. Factors to be taken into account when estimating the occurrence of a hazardous event are, among others, a) reliability and other statistical data, b) accident history, c) history of damage to health, and d) comparison of risks (see 5.6.3).		
5.5.2.3.3	Possibility of avoiding or limiting harm The possibility of avoiding or limiting harm influences the probability of occurrence of harm. Factors to be taken into account when estimating the possibility of avoiding or limiting harm are, among others, the following: a) different persons who can be exposed to the hazard(s), for example, – skilled, – unskilled; b) how quickly the hazardous situation could lead to harm, for example, – suddenly, – quickly, – slowly; c) any awareness of risk, for example, – by general information, in particular, information for use, – by direct observation, – through warning signs and indicating devices, in particular, on the machinery; d) the human ability to avoid or limit harm (for example, reflex, agility, possibility of escape); e) practical experience and knowledge, for example, – of the machinery, – of similar machinery, – no experience.		P
5.5.3	Aspects to be considered during risk estimation		P
5.5.3.1	Persons exposed Risk estimation shall take into account all persons (operators and others) for whom exposure to the hazard is reasonably foreseeable.		P
5.5.3.2	Type, frequency and duration of exposure The estimation of the exposure to the hazard under consideration (including long-term damage to health) requires analysis of, and shall account for, all modes of operation of the machinery and methods of working. In particular, the analysis shall account for the		P

	needs for access during loading/unloading, setting, teaching, process changeover or correction, cleaning, fault-finding and maintenance. The risk estimation shall also take into account tasks, for which it is necessary to suspend protective measures.		
5.5.3.3	Relationship between exposure and effects The relationship between an exposure to a hazard and its effects shall be taken into account for each hazardous situation considered. The effects of accumulated exposure and combinations of hazards shall also be considered. When considering these effects, risk estimation shall, as far as practicable, be based on appropriate recognized data.		P
5.5.3.4	Human factors Human factors can affect risk and shall be taken into account in the risk estimation, including, for example, a) the interaction of person(s) with the machinery, including correction of malfunction, b) interaction between persons, c) stress-related aspects, d) ergonomic aspects, e) the capacity of persons to be aware of risks in a given situation depending on their training, experience and ability, f) fatigue aspects, and g) aspects of limited abilities (due to disability, age, etc.).		P
5.5.3.5	Suitability of protective measures Risk estimation shall take into account the suitability of protective measures and shall a) identify the circumstances which can result in harm, b) whenever appropriate, be carried out using quantitative methods to compare alternative protective measures (see ISO/TR 14121-2), and c) provide information that can assist with the selection of appropriate protective measures. When estimating risk, those components and systems identified as immediately increasing the risk in case of failure need special attention. When protective measures include work organization, correct behaviour, attention, application of personal protective equipment (PPE), skill or training, the relatively low reliability of such measures compared with proven technical protective measures shall be taken into account in the risk estimation.		P
5.5.3.6	Possibility of defeating or circumventing protective measures		P

	For the continued safe operation of a machine, it is important that the protective measures allow its easy use and do not hinder its intended use. Otherwise, there is a possibility that protective measures might be bypassed in order for maximum utility of the machine to be achieved. Risk estimation shall take account of the possibility of defeating or circumventing protective measures. It shall also take account of the incentive to defeat or circumvent protective measures when, for example, a) the protective measure slows down production or interferes with another activity or preference of the user, b) the protective measure is difficult to use, c) persons other than the operator are involved, or d) the protective measure is not recognized by the user or not accepted as being suitable for its function. Whether or not a protective measure can be defeated depends on both the type of protective measure, such as an adjustable guard or programmable trip device, and its design details. Protective measures that use programmable electronic systems introduce additional possibilities of defeat or circumvention if access to safety-related software is not appropriately restricted by design and monitoring methods. Risk estimation shall identify where safety-related functions are not separated from other machine functions and shall determine the extent to which access is possible. This is particularly important when remote access for diagnostic or process correction purposes is required.		
5.5.3.7	Ability to maintain protective measures Risk estimation shall consider whether the protective measures can be maintained in the condition necessary to provide the required level of protection.		P
5.6	Risk evaluation		P
5.6.1	General After risk estimation has been completed, risk evaluation shall be carried out to determine if risk reduction is required. If risk reduction is required, then appropriate protective measures shall be selected and applied (see Clause 6). As shown in Figure 1, the adequacy of the risk reduction shall be determined after applying each of the three steps of risk reduction described in Clause 6. As part of this		P

	iterative process, the designer shall also check whether additional hazards are introduced or other risks increased when new protective measures are applied. If additional hazards do occur, they shall be added to the list of identified hazards and appropriate protective measures will be required to address them. Achieving the objectives of risk reduction and a favourable outcome of risk comparison applied when practicable gives confidence that risk has been adequately reduced.		
5.6.2	Adequate risk reduction Application of the three-step method described in 6.1 is essential in achieving adequate risk reduction. Following the application of the three-step method, adequate risk reduction is achieved when – all operating conditions and all intervention procedures have been considered, – the hazards have been eliminated or risks reduced to the lowest practicable level, – any new hazards introduced by the protective measures have been properly addressed, – users are sufficiently informed and warned about the residual risks (see 6.1, step 3), – protective measures are compatible with one another, – sufficient consideration has been given to the consequences that can arise from the use in a nonprofessional/non-industrial context of a machine designed for professional/industrial use, and – the protective measures do not adversely affect the operator's working conditions or the usability of the machine.		P
5.6.3	Comparison of risks As part of the process of risk evaluation, the risks associated with the machinery or parts of machinery can be compared with those of similar machinery or parts of machinery, provided the following criteria apply: – the similar machinery is in accordance with the relevant type-C standard(s); – the intended use, reasonably foreseeable misuse and the way both machines are designed and constructed are comparable; – the hazards and the elements of risk are comparable; – the technical specifications are comparable; – the conditions for use are comparable. The use of this comparison method does not eliminate the need to follow the risk assessment process as described in this International Standard for the specific conditions of use. For example, when a band saw used		P

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Clause	Requirement-Test	Result-Remark	Verdict
6	Risk reduction		P
6.1	General The objective of risk reduction can be achieved by the elimination of hazards, or by separately or simultaneously reducing each of the two elements that determine the associated risk: – severity of harm from the hazard under consideration; – probability of occurrence of that harm. All protective measures intended for reaching this objective shall be applied in the following sequence, referred to as the three-step method (see also Figures 1 and 2). Step 1: Inherently safe design measures Inherently safe design measures eliminate hazards or reduce the associated risks by a suitable choice of design features of the machine itself and/or interaction between the exposed persons and the machine. See 6.2. Step 2: Safeguarding and/or complementary protective measures Taking into account the intended use and the reasonably foreseeable misuse, appropriately selected safeguarding and complementary protective measures can be used to reduce risk when it is not practicable to eliminate a hazard, or reduce its associated risk sufficiently, using inherently safe design measures. See 6.3. Step 3: Information for use Where risks remain despite inherently safe design measures, safeguarding and the adoption of complementary protective measures, the residual risks shall be identified in the information for use. The information for use shall include, but not be limited to, the following: – operating procedures for the use of the machinery consistent with the expected ability of personnel who use the machinery or other persons who can be exposed to the hazards associated with the machinery; – the recommended safe working practices for the use of the machinery and the related training requirements adequately described; – sufficient information, including warning of residual risks for the different phases of the life of the machinery; – the description of any recommended personal protective equipment, including detail as to its need as well as to training needed for its use. Information for use shall not be a substitute for the correct		P

	application of inherently safe design measures, safeguarding or complementary protective measures.		
6.2	Inherently safe design measures		P
6.2.1	General Inherently safe design measures are the first and most important step in the risk reduction process. This is because protective measures inherent to the characteristics of the machine are likely to remain effective, whereas experience has shown that even well-designed safeguarding can fail or be violated and information for use may not be followed. Inherently safe design measures are achieved by avoiding hazards or reducing risks by a suitable choice of design features for the machine itself and/or interaction between the exposed persons and the machine.		P
6.2.2	Consideration of geometrical factors and physical aspects		P
6.2.2.1	Geometrical factors Such factors include the following. a) The form of machinery is designed to maximize direct visibility of the working areas and hazard zones from the control position — reducing blind spots, for example — and choosing and locating means of indirect vision where necessary (mirrors, etc.) so as to take into account the characteristics of human vision, particularly when safe operation requires permanent direct control by the operator, for example: – the travelling and working area of mobile machines; – the zone of movement of lifted loads or of the carrier of machinery for lifting persons; – the area of contact of the tool of a hand-held or hand-guided machine with the material being worked. The design of the machine shall be such that, from the main control position, the operator is able to ensure that there are no exposed persons in the danger zones. b) The form and the relative location of the mechanical components parts: for instance, crushing and shearing hazards are avoided by increasing the minimum gap between the moving parts, such that the part of the body under consideration can enter the gap safely, or by reducing the gap so that no part of the body can enter it (see ISO 13854 and ISO 13857). 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,		P

	flanged or trimmed, and open ends of tubes which can cause a "trap" shall be capped. d) The form of the machine is designed so as to achieve a suitable working position and provide accessible manual controls (actuators).		
6.2.2.2	Physical aspects 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; b) limiting the mass and/or velocity of the movable elements, and hence their kinetic energy; c) limiting the emissions by acting on the characteristics of the source using measures for reducing 1) noise emission at source (see ISO/TR 11688-1), 2) the emission of vibration at source, such as redistribution or addition of mass and changes of process parameters [for example, frequency and/or amplitude of movements (for hand-held and hand-guided machinery, see CR 1030-1)], 3) the emission of hazardous substances, including the use of less hazardous substances or dust-reducing processes (granules instead of powders, milling instead of grinding), and 4) radiation emissions, including, for example, avoiding the use of hazardous radiation sources, limiting the power of radiation to the lowest level sufficient for the proper functioning of the machine, designing the source so that the beam is concentrated on the target, increasing the distance between the source and the operator or providing for remote operation of the machinery [measures for reducing emission of non-ionizing radiation are given in 6.3.4.5 (see also EN 12198-1 and EN 12198-3)].		P
6.2.3	Taking into account general technical knowledge of machine design This general technical knowledge can be derived from technical specifications for design (standards, design codes, calculation rules, etc.), which should be used to cover a) mechanical stresses such as – stress limitation by implementation of correct calculation, construction and fastening methods as regards, for example, bolted assemblies and welded assemblies, – stress limitation by overload prevention (bursting disk,pressure-limiting valves, breakage points, torque-limiting devices, etc.), – avoiding fatigue in elements under variable stresses (notably		P

	cyclic stresses), and – static and dynamic balancing of rotating elements, b) materials and their properties such as – resistance to corrosion, ageing, abrasion and wear, – hardness, ductility, brittleness, – homogeneity, – toxicity, and – flammability, and c) emission values for – noise, – vibration, – hazardous substances, and – radiation. When the reliability of particular components or assemblies is critical for safety (for example, ropes, chains, lifting accessories for lifting loads or persons), stress limits shall be multiplied by appropriate working coefficients.		
6.2.4	Choice of appropriate technology One or more hazards can be eliminated or risks reduced by the choice of the technology to be used in certain applications such as the following: a) on machines intended for use in explosive atmospheres, using – appropriately selected pneumatic or hydraulic control system and machine actuators, – intrinsically safe electrical equipment (see IEC 60079-11); b) for particular products to be processed (for example, by a solvent), by using equipment that ensures the temperature will remain far below the flash point; c) the use of alternative equipment to avoid high noise levels, such as – electrical instead of pneumatic equipment, – in certain conditions, water-cutting instead of mechanical equipment.		P
6.2.5	Applying principle of positive mechanical action Positive mechanical action is achieved when a moving mechanical component inevitably moves another component along with it, either by direct contact or via rigid elements. An example of this is positive opening operation of switching devices in an electrical circuit (see IEC 60947-5-1 and ISO 14119).		P
6.2.6	Provisions for stability Machines shall be designed so that they have sufficient stability to allow them to be used safely in their specified conditions of use. Factors to be taken into account include		P

	– the geometry of the base, – the weight distribution, including loading, – the dynamic forces due to movements of parts of the machine, of the machine itself or of elements held by the machine which can result in an overturning moment, – vibration, – oscillations of the centre of gravity, – characteristics of the supporting surface in case of travelling or installation on different sites (ground conditions, slope, etc.), and – external forces, such as wind pressure and manual forces. Stability shall be considered in all phases of the life cycle of the machine, including handling, travelling, installation, use, dismantling, disabling and scrapping.		
6.2.7	Provisions for maintainability When designing a machine, the following maintainability factors shall be taken into account to enable maintenance of the machine: – accessibility, taking into account the environment and the human body measurements, including the dimensions of the working clothes and tools used; – ease of handling, taking into account human capabilities; – limitation of the number of special tools and equipment.		P
6.2.8	Observing ergonomic principles Ergonomic principles shall be taken into account in designing machinery so as to reduce the mental or physical stress of, and strain on, the operator. These principles shall be considered when allocating functions to operator and machine (degree of automation) in the basic design. 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 elements of the operator–machine interface, such as controls, signalling or data display elements, shall be designed to be easily understood so that clear and unambiguous interaction between the operator and the machine is possible. See EN 614-1, EN 13861 and IEC 61310-1. The designer's attention is particularly drawn to following ergonomic aspects of machine design. a) Avoid the necessity for stressful postures and movements during the use of the machine (for example, providing facilities to adjust the machine to suit the various operators). b) Design machines, especially hand-held and mobile machines,		P

	so as to enable them to be operated easily, taking into account human effort, actuation of controls and hand, arm and leg anatomy. c) Limit as far as possible noise, vibration and thermal effects such as extreme temperatures. d) Avoid linking the operator's working rhythm to an automatic succession of cycles. e) Provide 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 or the lighting source has to be adjusted, its location shall be such that it does not cause any risk to persons making the adjustment. f) Select, locate and identify manual controls (actuators) so that – they are clearly visible and identifiable, and appropriately marked where necessary (see 6.4.4), – they can be safely operated without hesitation or loss of time and without ambiguity (for example, 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), – their location (for push-buttons) and their movement (for levers and hand wheels) are consistent with their effect (see IEC 61310-3), and – their operation cannot cause additional risk. See also ISO 9355-3. Where a control is designed and constructed to perform several different actions — namely, where there is no one-to-one correspondence (for example, keyboards) — the action to be performed shall be clearly displayed and subject to confirmation where necessary. Controls shall be so arranged that their layout, travel and resistance to operation are compatible with the action to be performed, taking account of ergonomic principles. Constraints due to the necessary or foreseeable use of personal protective equipment (such as footwear, gloves) shall be taken into account. g) Select, design and locate indicators, dials and visual display units so that – they fit within the parameters and characteristics of human perception, – 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, and – the operator is able to perceive them from the control position.		
6.2.9	Electrical hazards For the design of the electrical equipment of machines, IEC 60204-1 gives general provisions about disconnection and switching of electrical circuits and for protection against electric shock. For requirements related to specific machines, see corresponding IEC standards (for example, IEC 61029, IEC 60745 or IEC 60335).		P
6.2.10	Pneumatic and hydraulic hazards Pneumatic and hydraulic equipment of machinery shall be designed so that – the maximum rated pressure cannot be exceeded in the circuits (using, for example, pressure-limiting devices), – no hazard results from pressure fluctuations or increases, or from loss of pressure or vacuum, – no hazardous fluid jet or sudden hazardous movement of the hose (whiplash) results from leakage or component failures, – air receivers, air reservoirs or similar vessels (such as in gas-loaded accumulators) comply with the applicable design standard codes or regulations for these elements, – all elements of the equipment, especially pipes and hoses, are protected against harmful external effects, – as far as possible, reservoirs and similar vessels (for example, gas-loaded accumulators) are automatically depressurized when isolating the machine from its power supply (see 6.3.5.4) and, if not possible, means are provided for their isolation, local depressurizing and pressure indication (see also ISO 14118:2000, Clause 5), and – all elements which remain under pressure after isolation of the machine from its power supply are provided with clearly identified exhaust devices, and there is a warning label drawing attention to the necessity of depressurizing those elements before any setting or maintenance activity on the machine.		P
6.2.11	Applying inherently safe design measures to control systems		P
6.2.11.1	General 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). The correct design of machine control systems can avoid unforeseen and potentially hazardous machine behaviour. Typical causes of hazardous machine behaviour are		P

	– an unsuitable design or modification (accidental or deliberate) of the control system logic, – a temporary or permanent defect or failure of one or several components of the control system, – a variation or a failure in the power supply of the control system, and – inappropriate selection, design and location of the control devices. Typical examples of hazardous machine behaviour are – unexpected start-up (see ISO 14118), – uncontrolled speed change, – failure to stop moving parts, – dropping or ejection of part of the machine or of a workpiece clamped by the machine, and – machine action resulting from inhibition (defeating or failure) of protective devices. 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. These principles and methods shall be applied singly or in combination as appropriate to the circumstances (see ISO 13849-1, IEC 60204-1 and IEC 62061). 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; – provision for specific operating modes (for example, 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); – clear display of the faults; – measures to prevent accidental generation of unexpected start commands (for example, shrouded start device) likely to cause dangerous machine behaviour (see ISO 14118:2000, Figure 1); – maintained stop commands (for example, interlock) to prevent restarting that could result in dangerous machine behaviour (see ISO 14118:2000, Figure 1). An assembly of machines may be divided into several zones for emergency stopping, for stopping as a result of protective devices and/or for isolation and energy dissipation. The different zones shall be clearly defined and it shall be obvious which parts of the		

	machine belong to which zone. Likewise, it shall be obvious which control devices (for example, emergency stop devices, supply disconnecting devices) and/or protective devices belong to which zone. The interfaces between zones shall be designed such that no function in one zone creates hazards in another zone which has been stopped for an intervention. Control systems shall be designed to limit the movements of parts of the machinery, the machine itself, or work pieces and/or loads held by the machinery, to the safe design parameters (for example, range, speed, acceleration, deceleration, load capacity). Allowance shall be made for dynamic effects (swinging of loads, etc.). For example: – the travelling speed of mobile pedestrian controlled machinery other than remote-controlled shall be compatible with walking speed; – 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; – the range of movements of parts of machinery for lifting loads shall be kept within specified limits. When the machinery contains various elements that can be operated independently, the control system shall be designed to prevent risks arising out of a lack of coordination (for example, collision prevention system).		
6.2.11.2	Starting of an internal power source/switching on an external power supply 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 IEC 60204-1:2005, 7.5 (see also Annexes A and B).		P
6.2.11.3	Starting/stopping of a mechanism The primary action for starting or accelerating the movement of a mechanism should be performed by the application or an increase of voltage or fluid pressure, or — if binary logic elements are considered — by passage from state 0 to state 1 (where state 1 represents the highest energy state).		P

	The primary action for stopping or slowing down should be performed by removal or reduction of voltage or fluid pressure, or — if binary logic elements are considered — by passage from state 1 to state 0 (where state 1 represents the highest energy state). In certain applications, such as high-voltage switchgear, this principle cannot be followed, in which case other measures should be applied to achieve the same level of confidence for the stopping or slowing down. When, in order for the operator to maintain permanent control of deceleration, this principle is not observed, the machine shall be equipped with a means of slowing and stopping in case of failure of the main braking system.		
6.2.11.4	Restart after power interruption If a hazard could be generated, the spontaneous restart of a machine when it is re-energized after power interruption shall be prevented (for example, by use of a self-maintained relay, contactor or valve).		P
6.2.11.5	Interruption of power supply Machinery shall be designed to prevent hazardous situations resulting from interruption or excessive fluctuation of the power supply. At least the following requirements shall be met: – the stopping function of the machinery shall remain; – all devices whose permanent operation is required for safety shall operate in an effective way to maintain safety (for example, locking, clamping devices, cooling or heating devices, power-assisted steering of self-propelled mobile machinery); – 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.		P
6.2.11.6	Use of automatic monitoring Automatic monitoring is intended to ensure that a safety function or functions implemented by a protective measure do not fail to be performed if the ability of a component or an element to perform its function is diminished, or if the process conditions are changed such that hazards are generated. Automatic monitoring either detects a fault immediately or carries out periodic checks so that a fault is detected before the next demand upon the safety function. In either case, the protective measure can be initiated immediately or delayed until a specific event occurs (for example, the beginning of the machine cycle). The protective measure may be, for example,		P

	– the stopping of the hazardous process, – preventing the restart of this process after the first stop following the failure, or – the triggering of an alarm.		
6.2.11.7	Safety functions implemented by programmable electronic control systems		P
6.2.11.7.1	General A control system that includes programmable electronic equipment (for example, programmable controllers) can, where appropriate, be used to implement safety functions at machinery. Where a programmable electronic control system is used, it is necessary to consider its performance requirements in relation to the requirements for the safety functions. 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 ffect the performance of the safety-related control function(s) is sufficiently low. Where a programmable electronic control system performs a monitoring function, the system behaviour on detection of a fault shall be considered (see also the IEC 61508 series for further guidance).		P
6.2.11.7.2	Hardware aspects The hardware (including, for example, sensors, actuators and 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 – architectural constraints (the configuration of the system, its ability to tolerate faults, its behaviour on detection of a fault, etc.), – selection, and/or design, of equipment and devices with an appropriate probability of dangerous random hardware failure, and – the incorporation of measures and techniques within the hardware so as to avoid systematic failures and control systematic faults.		P
6.2.11.7.3	Software aspects 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). Application software should not be reprogrammable by the user. This may be achieved by use of embedded software in a non-reprogrammable memory [for example, micro-controller, application-specific integrated		P

	circuit (ASIC)]. When the application requires reprogramming by the user, the access to the software dealing with safety functions should be restricted (for example, by locks or passwords for the authorized persons).		
6.2.11.8	Principles relating to manual control These are as follows. a) Manual control devices shall be designed and located according to the relevant ergonomic principles given in 6.2.8, item f). 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. 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. d) Whenever possible, control devices and control positions shall be located so that the operator is able to observe the working area or hazard zone. 1) The driver of a ride-on mobile machine shall be able to actuate all control devices required to operate the machine from the driving position, except for functions which can be controlled more safely from other positions. 2) On machinery intended for lifting persons, controls for lifting and lowering and, if appropriate, for moving the carrier shall generally be located in the carrier. 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. e) If it is possible to start the same hazardous element by means of several controls, the control circuit shall be so arranged that only one control is effective at a given time. This applies especially to machines which can be manually controlled by means of, among others, a portable control unit (such as a teach pendant), with which the operator can enter danger zones. 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, ISO 9355-3 and ISO 447). g) For machine functions whose safe operation depends on permanent, direct control by the operator, measures shall be		P

	implemented to ensure the presence of the operator at the control position. h) For cableless control, an automatic stop shall be performed when correct control signals are not received, including loss of communication (see IEC 60204-1).		
6.2.11.9	Control mode for setting, teaching, process changeover, fault-finding, cleaning or maintenance 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 into operation, the safety of the operator shall be achieved using a specific control mode which simultaneously a) disables all other control modes, b) permits operation of the hazardous elements only by continuous actuation of an enabling device, a two-hand control device or a hold-to-run control device, c) permits operation of the hazardous elements only in reduced risk conditions (for example, reduced speed, reduced power/force, step-by-step, for example, with a limited movement control device), and d) prevents any operation of hazardous functions by voluntary or involuntary action on the machine's sensors.		P
6.2.11.10	Selection of control and operating modes 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 (for example, to allow for adjustment, setting, maintenance, inspection), it shall be fitted with a mode selector which can be locked in each position. Each position of the selector shall be clearly identifiable and shall exclusively allow one control or operating mode. The selector may be replaced by another selection means which restricts the use of certain functions of the machinery to certain categories of operators.		P
6.2.11.11	Applying measures to achieve electromagnetic compatibility (EMC) For guidance on electromagnetic compatibility, see IEC 60204-1 and IEC 61000-6.		P
6.2.11.12	Provision of diagnostic systems to aid fault-finding Diagnostic systems to aid fault-finding should be included in the control system so that there is no need to disable any protective measure.		P

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Clause	Requirement-Test	Result-Remark	Verdict
6.2.12	Minimizing probability of failure of safety functions		P
6.2.12.1	General 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 the measures given in 6.2.12.2 to 6.2.12.4.		P
6.2.12.2	Use of reliable components “Reliable components” means components which are capable of withstanding all disturbances and stresses associated with the usage of the equipment in the conditions of intended use (including the environmental conditions), for the period of time or the number of operations fixed for the use, with a low probability of failures generating a hazardous malfunctioning of the machine. Components shall be selected taking into account all factors mentioned above (see also 6.2.13).		P
6.2.12.3	Use of “oriented failure mode” components “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 the effect of such a failure on the machine function can be predicted.		P
6.2.12.4	Duplication (or redundancy) of components or subsystems In the design of safety-related parts of the machine, duplication (or redundancy) of components may be used so that, if one component fails, another component or components continue to perform the respective function(s), thereby ensuring that the safety function remains available. In order to allow the proper action to be initiated, component failure shall be detected by automatic monitoring (see 6.2.11.6) or in some circumstances by regular inspection, provided that the inspection interval is shorter than the expected lifetime of the components. Diversity of design and/or technology can be used to avoid common cause failures or common mode failures.		P
6.2.13	Limiting exposure to hazards through reliability of equipment Increased reliability of all component parts of machinery reduces the frequency of incidents requiring intervention, thereby reducing exposure to hazards. This applies to power systems (operative part, see Annex A) as well as to control systems, and to safety functions as well as to other functions of machinery.Safety-related components of known		P

	reliability shall be used.		
6.2.14	Limiting exposure to hazards through mechanization or automation of loading (feeding)/unloading (removal) operations Mechanization and automation of machine loading/unloading operations and, more generally, of handling operations — of workpieces, materials or substances — limits the risk generated by these operations by reducing the exposure of persons to hazards at the operating points. Automation can be achieved by, for example, robots, handling devices, transfer mechanisms and air-blast equipment. Mechanization can be achieved by, for example, feeding slides, push-rods and hand-operated indexing tables. 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 corrected. Care shall be taken to ensure that the use of these devices does not introduce further hazards, such as trapping or crushing, between the devices and parts of the machine or workpieces/materials being processed. Suitable safeguards (see 6.3) shall be provided if this cannot be ensured. Automatic feeding and removal devices with their own control systems and the control system of the associated machine shall be interconnected after thorough study of how all safety functions are performed in all the control and operation modes of the entire equipment.		P
6.2.15	Limiting exposure to hazards through location of setting and maintenance points outside danger zones 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		P
6.3.1	General Guards and protective devices shall be used to protect persons whenever an inherently safe design measure does not reasonably make it possible either to remove hazards or to sufficiently reduce risks. Complementary protective measures involving additional equipment (for example, emergency stop equipment) may have to be implemented.		P
6.3.2	Selection and implementation of guards and protective devices		P
6.3.2.1	General This subclause gives guidelines for the selection and the implementation of guards and protective devices the primary purpose of which is to protect persons against hazards generated		P

	by moving parts, according to the nature of those parts (see Figure 4) and to the need for access to the danger zone(s). The exact choice of a safeguard for a particular machine shall be made on the basis of the risk assessment for that machine. 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 the access of an operator into a danger zone is not required during the normal operation (operation without malfunction) of the machinery. As the need for frequency of access increases, this inevitably leads to the fixed guard not being replaced. This requires the use of an alternative protective measure (movable interlocking guard, sensitive protective equipment). A combination of safeguards can sometimes be required. For example, where, in conjunction with a fixed guard, a mechanical loading (feeding) device is used to feed a workpiece into a machine, thereby removing the need for access to the primary hazard zone, a trip device can be required to protect against the secondary drawing-in or shearing hazard between the mechanical loading (feeding) device, when reachable, and the fixed guard. Consideration shall be given to the enclosure of control positions or intervention zones to provide combined protection against several hazards including a) hazards from falling or ejected objects, using, for example, protection in the form of a falling object protection structure (FOPS), b) emission hazards (protection against noise, vibration, radiation, substances hazardous to health, etc.), c) hazards due to the environment (protection against heat, cold, foul weather, etc.), d) hazards due to tipping over or rolling over of machinery, using, for example, protection in the form of roll-over or tip-over protection structures (ROPS and TOPS). The design of enclosed work stations, such as cabs and cabins, shall take into account ergonomic principles concerning visibility, lighting, atmospheric conditions, access, posture.		
6.3.2.2	Where access to the hazard zone is not required during normal operation Where access to the hazard zone is not required during normal operation of the machinery, safeguards should be selected from the following:		P

	a) fixed guards (see also ISO 14120); b) interlocking guards with or without guard locking (see also 6.3.3.2.3, ISO 14119 and ISO 14120); c) self-closing guards (see ISO 14120:2002, 3.3.2); d) sensitive protective equipment, such as electrosensitive protective equipment (see IEC 61496) or pressure-sensitive protective devices (see ISO 13856).		
6.3.2.3	Where access to the hazard zone is required during normal operation Where access to the hazard zone is required during normal operation of the machinery, safeguards should be selected from the following: a) interlocking guards with or without guard locking (see also ISO 14119, ISO 14120 and 6.3.3.2.3 of this document); b) sensitive protective equipment, such as electrosensitive protective equipment (see IEC 61496); c) adjustable guards; d) self-closing guards (see ISO 14120:2002, 3.3.2); e) two-hand control devices (see ISO 13851); f) interlocking guards with a start function (control guard) (see 6.3.3.2.5).		P
6.3.2.4	Where access to the hazard zone is required for machine setting, teaching, process changeover, fault-finding, cleaning or maintenance As far as possible, machines shall be designed so that the safeguards provided for the protection of the production operator also ensure the protection of personnel carrying out setting, teaching, process changeover, fault-finding, cleaning or maintenance, without hindering them in the performance of their task. Such tasks shall be identified and considered in the risk assessment as parts of the use of the machine (see 5.2).		P
6.3.2.5	Selection and implementation of sensitive protective equipment1)		P
6.3.2.5.1	Selection 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. The following provisions are intended to provide the designer with criteria for selecting, for each application, the most suitable device(s). Types of sensitive protective equipment include – light curtains, – scanning devices, for example, laser scanners, – pressure-sensitive mats, and		P

	– trip bars, trip wires. Sensitive protective equipment can be used – for tripping purposes, – for presence sensing, – for both tripping and presence sensing, or – to re-initiate machine operation — a practice subject to stringent conditions. The following characteristics of the machinery, among others, can preclude the sole use of sensitive protective equipment: – tendency for the machinery to eject materials or component parts; – necessity to guard against emissions (noise, radiation, dust, etc.); – erratic or excessive machine stopping time; – inability of a machine to stop part-way through a cycle.		
6.3.2.5.2	Implementation Consideration should be given to a) the size, characteristics and positioning of the detection zone (see ISO 13855, which deals with the positioning of some types of sensitive protective equipment), b) the reaction of the device to fault conditions (see IEC 61496 for electrosensitive protective equipment), c) the possibility of circumvention, and d) detection capability and its variation over the course of time (as a result, for example, of its susceptibility to different environmental conditions such as the presence of reflecting surfaces, other artificial light sources and sunlight or impurities in the air). Sensitive protective equipment shall be integrated in the operative part and associated with the control system of the machine so that – a command is given as soon as a person or part of a person is detected, – the withdrawal of the person or part of a person detected does not, by itself, restart the hazardous machine function(s), and therefore the command given by the sensitive protective equipment is maintained by the control system until a new command is given, – 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, – the machine cannot operate during interruption of the detection function of the sensitive protective equipment, except during muting phases, and		P

	– the position and the shape of the detection field prevents, possibly together with fixed guards, a person or part of a person from entering or being present in the hazard zone without being detected.		
6.3.2.5.3	Additional requirements for sensitive protective equipment when used for cycle initiation In this exceptional application, the 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. Cycle initiation by sensitive protective equipment shall be subject to the following conditions: a) only active optoelectronic protective devices (AOPDs) complying with IEC 61496 series shall be used; 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; c) the cycle time of the machine is short and the facility to re-initiate the machine upon clearing of the sensing field is limited to a period commensurate with a single normal cycle; d) entering the sensing field of the AOPD(s) or opening interlocking guards is the only way to enter the hazard zone; e) if there is more than one AOPD safeguarding the machine, only one of the AOPDs is capable of cycle re-initiation; 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.		P
6.3.2.6	Protective measures for stability If stability cannot be achieved by inherently safe design measures such as weight distribution (see 6.2.6), it shall be maintained by the use of protective measures such as – anchorage bolts, – locking devices, – movement limiters or mechanical stops, – acceleration or deceleration limiters, – load limiters, and		P

	– alarms warning of the approach to stability or tipping limits.		
6.3.2.7	Other protective devices When a machine requires continuous control by the operator (for example, 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 – when the operator has insufficient visibility of the hazard zone, – when the operator lacks knowledge of the actual value of a safety-related parameter (distance, speed, mass, angle, etc.), and – when hazards can result from operations other than those controlled by the operator. The necessary devices include a) devices for limiting parameters of movement (distance, angle, velocity, acceleration), b) overloading and moment limiting devices, c) devices to prevent collisions or interference with other machines, d) devices for preventing hazards to pedestrian operators of mobile machinery or other pedestrians, e) torque limiting devices, and breakage points to prevent excessive stress of components and assemblies, f) devices for limiting pressure or temperature, g) devices for monitoring emissions, h) devices to prevent operation in the absence of the operator at the control position, i) devices to prevent lifting operations unless stabilizers are in place, j) devices to limit inclination of the machine on a slope, and k) devices to ensure that components are in a safe position before travelling. Automatic protective measures triggered by such devices that take operation of the machinery out of the control of the operator (for example, 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).		P
6.3.3	Requirements for design of guards and protective devices		P
6.3.3.1	General requirements 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		P

	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 shall a) be of robust construction, b) not give rise to any additional hazard, c) not be easy to bypass or render non-operational, d) be located at an adequate distance from the danger zone (see ISO 13855 and ISO 13857), e) cause minimum obstruction to the view of the production process, and f) enable essential work to be carried out for the installation and/or replacement of tools and for maintenance by allowing access only to the area where the work has to be carried out — if possible, without the guard having to be removed or protective device having to be disabled. For openings in the guards, see ISO 13857.		
6.3.3.2	Requirements for guards		P
6.3.3.2.1	Functions of guards The functions that guards can achieve are – prevention of access to the space enclosed by the guard, and/or – containment/capture of materials, workpieces, chips, liquids which can be ejected or dropped by the machine, and reduction of emissions (noise, radiation, hazardous substances such as dust, fumes, gases) that can be generated by the machine. Additionally, they could need to have particular properties relating to electricity, temperature, fire, explosion, vibration, visibility (see ISO 14120) and operator position ergonomics (for example, usability, operator's movements, postures, repetitive movements).		P
6.3.3.2.2	Requirements for fixed guards Fixed guards shall be securely held in place either – permanently (for example 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).		P
6.3.3.2.3	Requirements for movable guards Movable guards which provide protection against hazards generated by moving transmission parts shall a) as far as possible when open remain fixed to the machinery or other structure (generally by means of hinges or guides), and b) be interlocking (with guard locking when necessary) (see ISO 14119). See Figure 4.		P

	Movable guards against hazards generated by non-transmission moving parts shall be designed and associated with the machine control system so that – moving parts cannot start up while they are within the operator's reach and the operator cannot reach moving parts once they have started up, with this able to be achieved by interlocking guards, with guard locking when necessary, – they can be adjusted only by an intentional action, such as the use of a tool or a key, and – the absence or failure of one of their components either prevents starting of the moving parts or stops them, with this able to be achieved by automatic monitoring (see 6.2.11.6).		
6.3.3.2.4	Requirements for adjustable guards Adjustable guards may only be used where the hazard zone cannot for operational reasons be completely enclosed. Manually adjustable guards shall be – designed so that the adjustment remains fixed during a given operation, and – readily adjustable without the use of tools.		P
6.3.3.2.5	Requirements for interlocking guards with a start function (control guards) An interlocking guard with a start function may only be used provided that a) all requirements for interlocking guards are satisfied (see ISO 14119), b) the cycle time of the machine is short, c) the maximum opening time of the guard is preset to a low value (for example, equal to the cycle time) and, when this time is exceeded, the hazardous function(s) cannot be initiated by the closing of the interlocking guard with a start function and resetting is necessary before restarting the machine, d) the dimensions or shape of the machine do not allow a person, or part of a person, to stay in the hazard zone or between the hazard zone and the guard while the guard is closed (see ISO 14120), e) all other guards, whether fixed (removable type) or movable, are interlocking guards, f) the interlocking device associated with the interlocking guard with a start function is designed such that — for example, by duplication of position detectors and use of automatic monitoring (see 6.2.11.6) — its failure cannot lead to an unintended/unexpected start-up, and g) the guard is securely held open (for example, by a spring or		P

	counterweight) such that it cannot initiate a start while falling by its own weight.		
6.3.3.2.6	Hazards from guards Care shall be taken to prevent hazards which could be generated by – the guard construction (sharp edges or corners, material, noise emission, etc.), – the movements of the guards (shearing or crushing zones generated by power-operated guards and by heavy guards which are liable to fall).		P
6.3.3.3	Technical characteristics of protective devices Protective devices shall be selected or designed and connected to the control system such that correct implementation of their safety function(s) is ensured. Protective devices shall be selected on the basis of their having met the appropriate product standard (for example, IEC 61496 for active optoelectronic protective devices) or shall be designed according to one or several of the principles formulated in ISO 13849-1 or IEC 62061. Protective devices shall be installed and connected to the control system so that they cannot be easily defeated.		P
6.3.3.4	Provisions for alternative types of safeguards Provisions should be made to facilitate the fitting of alternative types of safeguards on machinery where it is known that it will be necessary to change the safeguards because of the range of work to be carried out.		P
6.3.4	Safeguarding to reduce emissions		P
6.3.4.1	General If the measures for the reduction of emissions at source specified in 6.2.2.2 are not adequate, the machine shall be provided with additional protective measures (see 6.3.4.2 to 6.3.4.5).		P
6.3.4.2	Noise Additional protective measures against noise include – enclosures (see ISO 15667), – screens fitted to the machine, and – silencers (see ISO 14163).		P
6.3.4.3	Vibration Additional protective measures against vibration include – vibration isolators, such as damping devices placed between the source and the exposed person, – resilient mounting, and – suspended seats. For measures for vibration isolation of stationary industrial		P

	machinery see EN 1299.		
6.3.4.4	Hazardous substances Additional protective measures against hazardous substances include – encapsulation of the machine (enclosure with negative pressure), – local exhaust ventilation with filtration, – wetting with liquids, and – special ventilation in the area of the machine (air curtains, cabins for operators). See ISO 14123-1.		P
6.3.4.5	Radiation Additional protective measures against radiation include – use of filtering and absorption, and – use of attenuating screens or guards.		P
6.3.5	Complementary protective measures		P
6.3.5.1	General Protective measures which are neither inherently safe design measures, nor safeguarding (implementation of guards and/or protective devices), nor information for use, could 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, those dealt with in 6.3.5.2 to 6.3.5.6.		P
6.3.5.2	Components and elements to achieve emergency stop function If, following a risk assessment, a machine needs to be fitted with components and elements to achieve an emergency stop function for enabling actual or impending emergency situations to be averted, the following requirements apply: – the actuators shall be clearly identifiable, clearly visible and readily accessible; – the hazardous process shall be stopped as quickly as possible without creating additional hazards, but 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 emergency stop control shall trigger or permit the triggering of certain safeguard movements where necessary.		P
6.3.5.3	Measures for the escape and rescue of trapped persons Measures for the escape and rescue of trapped persons may consist, among others, of – escape routes and shelters in installations generating operator-trapping hazards,		P

	– arrangements for moving some elements by hand, after an emergency stop, – arrangements for reversing the movement of some elements, – anchorage points for descender devices, – means of communication to enable trapped operators to call for help.		
6.3.5.4	Measures for isolation and energy dissipation Machines shall be equipped with the technical means to achieve isolation from power supply(ies) and dissipation of stored energy by means of the following actions: a) isolating (disconnecting, separating) the machine (or defined parts of the machine) from all power supplies; b) locking (or otherwise securing) all the isolating units in the isolating position; c) dissipating or, if this is not possible or practicable, restraining (containing) any stored energy which can give rise to a hazard; d) verifying, by means of safe working procedures, that the actions taken according to a), b) and c) above have produced the desired effect.		P
6.3.5.5	Provisions for easy and safe handling of machines and their heavy component parts Machines and their component parts which cannot be moved or transported by hand shall be provided or be capable of being provided with suitable attachment devices for transport by means of lifting gear. These attachments may be, among others, – standardized lifting appliances with slings, hooks, eyebolts, or tapped holes for appliance fixing, – appliances for automatic grabbing with a lifting hook when attachment is not possible from the ground, – fork locating devices for machines to be transported by a lift truck, – lifting and stowing gear and appliances integrated into the machine. Parts of machinery which can be removed manually in operation shall be provided with means for their safe removal and replacement.		P
6.3.5.6	Measures for safe access to machinery 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. Where this is not possible, machines shall have built-in platforms, stairs or other facilities to provide safe access for those tasks;		P

	however, care should be taken to ensure that such platforms or stairs do not give access to danger zones of machinery. 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, shall be provided with suitable guard-rails (see ISO 14122-3). In large automated installations, particular attention shall be given to safe means of access, such as walkways, conveyor bridges or crossover points. Means of access to parts of machinery located at height shall be provided with collective means of protection against falls (for example, guard-rails for stairways, stepladders and platforms and/or safety cages for ladders). As necessary, anchorage points for personal protective equipment against falls from height shall also be provided (for example, in carriers of machinery for lifting persons or with elevating control stations). Openings shall, whenever possible, open towards a safe position. They shall be designed to prevent hazards due to unintended opening. The necessary aids for access shall be provided (steps, handholds, etc.). Control devices shall be designed and located to prevent their being used as aids for access. When machinery for lifting goods and/or persons includes landings at fixed levels, these shall be equipped with interlocking guards for preventing falls when the platform is not present at a level. Movement of the lifting platform shall be prevented while the guards are open. For detailed provisions see ISO 14122.		
6.4	Information for use		P
6.4.1	General requirements		P
6.4.1.1	Drafting information for use is an integral part of the design of a machine (see Figure 2). Information for use consists of communication links, such as texts, words, signs, signals, symbols or diagrams, used separately or in combination to convey information to the user. Information for use is intended for professional and/or non-professional users.		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. 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. The information shall indicate, as appropriate,		P

	– the need for training, – the need for personal protective equipment, and – the possible need for additional guards or protective devices (see Figure 2, Footnote d). 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.		
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.		P
6.4.2	Location and nature of information for use 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 a) in/on the machine itself (see 6.4.3 and 6.4.4), b) in accompanying documents (in particular instruction handbook, see 6.4.5), c) on the packaging, d) by other means such as signals and warnings outside the machine. Standardized phrases shall be considered where important messages such as warnings are given (see also IEC 62079).		P
6.4.3	Signals and warning devices Visual signals, such as flashing lights and audible signals such as sirens may be used to warn of an impending hazardous event such as machine start-up or overspeed. Such signals may also be used to warn the operator before the triggering of automatic protective measures (see 6.3.2.7). It is essential that these signals a) be emitted before the occurrence of the hazardous event, b) be unambiguous, c) be clearly perceived and differentiated from all other signals used, and d) be clearly recognized by the operator and other persons. The warning devices shall be designed and located such that checking is easy. The information for use shall prescribe regular checking of warning devices. The attention of designers is drawn to the possibility of “sensorial saturation”, which can result from too		P

	many visual and/or acoustic signals and which can also lead to defeating the warning devices.		
6.4.4	Markings, signs (pictograms) and written warnings Machinery shall bear all markings which are necessary a) for its unambiguous identification, including at least 1) the name and address of the manufacturer, 2) the designation of series or type, and 3) the serial number, if any, b) in order to indicate its compliance with mandatory requirements, comprising 1) marking, and 2) written indications, such as the authorized representative of the manufacturer, designation of the machinery, year of construction, and intended use in potentially explosive atmospheres), c) for its safe use, for example, 1) maximum speed of rotating parts, 2) maximum diameter of tools, 3) mass (in kilograms) of the machine itself and/or of removable parts, 4) maximum working load, 5) necessity of wearing personal protective equipment, 6) guard adjustment data, and 7) frequency of inspection. Information printed directly on the machine should be permanent and remain legible throughout the expected life of the machine. Signs or written warnings indicating only “Danger” shall not be used. Markings, signs and written warnings shall be readily understandable and unambiguous, especially as regards the part of the function(s) of the machine to which they are related. Readily understandable signs (pictograms) should be used in preference to written warnings. Signs and pictograms should only be used if they are understood in the culture in which the machinery is to be used.		P
6.4.5	Accompanying documents (in particular — instruction handbook)		P
6.4.5.1	Contents The instruction handbook or other written instructions (for example, on the packaging) shall contain, among others, the following: a) information relating to transport, handling and storage of the machine, such as 1) storage conditions for the machine, 2) dimensions, mass value(s), position of the centre(s) of gravity,		P

	and 3) indications for handling (for example, drawings indicating application points for lifting equipment); b) information relating to installation and commissioning of the machine, such as 1) fixing/anchoring and dampening of noise and vibration requirements, 2) assembly and mounting conditions, 3) space needed for use and maintenance, 4) permissible environmental conditions (for example, temperature, moisture, vibration, electromagnetic radiation), 5) instructions for connecting the machine to power supply (particularly on protection against electrical overloading), 6) advice on waste removal/disposal, and 7) if necessary, recommendations related to protective measures which have to be implemented by the user — for example, additional safeguards (see Figure 2, Footnote d), safety distances, safety signs and signals; c) information relating to the machine itself, such as 1) detailed description of the machine, its fittings, guards and/or protective devices, 2) the 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, 3) diagrams (especially schematic representation of safety functions), 4) data on noise and vibration generated by the machine, and on radiation, gases, vapours and dust emitted by it, with reference to the measuring methods (including measurement uncertainties) used, 5) technical documentation of electrical equipment (see IEC 60204), and 6) documents attesting that the machine complies with mandatory requirements; d) information relating to the use of the machine, such as that related to or describing 1) intended use, 2) manual controls (actuators), 3) setting and adjustment, 4) modes and means for stopping (especially emergency stop), 5) risks which could not be eliminated by the protective measures implemented by the designer,		

	6) particular risks which can be generated by certain applications, by the use of certain fittings, and about specific safeguards necessary for such applications, 7) reasonably foreseeable misuse and prohibited applications, 8) fault identification and location, for repair and for restarting after an intervention, and 9) personal protective equipment needed to be used and the training that is required; e) information for maintenance, such as 1) the nature and frequency of inspections for safety functions, 2) specification of the spare parts to be used when these can affect the health and safety of operators, 3) instructions relating to maintenance operations which require a definite technical knowledge or particular skills and hence need to be carried out exclusively by skilled persons (for example, maintenance staff, specialists), 4) instructions relating to maintenance actions (replacement of parts, etc.) which do not require specific skills and hence may be carried out by users (for example, operators), and 5) drawings and diagrams enabling maintenance personnel to carry out their task rationally (especially fault-finding tasks); f) information relating to dismantling, disabling and scrapping; g) information for emergency situations, such as 1) the operating method to be followed in the event of accident or breakdown, 2) the type of fire-fighting equipment to be used, and 3) a warning of possible emission or leakage of hazardous substance(s) and, if possible, an indication of means for fighting their effects; h) maintenance instructions provided for skilled persons [item e) 3) above] and maintenance instructions provided for unskilled persons [item e) 4) above], that need to appear clearly separated from each other.		
6.4.5.2	Production of instruction handbook The following applies to the production and presentation of the instruction handbook. a) The type fount and size of print shall ensure the best possible legibility. Safety warnings and/or cautions should be emphasized by the use of colours, symbols and/or large print. b) The information for use shall be given in the language(s) of the		P

	country in which the machine will be used for the first time and in the original version. If more than one language is to be used, each should be readily distinguished from another, and efforts should be made to keep the translated text and relevant illustration together. NOTE In some countries the use of specific language(s) is covered by legal requirements. c) Whenever helpful to the understanding, text should be supported by illustrations. These illustrations should be supplemented with written details enabling, for example, manual controls (actuators) to be located and identified. They should not be separated from the accompanying text and should follow sequential operations. d) Consideration should be given to presenting information in tabular form where this will aid understanding. Tables should be adjacent to the relevant text. e) The use of colours should be considered, particularly in relation to components requiring quick identification. f) When information for use is lengthy, a table of contents and/or an index should be provided. g) Safety-relevant instructions which involve immediate action should be provided in a form readily available to the operator.		
6.4.5.3	Drafting and editing information for use The following applies to the drafting and editing of information for use. 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). b) Communication principles: when information for use is being prepared, the communication process “see – think – use” should be followed in order to achieve the maximum effect and should follow sequential operations. The questions, “How?” and “Why?” should be anticipated and the answers provided. 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. 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 user. If personal protective equipment is required for the safe use of the machine, clear advice should be given, for example, on the packaging as well as on the machine, so that this information is prominently displayed at the point of sale.		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 can be useful to mark them “keep for future reference”. Where information for use is kept in electronic form (CD, DVD, tape, hard disk, etc.), information on safety-related issues that need immediate action shall always be backed up with a hard copy that is readily available.		
7	Documentation of risk assessment and risk reduction The documentation shall demonstrate the procedure that has been followed and the results that have been achieved. This includes, when relevant, documentation of a) the machinery for which the risk assessment has been made (for example, specifications, limits, intended use); b) any relevant assumptions that have been made (loads, strengths, safety factors, etc.); c) the hazards and hazardous situations identified and the hazardous events considered in the risk assessment; 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; e) the risk reduction objectives to be achieved by protective measures; f) the protective measures implemented to eliminate identified hazards or to reduce risk; g) residual risks associated with the machinery; h) the result of the risk assessment (see Figure 1); i) any forms completed during the risk assessment. Standards or other specifications used to select protective measures referred to in f) above should be referenced.		P

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

4.	GENERAL REQUIREMENTS		–
4.1	General considerations		–
	hazard and risk assessment	Complied	P
4.2	Selection of equipment		–
4.2.1	electrical components/devices suitable for their intended use; and	Major electrical components and devices confirm to relevant EN standards.	P
	conform to the relevant IEC or EN standards..... :	See above	P
	and be applied in accordance with the supplier's instructions	Complied	P
4.2.2	The electrical equipment of the machine satisfies the safety requirements identified by the risk assessment of the machine.	Complied	P
	Depending upon the machine, its intended use and its electrical equipment, parts of the electrical equipment of the machine are in compliance with EN 60439-1 and, as necessary, other relevant parts of the EN 60439 series (see also Annex F).		N
4.3	Power supply and related conditions:		–
4.3.1	Electrical equipment to be designed for correct operation with conditions of mains power supply	See 4.3.2 and 4.3.3	P
4.3.2	Supply Voltage..... :	220~230V ± 10%	P
	Frequency..... :	50/60Hz ± 1%	P
	Harmonics..... :	Less than 10%	P
	Voltage unbalance..... :	Less than 2% of positive sequence components	P
	Voltage interruption..... :	< 3ms; 1s between interruption	P
	Voltage dips ..... :	< 20%; 1s between interruption	P
4.3.3	DC Voltage ..... :	No DC main voltage	N
	Voltage interruption..... :	See above	N
	Ripple (peak-peak) ..... :	See above	N
4.3.4	Onboard power supply acc. to cl. 4.3.2 and 4.3.3	No on-board generator	N
4.4	Physical environment and operating conditions		–
4.4.1	Electrical equipment to be suitable for use in physical environment and operating conditions	See 4.4.2 to 4.4.8.	P
	An agreement between user and supplier (see 4.1 and Annex B).	See above	N
4.4.2	Electromagnetic compatibility (EMC)		–
	Equipment not to generate electromagnetic disturbances above harmful	Verified at installation	–

	levels ..... : (applicable generic EMC-standard: EN 61000-6-3 or EN 61000-6-4)		
	Equipment has adequate level of immunity to EMC (applicable generic EMC-standards: EN 61000-6-1 or EN 61000-6-2).....:	See above	–
4.4.3	Electrical equipment to be capable for correct operation at intended ambient air temperature	Between +0 oC and +40 oC	P
4.4.4	Electrical equipment to be capable for correct operation at specified relative humidity: at and	Relative humidity rating of major electrical components and devices is not less than 50% at a temperature of +40 oC	P
4.4.5	Electrical equipment capable of operating correctly at altitudes up to 1000 m above m.s.l.	Up to 1000 m	P
4.4.6	Electrical equipment shall be adequately protected against ingress of solid properties and liquids	The equipment has been designed for the IP55	P
4.4.7	Equipment subject to radiation, additional measures to be taken to avoid equipment malfunction	No radiation and additional measures to be taken to avoid equipment malfunction	N
4.4.8	Undesirable effects of vibration, shock and bump avoided	See instruction manual	P
4.5	Electrical equipment designed to withstand the effects of transportation and storage within a temperature range of -25 to +55 °C	Temp. range of transportation and storage for major electrical components and devices are within a range of 0 oC to +50 oC	P
	A special agreement between supplier and user (see Annex B).	See above	N
4.6	Heavy or bulky electrical equipment of the machine provided with suitable means for handling	Information for transportation and installation is provided in instructions and handling devices are equipped where necessary.	P
4.7	Electrical equipment installed and operated in accordance with the supplier’s instruction	See instruction manual	P
5.	INCOMING SUPPLY CONDUCTOR TERMINATIONS AND DEVICES FOR DISCONNECTING AND SWITCHING OFF		–
5.1	Incoming supply conductor terminal		–
	electrical equipment of a machine connected to a single power supply	Single power supply of 220~230 V~, 50/60 Hz	P
	power supply conductors terminated to main disconnecting device of electrical equipment	Incoming supply is directly connected to the supply terminal of the main circuit	P

		breaker. (see installation instruction)	
	neutral conductor ”N” clearly indicated in technical documentation (see 16.1 and also annex B).	No neutral conductor	N
	no connection between neutral conductor and protective bonding circuit nor combined PEN-terminals.		N
	All terminals of incoming supply clearly marked (symbols acc. to EN 60445 and 16.1)	Terminals identified with markings of L1, L2, L3	P
5.2	Terminal for connection to external protective earthing system		–
	Terminal for connection of external protective conductor provided and marked with ”PE”	PE terminal on the bottom of the control panel	P
	Cross section of incoming PE conductor acc. to cl. 5.2, table 1	According to clause 5.2, Table 1	P
	Terminals allow connection of external protective earth conductors PE (see EN 60445 and also 8.2.6)	Main terminal block	P
5.3	Supply disconnecting device		–
5.3.1	Power supply disconnecting device provided for electrical equipment	Verified at installation	N
5.3.2	Type of power supply disconnecting device:		–
	a) Switch-disconnector, acc. to EN 60947-3 for appliance category AC-23 B or DC-23 B		N
	b) Disconnector with or without fuses, with aux. contact (acc. to EN 60947-3)		N
	c) Power CB suitable for isolation (acc. to EN 60947-2)		N
	d) Any other switching device in accordance with an IEC product standard for that device and which meets the isolation requirements of EN 60947-1 as well as a utilization category defined in the product standard as appropriate for on-load switching of motors or other inductive loads		N
	e) plug and socket outlets or appliance couplers for flexible cable supply		N
5.3.3	When the supply disconnecting device is one of the types specified in 5.3.2 a) to d):		–
	Isolator for electrical equipment from supply (acc. to EN 60947-2)	See above	N
	One OFF (isolated) and one ON position only		N
	Clearly marked with ”0” and ”I”		N
	visible isolating distance or		N
	Position indication which cannot indicate the		N

	OFF-position until all contacts are actually open		
	External operating device provided (except power operated CB's)		N
	Colour black or grey preferred, where the external operating means is not intended for emergency operations (see 10.7.4 and 10.8.4)		N
	If used as an emergency stop, red/yellow combination selected		N
	Locking means provided to lock in OFF-position		N
	In locked position, remote or local closing prevented		N
	Disconnection of all live conductors (Exception: TN- supply systems, neutral conductor)		N
	Sufficient breaking capacity		N
	When the supply disconnecting device is a plug/socket combination:		–
	– have the switching capability, or be interlocked with a switching device that has a breaking capacity, sufficient to interrupt the current of the largest motor when stalled together with the sum of the normal running currents of all other motors and/or loads.		N
	When the interlocked switching device is electrically operated (for example a contactor) it has an appropriate utilization category		N
	– a) to f) of 13.4.5.		N
	Where the supply disconnecting device is a plug/socket combination,		–
	– a switching device with an appropriate utilization category provided for switching the machine on and off (e.g. by the use of the interlocked switching device described above);		N
5.3.4	Handle of disconnecting device to be easily accessible	See above	N
	Handle located between 0.6m and 1.9m above service level (upper limit of 1.7 m is recommended)		N
5.3.5	Following circuits not disconnected by supply disconnecting device:		–
	Lighting circuits during maintenance or repair		N
	Plug/socket outlets exclusively used for maintenance or repair		N
	Undervoltage protection circuits used for automatic tripping only at power supply failures		N
	Circuits of equipment to remain normally energised for satisfactory operation		N

	Control circuits for interlocking purposes		N
	Circuits which are not disconnected by supply disconnecting device:		–
	Permanent warning labels placed in proximity of supply disconnectors (see 16.1)		N
	Corresponding statement in maintenance manual, and		N
	Warning label in proximity of circuit concerned		N
	or wiring separated from other wiring		N
	or conductors identified by colour taking into account the recommendation of 13.2.4		N
5.4	Disconnecting devices to prevent unexpected start-up:		–
	Means shall be provided to prevent inadvertent and / or mistaken closure of the disconnecting device (see also 5.6)	NFB0	N
	Such devices appropriate and convenient for intended use		N
	Suitable placed		N
	Readily identifiable (see 16.1)		N
	Devices that fulfill the isolation function provided:		–
	– devices described in 5.3.2,	See 5.3.2	N
	– disconnectors, withdrawable fuse links and withdrawable links only if located in an enclosed electrical operating area (see 3.19).		N
	Devices that do not fulfill the isolation function (for example a contactor switched off by a control circuit) for the following situations only:		
	– inspections;		N
	– adjustments;		N
	– work on the electrical equipment where:		
	• there is no hazard arising from electric shock (see Clause 6) and burn;		N
	• the switching off means remains effective throughout the work;		N
	• the work is of a minor nature (for example replacement of plug-in devices without disturbing existing wiring).		N
5.5	Devices provided for disconnecting (isolating) electrical equipment to enable work to be carried out when it is de-energized and isolated.		N
	Such disconnecting devices appropriate and convenient for intended use and		N
	Suitably located and		N
	readily identifiable to which part it serves (see		N

	16.1).		
	Provided with adequate means to prevent unauthorised, inadvertent and /or mistaken closing (see also 5.6)		N
	Supply-disconnecting device used (see 5.3)		N
	Disconnecting device provided for each separated part of the machine or partial machine where necessary		N
	In addition to the supply disconnecting device as above:		–
	Devices described in 5.3.2;		N
	Disconnectors, fuse links etc. used only in enclosed electrical operating areas (see 3.15) and		N
	and relevant information is provided with the electrical equipment (see 17.2 b) 9) and b)12)).		N
5.6	Devices acc. to cl. 5.4 and 5.5 that are located outside an enclosed electrical operating area		N
	Means provided with device to secure them in the OFF position (disconnected state), (for example by provisions for padlocking, trapped key interlocking)		N
	When so secured, remote as well as local reconnection shall be prevented.		N
	Other means of protection against reconnection (for example warning labels in accordance with 16.1) used for non-lockable disconnecting devices (for example withdrawable fuse-links, withdrawable links)		N
	Locking device not necessary for plug/ socket outlet combinations, if located in a suitable manner and		N
	Under immediate supervision of the person carrying out the work		N
6	PROTECTION AGAINST ELECTRIC SHOCK		–
6.2	Protection against direct contact:		–
6.2.1	- by means of protection by enclosure	All live parts were protected by enclosure or integrated insulation with the approved components.	P
	- by means of insulation of live parts	See 6.2.3	P
	- by means of protection against residual voltages	See 18.5	P
6.2.2	Protection by enclosure:		–
	Live parts located inside enclosures conform to relevant requirements of clauses 4, 11 and 14	IP 55 Motor	P

	Protection against direct contact at least IP2X or IPXXB		
	Where top surfaces of enclosures are readily accessible, degree of protection against direct contact is IP4X or IPXXD.		N
	Opening of enclosure possible only under following conditions:		
	a) use of a key or a tool. Special requirements for enclosed electrical operating areas may apply		N
	live parts inside of doors with protection degree of IP1X or IPXXA		N
	live parts likely to be touched during resetting or adjustment with protection degree IP2X or IPXXB		N
	b) disconnection of live parts inside enclosure prior to opening of enclosure		N
	at door interlocking safety circuit, door will open only when main isolator is in open position		N
	- opening of disconnector possible at all times while interlock is defeated	See above b)	N
	- and lock the disconnecting device in the OFF (isolated) position or otherwise prevent unauthorised closure of the disconnecting device;		N
	- upon closing the door, interlock is automatically restored		N
	– all live parts, that are likely to be touched when resetting or adjusting devices intended for such operations while the equipment is still connected, are protected against direct contact to at least IP2X or IPXXB and other live parts on the inside of doors are protected against direct contact to at least IP1X or IPXXA;		N
	– relevant information is provided with the electrical equipment (see 17.2 b)9) and b)12)).		N
	Means provided to restrict access to live parts behind doors not directly interlocked with the disconnecting means to skilled or instructed persons. (See 17.2 b)12)).		N
	All parts remaining live after switching off mains supply to be protected against direct contact with at least IP2X or IPXXB		N
	Such parts marked with warning symbol acc. to cl.16.2.1 (see also 13.2.4 for identification of conductors by colour).		N
	Excepted from this requirement for marking are:		–

	- Parts that can be live only due to connection to interlocking circuits, distinguished by colour as potentially live acc. to cl. 13.2.4		N
	- Terminals of supply disconnecting device when latter mounted alone in a separate enclosure		N
	c) opening of doors without use of key or tool and without disconnection of live parts possible only when all live parts are protected against direct contact by IP2X or IPXXB		N
	where protection is provided by barriers, tools required for their removal or		N
	all live parts automatically disconnected when barrier is removed		N
6.2.3	Protection by insulation of live parts:		–
	Live parts completely covered with insulation	All the liver parts insulated appropriately for intended use in the equipment	P
	insulation can be removed only by destruction	Complied	P
	insulation capable to withstand mechanical, chemical, electrical and thermal stress occurring under normal service conditions	Complied	P
	Paint, varnish lacquer etc. not used as insulation	Complied	P
6.2.4	Protection of residual voltage:		–
	Live parts with residual voltage > 60V after disconnection, to be discharged to ≤ 60V within 5s after disconnection, except for components with charges ≤ 60 µC	see 18.5 for test results	P
	Where pins of plugs or similar devices after withdrawal are exposed, discharge time ≤ 1s,	None	N
	Or, such conductors protected against direct contact by at least IP2X or IPXXB	See above	N
	if above requirements cannot be achieved (for example a warning notice in accordance with 16.1), additional disconnecting devices or appropriate warning devices shall be applied. (see cl. 12.7.4)	See above	N
6.2.5	Protection by barriers acc. to EN 60364-4-41 cl. 412.2	No barriers for protection	N
6.2.6	Protection by placing out of reach or protection by obstacles acc. to EN 60364-4-41, cl. 412.4 and 412.3)	No such protection	N
	For collector wire- or bar systems, with protection less than IP2X, see cl. 13.8.1	See above	N
6.3	Protection against indirect contact:		–

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

6.3.2	Measures to prevent the occurrence of a hazardous touch voltage		–
6.3.2.2	use of class II electrical devices or apparatus (double insulation, reinforced insulation or by equivalent insulation acc. to EN 61140)	External wires and cables have been protected by use of double insulation or reinforced insulation.	P
	use of switchgear and controlgear assemblies with total insulation acc. to EN 60439-1	See above	N
	application of supplementary or reinforced insulation acc. to EN 60364-4-41, 413.2	See above	N
6.3.2.3	Electrical separation of an individual circuit to prevent hazardous touch voltage acc. to EN 60364-4-41, cl. 413.5		N
6.3.3	Protection by automatic disconnection of supply by means of:		–
	Protective bonding of exposed conductive parts (see 8.2.3), and	Complied	P
	a) Overcurrent protective device for automatic disconnection on detection of an insulation fault in a TN-system, or	The advice found in manual, the device provided by user	P
	b) Residual current protective devices to initiate the automatic disconnection of the supply on detection of an insulation fault from a live part to exposed conductive parts or to earth in TT systems, or		N
	c) Use of insulation monitoring or residual current protective devices to initiate automatic disconnection in a IT-System, and		N
	Except where a protective device is provided to interrupt the supply in the case of the first earth fault, an insulation monitoring device shall be provided to indicate the occurrence of a first fault from a live part to exposed conductive parts or to earth, initiating an audible and/or visual signal which shall continue as long as the fault persists.		N
	Where automatic disconnection is provided in accordance with a) and disconnection within the time specified in Clause A.1 cannot be assured, supplementary bonding shall be provided as necessary to meet the requirements of Clause A.3.		N
6.4	Protection by application of PELV circuit which have to fulfil following requirements:		–
6.4.1	a) nominal voltage not to exceed 25 AC (r.m.s.) or 60 DC (ripple-free) or		N
	6VAC or 15VDC for all other cases		N
	b) one side of PELV- circuit or one point of source of supply to be connected to PE- circuit		N

	c) live parts of PELV- circuits to be electrically separated from other live circuits.		N
	Electrical separation equal as required for safety isolating transformers (see IEC 61558-1 and IEC 61558-2-6)		N
	d) conductors of each PELV circuit to be physically separated from those of any other circuit.		N
	If not practicable, insulation provisions acc. to cl. 13.1.3 shall be applied		N
	e) plugs and socket outlets for PELV- circuits shall conform to following requirements:		–
	plugs shall not be able to enter socket outlets of other voltage systems	None	N
	socket outlets shall not admit plugs of other voltage systems	None	N
6.4.2	Sources for PELV- circuits to be one of the following:		–
	safety isolating transformers acc. to IEC 61558-1 and IEC 61558-2-6		N
	source of current providing a degree of safety, equivalent to safety isolating transformers		N
	electrochemical or other source, independent of circuit with higher voltage		N
	electronic power supply conforming to appropriate standards		N
7	PROTECTION EQUIPMENT		–
7.2	Overcurrent protection:		–
7.2.1	Overcurrent protection device provided	See manual	N
7.2.2	Overcurrent protective device at incoming feeder to the electrical equipment (see to cl. 7.2.10 and cl. 18.5)		N
	Electrical equipment supplier state data for overcurrent protective device	See instructions	N
7.2.3	Power circuits:		–
	Overcurrent protective devices applied to each live conductors except for neutral earth conductor		N
	The following conductors, as applicable, are not disconnected without disconnecting all associated live conductors:		
	– the neutral conductor of a.c. power circuits;	None	N
	– the earthed conductor of d.c. power circuits;	None	N
	– d.c. power conductors bonded to exposed conductive parts of mobile machines.	No mobile machines	N
	Cross sectional area of neutral conductor to be at		P

	least equal to phase conductor, no overcurrent protective/ disconnecting device required		
	For neutral earth conductors with cross sections smaller than phase conductors, measures acc. to 524 of IEC 60364-5-52 will apply		P
	For IT-systems use of neutral earth conductor (N) is not recommended. Nevertheless if a N-conductor is used, measures acc. to cl. 473.3.2.2 of IEC 60364-4-43 shall apply.	No IT-systems	N
7.2.4	Control circuits:		–
	Conductors of control circuits directly connected to supply voltage and circuits feeding control voltage transformers protected against overcurrent acc. to cl. 7.2.3		N
	Conductors of control circuits supplied by a control circuit transformer or d.c. supply are protected against overcurrent (see also 9.4.3.1):		
	– in control circuits connected to the protective bonding circuit, by inserting an overcurrent protective device into the switched conductor;		N
	– in control circuits not connected to the protective bonding circuit:		–
	- where the same cross sectional area conductors are used in all control circuits, by inserting an overcurrent protective device into the switched conductor, and;		N
	- where different cross sectional areas conductors are used in different sub-circuits, by inserting an overcurrent protective device into both switched and common conductors of each sub-circuit.		N
7.2.5	Socket outlets and their associated conductors:		–
	Overcurrent protection devices for socket outlets provided for non-earthed live conductors of each circuit feeding such socket outlets		N
7.2.6	Lighting circuits:		–
	All unearthed conductors of local lighting circuits protected by overcurrent protective devices		N
7.2.7	Transformers:		–
	Transformers protected against overcurrent acc. to with the manufacturer’s instructions.		N
	Avoid unnecessary tripping due to overcurrent caused by magnetising inrush currents		N
	Avoid temperature rise of transformer winding in excess of its permitted of its insulation class of transformer in case of short circuit at secondary		N

	terminals		
	Type and setting of overcurrent protective device acc. to recommendations of transformer manufacturer		N
7.2.8	Location of protective devices:		–
	Overcurrent protective device located at point where a reduction in the cross sectional area of the conductors or another change reduces the current-carrying capacity of the conductors, except		N
	Current carrying capacity of conductors at least equal to that the load, and		N
	The part of the conductor between the point of reduction of current-carrying capacity and the position of the overcurrent protective device not longer than 3 meters, and		N
	Conductor installed in such a manner as to reduce the possibility of a short-circuit, for example, protected by an enclosure or duct		N
7.2.9	Overcurrent protective devices:		–
	Rated short-circuit breaking capacity at least equal to prospective fault current at point of installation		N
	Current other than those coming from supply side taken into account		N
	Reduced breaking capacity is permitted, where another protective device is installed at supply side with the necessary breaking capacity		N
	Back-up protection carefully checked, no destruction of conductor or overcurrent protective device may result		N
	Co-ordination with other protective devices in circuit required		N
	Where fuses are provided as overcurrent protective devices, a type readily available in the country of use shall be selected, or arrangements shall be made for the supply of spare parts.		N
7.2.10	Rating and setting of overcurrent protective devices:		–
	The rated current or setting of an overcurrent protective device is determined by the current carrying capacity of the conductors to be protected in accordance with 12.4, D.2 and the maximum allowable interrupting time *t* in accordance with Clause D.3, taking into account the needs of co-	See manual	N

	ordination with other electrical devices in the protected circuit.		
	Settings of overcurrent protective devices appropriately listed in technical documentation		N
7.3	Protection of motors against overheating:		–
7.3.1	General		–
	Protection of motors against overheating provided for each motor rated at more than 0,5 kW	See manual	P
	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
	Overload protection achieved by overload protection (7.3.2), over-temperature protection (7.3.3) or current-limiting protection (7.3.4)	See manual	P
	Automatic restarting of motors prevented after operation of overload protective device, to avoid cause of a hazardous condition		N
7.3.2	Overload protection		–
	Current overload detection provided for each live conductor except for neutral conductor	EN 60034-1 certified induction motor	P
	However, where the motor overload detection is not used for cable overload protection (see also Clause D.2), the number of overload detection devices may be reduced at the request of the user (see also Annex B).		N
	For motors having single phase or d.c. power supply, detection in only one unearthed live conductor is permitted	See manual	P
7.3.3	Over-temperature protection		–
	The provision of motors with over-temperature protection (see IEC 60034-11) recommended in situations where the cooling can be impaired (for example dusty environments).	Verified in installation	N
	Depending upon the type of motor, protection under stalled rotor or loss of phase conditions is not always ensured by over-temperature protection, and additional protection should then be provided.		N
	Over-temperature protection also recommended for motors that cannot be overloaded (for example torque motors, motion drives that are either		N

	protected by mechanical overload protection devices or are adequately dimensioned), where the possibility of over-temperature exists (for example due to reduced cooling).		
7.3.4	Current limiting protection		–
	Where protection against the effects of overheating in three phase motors is achieved by current limitation, the number of current limitation devices may be reduced from 3 to 2 (see 7.3.2).	EN 60034-1 certified induction motor	P
	For motors having single phase a.c or d.c. power supplies, current limitation in only one unearthed live conductor is permitted.		N
7.4	Abnormal temperature protection:		–
	Resistance heating or similar devices which cause excessive heat, equipped with suitable overtemperature (for example, due to short-time rating or loss of cooling medium) detection	None	N
7.5	Protection against supply interruption or voltage reduction and subsequent restoration		
	Undervoltage protection provided for applications where loss of supply or undervoltage causes a hazardous condition	No malfunctioning resulting from a voltage drop or supply interruption.	N
	If interruption or reduction of supply voltage is allowed for a short period of time, delayed undervoltage protection provided.	See above	N
	Undervoltage protection not impair any stopping control of the machine	See above	N
	Upon restoration of supply voltage, automatic or unexpected restarting of machine prevented	No automatic restarting possible	N
	Undervoltage protection to initiate appropriate control responses to ensure co-ordination the groups of machines working together	See above	N
7.6	Motor overspeed protection:		–
	Overspeed protection provided where overspeeding causes a hazardous condition		N
	Overspeed protection initiates appropriate control response and prevents automatic restarting		N
	The overspeed protection operates in such a manner that the mechanical speed limit of the motor or its load is not exceeded.		N
7.7	Earth fault / residual current protection:		–
	To reduce damage to equipment due to earth fault currents less than the detection level of the		N

	overcurrent protection, earth fault/residual protection used		
	Detection level for earth fault protection set as low as possible		N
7.8	Phase sequence protection:		–
	Protection from incorrect phase sequence of supply voltage provided		N
7.9	Protection against overvoltages due to lightning strike or switching action:		–
	Protective devices for the suppression of overvoltages caused by lightning strikes or switching surges provided		N
	Devices for suppression of overvoltages due to lightning, connected at incoming terminals of the supply disconnecting device		N
	Devices for suppression of overvoltages due to switching surges connected across terminals of all equipment requiring such protection		N
8	EQUIPOTENTIAL BONDING		–
8.2.1	General:		–
	All parts of protective bonding circuit capable to withstand max. thermal and mechanical stress, caused by earth-fault currents	See 8.2.2 to 8.2.8	P
	A supplementary bonding conductor provided, where the conductance of structural parts of the electrical equipment or of the machine is less than that of the smallest protective conductor connected to the exposed conductive parts.	No supplementary bonding conductor	N
	This supplementary bonding conductor having a cross-sectional area not less than half that of the corresponding protective conductor.	See above	N
	When an IT distribution system is used, machine structure will be part of the protective bonding circuit in conjunction with insulation monitoring. See 6.3.3 c).	No IT distribution system	N
	Conductive structural parts of equipment in accordance with 6.3.2.2 need not be connected to the protective bonding circuit.	All accessible conductive parts connected to the protective bonding circuit	N
	Extraneous conductive parts which form the structure of the machine need not be connected to the protective bonding circuit where all the equipment provided is in accordance with 6.3.2.2.	See above	N
	Exposed conductive parts of equipment in accordance with 6.3.2.3 shall not be connected to	See above	N

	the protective bonding circuit.		
8.2.2	Protective conductors:		–
	Identification and marking of protective conductors acc. to cl. 13.2.2	See 13.2.2	P
	Copper conductors used as protective conductors	Complied	P
	Other conductor materials allowed, if cross section of such conductors is not less than 16 mm2	No conductor other than copper used	N
	Cross-sectional area of protective conductors determined acc. to IEC 60364-5-54, cl. 543 or EN 60439-1, cl. 7.4.3.1.7, table 4		P
	Relationship between cross-section area of phase conductor and PE acc. to table 1 (see 5.2). See also 8.2.8.	See above	P
8.2.3	Continuity of protective bonding circuit:		–
	All exposed conductive parts connected to protective bonding circuit acc. to 8.2.1. (see 8.2.5 for exception)	All exposed conductive parts connected to the protective bonding circuit	P
	In case of removal of parts of PE system, remaining parts not to be interrupted		N
	Current-carrying capacity of connections and bonding points not impaired by mechanical, chemical or electrochemical influences	Complied	P
	Particular consideration should be given if enclosure consists of aluminium and its alloys	None	N
	Metal conduits and cable armouring not used as protective conductors but connected to protective bonding circuit	No flexible metal conduits and metallic cable sheaths used as protective conductors	P
	Protective conductor in cables exposed to damage (e.g. flexible trailing cables) is ensured by appropriate measures (e.g. monitoring)	Complied	P
	For continuity of the protective conductor using collector wires, collector bars and slip-ring assemblies, see 12.7.2	None	N
8.2.4	Exclusions of switching devices from protective bonding circuit:		–
	Protective bonding circuit not incorporate a switching-/overcurrent protective device	No such devices in protective bonding circuit	P
	No means of interruption of the protective bonding conductor provided.	Complied	P
	Exception: links for test or measurement purposes that cannot be opened without the use of a tool and that are located in an enclosed electrical operating	None	N

	area.		
	Where the continuity of the protective bonding circuit can be interrupted by means of removable current collectors or plug/socket combinations, the protective bonding circuit shall be interrupted by a first make last break contact.	None	N
	This also applies to removable or withdrawable plug-in units (see also 13.4.5).	See above	N
8.2.5	Equipment parts that need not to be connected to protective bonding circuit:		–
	Parts which cannot be touched on large surfaces or grasped by hand due to its small size (less than approx. 50 x 50 mm), small parts such as screws, rivets, nameplates (see also 410.3.3.5 of IEC 60364-4-41) or	Nameplate, screws, etc.	P
	are located in such way, that either contact with live parts or an insulation failure is unlikely	Complied	P
8.2.6	Protective conductor connecting points:		–
	PE conductor connecting points have no other functions and not used for connection of appliances or other parts	No other function than PE connection	P
	Each protective conductor connecting point identified by using the symbol IEC 60417-5019 (DB:2002-10)	Complied	P
	or with the letters PE, the graphical symbol being preferred, or by use of the bicolour combination GREEN-AND-YELLOW, or by any combination of these.	See above (see 5.2)	N
8.2.7	Mobile machines		–
	On mobile machines with on-board power supplies, the protective conductors, the conductive structural parts of the electrical equipment, and those extraneous conductive parts which form the structure of the machine connected to a protective bonding terminal	No mobile machines	N
	Where a mobile machine is also capable of being connected to an external incoming power supply, this protective bonding terminal fixed to the connection point for the external protective conductor.	See above	N
8.2.8	Additional protective bonding requirements for electrical equipment having earth leakage currents higher than 10 mA a.c. or d.c.		–
	Where electrical equipment has an earth leakage current (for example adjustable speed		

	electrical power drive systems and information technology equipment) > 10 mA a.c. or d.c. in any incoming supply, for the associated protective bonding circuit:		
	a) the protective conductor having a cross-sectional area of at least 10 mm2 Cu or 16 mm2 Al, through its total run, or	Earth leakage currents < 10 mA a.c. or d.c.	N
	b) where the protective conductor has a cross-sectional area of less than 10 mm2 Cu or 16 mm2 Al, a second protective conductor of at least the same cross-sectional area provided up to a point where the protective conductor has a cross-sectional area not less than 10 mm2 Cu or 16 mm2 Al, or	See above	N
	c) automatic disconnection of the supply in case of loss of continuity of the protective conductor.	See above	N
	To prevent difficulties associated with electromagnetic disturbances, the requirements of 4.4.2 also apply to the installation of duplicate protective conductors.	See above	N
	In addition, a warning label provided adjacent to the PE terminal, and where necessary on the nameplate of the electrical equipment.	See above	N
	Information about the leakage current and the minimum cross sectional area of the external protective conductor (see 17.2 b) 1)).	See above	N
8.3	Functional bonding		–
	Protection against maloperation as a result of insulation failures by connecting to a common conductor in accordance with 9.4.3.1.	No functional bonding	N
	For recommendations regarding functional bonding to avoid maloperation due to electromagnetic disturbances, see 4.4.2.	See above	N
8.4	Measures to limit the effects of high leakage current		–
	Equipment having high leakage current by connection of that equipment to a dedicated supply transformer having separate windings	Earth leakage currents < 10 mA a.c. or d.c.	N
	The protective bonding circuit connected to exposed conductive parts of the equipment and, in addition, to the secondary winding of the transformer.	See above	N
	The protective conductor(s) between the equipment and the secondary winding of the transformer in compliance with one or more of the arrangements described in 8.2.8.	See above	N

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Clause	**Requirement – Test**	**Result – Remark**	**Verdict**

9	CONTROL CIRCUITS AND CONTROL FUNCTIONS		–
9.1.1	Control circuits supplied by transformers have separately isolated windings	Verified in installation	N
	If several transformers used, secondary voltages in phase	See above	N
	DC- control circuits connected to PE circuit supplied from a separate winding of the control circuit transformer or supplied from another control circuit transformer		N
	Transformers not mandatory for machines with a single motor starter and maximum of two control devices	See above	N
9.1.2	Nominal voltage not exceed 277VAC when supplied from a transformer		N
9.1.3	Control circuits provided with overcurrent protection		N
9.2	Control functions:		–
9.2.1	Start function initiated by energising relevant starting circuit		N
9.2.2	Stop functions:		–
	Stop category 0: Stopping by immediate removal of power to machine actuators		N
	Stop category 1: A controlled stop with power available to machine actuators. Then removal of power when stop condition has been achieved.	See above	N
	Stop category 2: A controlled stop with power left available to machine actuators	See above	N
9.2.3	Mode of operations of machines:		–
	Hazardous condition, resulting from a mode selection, prevented by suitable means		N
	Mode selection does not start up the machine		N
	Separate control action required by operator		N
	Relevant safety functions and/or protective measures implemented for each specific operating mode		N
	Indication of selected operating mode provided		N
9.2.4	If safety functions and/or protective measures (for example for setting or maintenance purposes) need to be suspended, protection be ensured by:		–
	– disabling all other operating (control) modes; and	Complied	N
	– other relevant means (see 4.11.9 of ISO 12100-2:2003), that can include, for example, one or more of the following:		–
	- initiation of operation by a hold-to-run device or by	None	N

	a similar control device;		
	- a portable control station with an emergency stop device and, where appropriate, an enabling device.	None	N
	Where a portable control station is in use, initiation of motion be possible only from that control station;	None	N
	- a cableless control station with a device to initiate stop functions in accordance with 9.2.7.3 and, where appropriate, an enabling device.	None	N
	Where a cableless control station is in use, initiation of motion be possible only from that control station;	None	N
	- limitation of the speed or the power of motion;	None	N
	- limitation of the range of motion.	None	N
9.2.5	Operation:		–
9.2.5.1	Necessary safety functions and/or protective measures (for example interlocks (see 9.3)) provided for safe operation		N
	Unintended or unexpected movement of machine prevented after any stopping of machine	No such movement likely	N
	Where a machine has more than one control station, measures be provided to ensure that initiation of commands from different control stations do not lead to a hazardous situation.		N
9.2.5.2	Start of operation possible only when all relevant safety functions and/or protective measures are functional, except for conditions stated in cl.9.2.4		N
	For machines where under certain operating conditions no safety functions and/or protective measures can be applied, manual control of such operations by hold-to- run controls, together with enabling devices		N
	Suitable interlocks provided to secure correct sequential start		N
	In the case of machines requiring the use of more than one control station to initiate a start:		–
	Each control station has a separate, manually actuated start control device		N
	The conditions to initiate a start be:		–
	All required conditions for automatic machine operation are fulfilled, and		N
	All start control devices in released position (OFF), then		N

	All start control devices simultaneously actuated (see 3.6)		N
9.2.5.3	Stop functions of stop categories 0, 1 and/or 2 shall be provided, based on a risk-assessment and functional requirements of the machine		N
	Stop functions override related start functions (see 9.2.5.2)		N
	Facilities provided for connection of protective devices / interlocks		N
	If such protective device/ interlock causes a machine stop, it may be necessary to send such condition to the logic of the control system		N
	Resetting of stop function must not initiate any hazardous situation		N
	Where more than one control station is provided, stop commands from any control station be effective when required by the risk assessment of the machine.		N
9.2.5.4	Emergency operations (emergency stop, emergency switching off)		–
9.2.5.4.1	General		–
	Both of emergency stop and emergency switching off functions of the emergency operations listed in Annex E initiated by a single human action.		N
	Once active operation of an emergency stop (see 10.7) or emergency switching off (see 10.8) actuator has ceased following a command, the effect of this command be sustained until it is reset.		N
	This reset possible only by a manual action at that location where the command has been initiated.		N
	The reset of the command do not restart the machinery but only permit restarting.		N
	Not be possible to restart the machinery until all emergency stop commands have been reset.		N
	Not be possible to reenergize the machinery until all emergency switching off commands have been reset.		N
9.2.5.4.2	Design of emergency stop equipment, including functional aspects acc. to ISO 13850.		N
	Emergency stop acts either as stop of category 0 or as stop of category 1 (see 9.2.2)		N
	For determination of category of emergency stop, see risk assessment		N
	In addition to the requirements for stop (see 9.2.5.3),		–

	Emergency stop has priority over all other functions and over all modes of operation		N
	Power to machine actuators that can cause hazardous situation(s) either removed immediately (stop category 0) or controlled in such a way to stop the hazardous motion as quickly as possible (stop category 1) without creating other hazards		N
	Resetting must not initiate a restart		N
9.2.5.4.3	Functional aspects of emergency switching-off function are given in 536.4 of IEC 60364-5-53 and should be provided where:		
	Protection against direct contact is achieved only by placing out of reach or by obstacles	None	N
	There is the possibility of other hazards or damage by electricity	None	N
	Emergency switching- off is accomplished by switching off the relevant incoming supply by electromechanical switching devices, effecting a stop category 0 of machine actuators connected to this incoming supply	None	N
	When a machine cannot tolerate a stop category 0 stop, other means of protection is to be provided so that emergency switching-off is not necessary	None	N
9.2.5.5	Monitoring of command actions:		–
	Movement or action of a machine or parts of it, that can result in a hazardous condition be monitored by providing, e.g. overtravel limiters, motor overspeed detection, mechanical overload detection or anti-collision devices.		N
9.2.6	Other control functions		–
9.2.6.1	Hold-to-run controls (inching switches) require continuous actuation of control devices to achieve operation	None	N
9.2.6.2	Three types of two-hand controls defined in ISO 13851:		–
	Type I: Two control devices and their and their simultaneous actuation by both hands	None	N
	Continuous simultaneous actuation during the hazardous situation	See above	N
	Machine operation to cease upon the release of either one or both control devices when the hazardous situations are still present	See above	N
	A Type I two-hand control device is not considered to be suitable for the initiation of hazardous operation.	See above	N

	Type II: Type I control, requiring release of both control devices before machine operation may be re-initiated	See above	N
	Type III: It shall be necessary to actuate the control de-vices within a certain time limit of each other, not exceeding 0.5 s	See above	N
	After exceeding this time limit, both controls shall be released before machine operation may be initiated	See above	N
9.2.6.3	Enabling control (see also 10.9) is a manually activated control function interlock that:		–
	a) when activated allows a machine operation to be initiated by a separate start control, and	None	N
	b) when de-activated		–
	– initiates a stop function in accordance with 9.2.5.3, and	See above	N
	– prevents initiation of machine operation.	See above	N
	Enabling control arranged so 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. It should not be possible to defeat the enabling function by simple means.	See above	N
9.2.6.4	Push-buttons and similar control devices, that when operated, alternately initiate and stop motion used only for functions which cannot produce a hazardous situation	None	N
9.2.7	Cableless control		–
9.2.7.1	Means provided to readily remove or disconnect power supply of operator control station (see also 9.2.7.3)	None	N
	Means provided as necessary to prevent unauthorised use of operator control station	See above	N
	Each operator control station shall carry an unambiguous indication of which machine is intended to be controlled by that operator control station	See above	N
9.2.7.2	Measures shall be taken to ensure that control commands:		–
	Affect intended machine only and	See above	N
	Affect intended functions only	See above	N
	Measures taken to prevent machine from responding signals other than those from intended operator control station(s)	See above	N

	If necessary, means shall be provided so that machine can be controlled only from operator control stations in one or more predetermined zones or locations	See above	N
9.7.2.3	Cableless control station include a separate, clearly identifiable mean to indicate stop function of machine or of all motions which could cause a hazardous situation	See above	N
	Actuating means to indicate this stop function, not marked or labelled as emergency stop device (see10.7)	See above	N
	Enabling control arranged so 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. It should not be possible to defeat the enabling function by simple means.	See above	N
	A machine equipped with cableless control to have means automatically initiating a stop to prevent a hazardous operation for the following situations:		–
	a stop signal is received	See above	N
	a fault is detected in the cableless control system	See above	N
	a valid signal (which includes a signal that communication is established and maintained) has not been detected within a certain time, outside of range of cableless control, where no hazardous situation can occur (see annex B)	See above	N
9.7.2.4	For machines with more than one operator control station, including one or more cableless control stations, measures provided to ensure, that one control station only can be enabled at a given time	See above	N
	Indication of which operator control station is in control of the machine, provided at suitable locations, as determined by risk assessment of the machine	See above	N
	Exception: stop commands from any one of the control stations shall be effective	See above	N
9.2.7.5	Variation in battery voltage not cause a hazardous condition	See above	N
	Clear warning given to operator of battery powered cableless control stations, if the are controlling one or more potentially hazardous motions when the battery voltage exceeds specified limits	See above	N

	Under those circumstances, cableless operator control station remain functional long enough for the operator to put the machine in a non-hazardous condition	See above	N
9.3	Protective interlocks:		–
9.3.1	Reclosing or resetting of an interlocking safeguard not to initiate hazardous machine operation		N
9.3.2	Where operating limit (for example speed, pressure, position) can be exceeded leading to a hazardous situation, means be provided to detect when a predetermined limit(s) is exceeded and initiate an appropriate control action		N
9.3.3	Where non-operation of devices for auxiliary functions causes a hazardous situation, damage to the machine or to the process, appropriate interlocking be provided	None	N
9.3.4	Interlocks of contactors, relays, etc. between different operations and for opposite motions, interlocks against such incorrect operation provided	None	N
	Reversing contactors interlocked in such way, that in normal service no short circuit occurs during switching operation	See above	N
	Where, for safety or for continuous operation, certain functions on the machine are required to be interrelated, proper co-ordination ensured by suitable interlocks	See above	N
	For a group of machines working together in a co-ordinated manner and having more than one controller, provisions made for co-ordination of this controller	See above	N
	If a failure of a mechanical brake actuator can result that the brake, is applied when the associated machine actuator is energised and a hazardous condition results, interlocks be provided to switch off the machine actuator	None	N
9.3.5	Where braking of a motor is accomplished by current reversal, effective measures provided to prevent motor starting in opposite direction at end of breaking where that reversal causes a hazardous situation, damage to the machine or to the process		N
	Control circuits arranged, so that rotation of a motor	No rotation	N

	shaft, not to result in a hazardous situation		
9.4	Control functions in the event of failure:		–
9.4.1	The electrical control circuits have an appropriate level of safety performance acc. to IEC 62061 (e.g. for PLC) and/or ISO 13849-1:1999, ISO 13849-2:2003, that has been determined from the risk assessment at the machine.		N
	Measures to reduce those risks include but are not limited to:		
	- protective devices on the machine, (e.g. interlocking guards, trip devices)	See 9.3.1	N
	- protective interlocking of electrical circuit	None	N
	- use of proven circuit techniques and components (see cl. 9.4.2.)		N
	- provision of partial or complete redundancy (see cl. 9.4.2.2) or diversity (see cl. 9.4.2.3)		N
	- provision for functional tests (see cl. 9.4.2.4)		N
	Where memory retention is achieved for example, by battery power, measures be taken to prevent hazardous situations arising from failure or removal of the battery	None	N
	Means provided to prevent unauthorized or inadvertent memory alteration by, for example, requiring the use of a key, access code or tool.	See above	N
9.4.2	Measures to minimize risk in the event of failure:		–
9.4.2.1	bonding of control circuits to protective circuit for operational purposes (see cl. 9.4.3.1 and figure 2)		N
	connection of control devices in accordance with cl. 9.4.3.1		N
	stopping by de-energising (see cl. 9.2.2)		N
	switching of all control circuit conductors to device being controlled (see cl. 9.4.3.1)		N
	use of switching devices having direct opening action (see IEC 60947-5-1)		N
	circuit design to reduce possibility of failures causing undesirable operations		N
9.4.2.2	on-line redundancy for normal operation		N
	off-line redundancy for protective functions, effective only when operating function fails	See above	N
	where off-line redundancy is used, suitable measures taken, to ensure that those control circuits are available when required	See above	N
9.4.2.3	Use of control circuits having different principles of operation or using different types		–

	of devices can reduce faults and failures. Examples include:		
	Combination of normally open and normally closed contacts operated by interlocking guards		N
	Use of different types of circuit components in control circuit		N
	Combination of electromechanical and electronic circuits in redundant configurations		N
	Combination of electrical and non-electrical systems (e.g. mechanical, hydraulic, pneumatic) may perform redundant functions and provide diversity		N
9.4.2.4	Automatic functional test carried out by the control system	None	N
	Manual function tests by inspection	None	N
	Tests at start-up and at predetermined intervals or as a	See above	N
	Combination as appropriate (see cl.17.2 and 18.6)	See above	N
9.4.3	Protection against maloperation due to earth faults, voltage interruptions and loss of circuit continuity:		−
9.4.3.1	Earth faults on any control circuit causes no unintentional starting, potentially hazardous motions or prevent stopping of machine		N
	Methods to meet these requirements include but are not limited to the following:		
	Method a) Control circuits, fed by control transformers:		
	1) In case of earthed control circuit supplies, the common conductor is connected to the protective bonding circuit at the point of supply.	See method b) below	N
	All contacts, solid state elements etc., which are intended to operate an electromagnetic or other device (for example, a relay, indicator light) are inserted between one side, the switched conductor of the control circuit supply and one terminal of the coil or device.		N
	The other terminal of the coil or device (preferably always having the same marking) is connected directly to the common conductor of the control circuit supply without any switching elements (see Figure 3).		N
	Exception: Contacts of protective devices may be connected between the common conductor and the coils, provided that:		−
	– the circuit is interrupted automatically in the event of an earth fault, or		N

	– the connection is very short (for example in the same enclosure) so that an earth fault is unlikely (for example overload relays).		N
	2) Control circuits fed from a control transformer and not connected to the protective bonding circuit, having the same arrangement as shown in Figure 3 and provided with a device that interrupts the circuit automatically in the event of an earth fault (see also 7.2.4).		N
	Method b) Control circuits fed from a control transformer with a centre-tapped winding, this centre tap connected to the protective bonding circuit, arranged as shown in Figure 4 with the overcurrent protective device having switching elements in all control circuit supply conductors.		N
	Method c) Where the control circuit is not fed from a control transformer and is either:		–
	1) directly connected between the phase conductors of an earthed supply, or;	See method b) above	N
	2) directly connected between the phase conductors or between a phase conductor and a neutral conductor of a supply that is not earthed or is earthed through a high impedance,		N
	Multi-pole control switches that switch all live conductors are used for START or STOP of those machine functions that can cause a hazardous situation or damage to the machine in the event of unintentional starting or failure to stop, or		N
	In the case of c) 2), a device shall be provided that interrupts the circuit automatically in the event of an earth fault.		N
9.4.3.2	If control system uses a memory device, proper functioning in the event of power failure ensured to prevent any loss of memory that could result in a hazardous situation	None	N
9.4.3.3	If loss of continuity of safety-related control circuits depending upon sliding contacts which could result in a hazardous situation, appropriate measures be taken	No sliding contacts	N
10	OPERATOR INTERFACE AND MACHINE-MOUNTED CONTROL DEVICES		–
10.1.1	Devices to be selected, mounted and identified or coded acc. to relevant parts of IEC 61310	No operator interface and control devices	N

	Possibility of inadvertent operation minimized by, for example, positioning of devices, suitable design, provision of additional protective measures.		N
	Particular consideration given to the selection, arrangement, programming and use of operator input devices such as touch screens, keypads and keyboards, for the control of hazardous machine operations. See IEC 60447.		N
10.1.2	Machine-mounted control devices readily accessible for service and maintenance and		N
	Mounted to minimise possibility of damage from activities such as material handling		N
	Actuators of hand-operated control devices selected and installed as follows:		–
	Mounted not less than 0.6 m above servicing level, and within easy reach for operator (normal working position)		N
	Placed so that operator is not exposed to a hazardous situation when operating them		N
	The actuators of foot-operated control devices selected and installed so that:		
	– they are within easy reach of the normal working position of the operator;	None	N
	– the operator is not placed in a hazardous situation when operating them.		N
10.1.3	Degree of protection sufficient for expected use against:		–
	Effects of aggressive liquids, vapours or gases in environment of machine		N
	Ingress of contaminants		N
	Operator interface control devices have a minimum degree of protection against direct contact of IPXXD		N
10.1.4	Position sensors arranged so, that they will not be damaged in the event of overtravel		N
	Position sensors used in circuits with safety-related control functions either have direct opening action or provide similar reliability		N
10.1.5	Portable or pendant operator control stations and control devices selected or arranged in such way as to minimise possibility of inadvertent machine operations caused by shocks and vibrations (see also 4.4.8)	None	N
10.2	Push-buttons		–
10.2.1	Pushbutton actuators colour-coded acc. to table 2 (see also 9.2 and Annex B)		N

	Where the same colour WHITE, GREY, or BLACK is used for various functions (for example WHITE for START/ON and for STOP/OFF actuators), a supplementary means of coding (for example shape, position, symbol) be used for the identification of push-button actuators.		N
10.2.2	Recommendation that push buttons are preferably marked directly on actuator with symbols acc. to table 3		N
10.3.1	Colours for indication lights: RED, YELLOW, GREEN, BLUE (for flashing indicator lights and displays, see 10.3.3)		N
	Colours for confirmation: BLUE and WHITE; GREEN may be used in some cases		N
	Indicator lights and displays selected and installed in such a manner as to be visible from the normal position of the operator (see also IEC 61310-1).		N
	Indicator light circuits used for warning lights fitted with facilities to check the operability of these lights.		N
10.3.2	Unless otherwise agreed between supplier and user, indicator lights colour-coded with respect to status of machine acc. to table 4		N
	Indicating towers on machines have the applicable colours in the following order from the top down; RED, YELLOW, BLUE, GREEN and WHITE.		N
10.3.3	Flashing lights for further information may be used for following purposes:		–
	- to attract attention or		N
	- to request immediate action or		N
	- to indicate a discrepancy between command and actual state or		N
	- to indicate a change in process (flashing during transition)		N
	Higher frequency of flashing lights (pulse/pause ratios) recommended for higher priority of information	None	N
	Where flashing lights or displays are used to provide higher priority information, audible warning devices also be provided.	See above	N
10.4	Illuminated push-button actuators colour-coded acc. to tables 2 and 4		N
	WHITE colour shall be used, if it is difficult in assigning an appropriate colour		N

	RED colour shall be used, for emergency stop actuators, not depending upon illumination conditions (ON /OFF status) only	No illuminated EMO	N
10.5	Rotary control devices having a rotational member such as potentiometers and selector switches, mounted in such way as to prevent rotation of stationary member	None	N
10.6	Start devices used to initiate start functions or movement of machine or elements designed and mounted such as to minimise inadvertent operation	None	N
	Mushroom - type actuators used for two-hand control devices (see also ISO 13851)	None	N
10.7	Devices for emergency stop:		–
10.7.1	Devices for emergency stop readily accessible	Verified at installation	N
	Devices for emergency stop located at each operator control station and other locations where initiation of emergency stop is required (see cl. 9.2.7.3 for exception)	See above	N
	For 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) be provided to minimise confusion.		N
10.7.2	Types of devices for emergency stop include following elements:		–
	push-button operated switch with a palm or mushroom head type or		N
	pull-cord operated switch or	None	N
	pedal-operated switch without mechanical guard	None	N
	Devices be of self- latching type and contacts are of direct opening operation (see IEC 60947-5-1, Annex K)		N
10.7.3	Actuators of emergency stop devices are coloured RED		N
	Background immediately around actuator is coloured YELLOW (See also ISO 13850)		N
10.7.4	Supply disconnecting device may be locally operated to serve as function of emergency stop when:		–
	it is readily accessible to operator		N
	it is of type described in cl. 5.3.2 a), b), c), or d)	See above	N
	Supply disconnecting device to meet colour requirements of cl. 10.7.3	See above	N
10.8	Devices for emergency switching off:		–

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10.8.1	Location of emergency switching-off devices normally placed separate from operator control station	None	N
	Where it is necessary to provide a control station with an emergency stop device and an emergency switching off device, means be provided to avoid confusion between these devices	See above	N
10.8.2	Types of emergency switching-off devices include:		–
	Push-button operated switch with a palm or mushroom head type of actuator or	See above	N
	Pull-cord operated switch	See above	N
	Devices of self-latching type and ensure direct opening action (see IEC 60947-5-1, Annex K)	See above	N
	Push-button operated switch in break-glass enclosure	See above	N
10.8.3	Actuators of emergency switching-off devices are coloured RED	See above	N
	Background immediately around actuator (push-button) coloured YELLOW	See above	N
	Where confusion can occur between emergency stop and emergency switching off devices, means be provided to minimise confusion.	See above	N
10.8.4	When supply disconnecting device is locally operated for emergency switching-off, it shall be readily accessible	See above	N
	Supply disconnecting device locally operated for emergency switching-off to meet colour requirement acc. to cl. 10.8.3	See above	N
10.9	Enabling control device		–
	Enabling control device to signal the enabling control to allow operation when actuated in one position only.	No enabling control device	N
	In any other position, operation stopped or prevented.		N
	Enabling control devices selected and arranged so as to minimize the possibility of defeating.	See above	N
	Enabling control devices selected that have the following features:		–
	– designed in accordance with ergonomic principles;	See above	N
	– for a two-position type:		–
	- position 1: off-function of the switch (actuator is not operated);	See above	N

	- position 2: enabling function (actuator is operated).	See above	N
	– for a three-position type:		–
	- position 1: off-function of the switch (actuator is not operated);	See above	N
	- position 2: enabling function (actuator is operated in its mid position);	See above	N
	- position 3: off-function (actuator is operated past its mid position);	See above	N
	- when returning from position 3 to position 2, the enabling function is not activated.	See above	N
11	CONTROLGEAR: LOCATION, MOUNTING, AND ENCLOSURES		–
11.1	All controlgear located and mounted so, as to facilitate:		–
	- its accessibility and maintainability		N
	- its protection against external influences or operating conditions under which operation is intended		N
	- operation and maintenance of the machine and its associated equipment		N
11.2	Location and mounting:		–
11.2.1	all control-gear components placed and oriented so, that identification is possible without moving them or the associated wiring		N
	Components checked for correct operation or possible replacement without dismantling other equipment or parts of the machine (except opening doors or removing covers, barriers or obstacles)		N
	Terminals not associated with controlgear also to conform to this requirement		N
	Operation and maintenance of all control gear possible from front of cabinet		N
	Special tools to adjust, maintain, or remove a device provided with the equipment	None	N
	Access for regular maintenance or adjustment to equipment, relevant devices located between 0.4m to 2.0 m above servicing level		N
	Terminals located at least 0.2 m above servicing level and placed such, that conductors and cables can be easily connected		N
	No devices mounted on doors, except those for operating, indicating, measuring and cooling purposes on normally removable access-covers of		N

	enclosure		
	Plug-in type control devices belonging functionally together, their association made clear by type (shape), marking or reference designation single or in combination (see cl. 13.4.5)	None	N
	Plug-in type control devices, that are handled during normal operation, shall be designed with non-interchangeable characteristics, where lack of such facility can result in malfunctioning	None	N
	Plug/socket combinations, handled during normal operation, shall be located and mounted so as to provide unobstructed access	None	N
	If test points for connection of test equipment are provided, they should be:		–
	- mounted so as to provide unobstructed access	None	N
	- clearly marked to correspond with the documentation (see cl. 17.3)	See above	N
	- adequately insulated	See above	N
	- sufficiently spaced	See above	N
11.2.2	Non-electrical parts and devices, not directly associated with the electrical equipment, not located within enclosures containing controlgear		N
	Devices such as solenoid valves separated from other electrical equipment		N
	Control devices mounted at same location and connected to the main supply voltage, or to both main supply and control voltage, are grouped separately from those connected to control voltage only		N
	Terminals separated into groups for:		–
	power circuits or		N
	associated control circuits or		N
	other control circuits, fed from external sources		N
	Terminal groups mounted adjacently, providing that each group is readily identified		N
	When arranging the location of devices, clearances and creepage distances specified for them by the supplier shall be maintained, taking into account external influences or physical conditions of its environment		N
11.2.3	Heat generating components located so, that temperature of each component in its vicinity remains within the permitted limits		N

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Clause	**Requirement – Test**	**Result – Remark**	**Verdict**
11.3	Degrees of protection:		–
	Protection of control gear against ingress of solid foreign objects and liquids shall be adequate.		N
	External influences under which the equipment is intended to operate is to be taken into account		N
	Its protection sufficient against dust, coolants and swarf		N
	Enclosures of control gear provide a degree of protection of at least IP22		N
	Exceptions:		–
	a) Where an electrical operating area is used as a protective enclosure for an appropriate degree of protection against ingress of solid bodies and liquids		N
	b) Where removable collectors on collector bar systems are used, and IP22 is not achieved but measures of cl. 6.2.5 are applied		N
11.4	Enclosures, doors and openings:		–
	Enclosures to withstand mechanical, electrical and thermal stress as well as effects of humidity and other environmental factors during normal service		N
	Fasteners for doors or covers of captive type	None	N
	Windows for viewing internally mounted indicating devices, made of material suitable to withstand mechanical stress and chemical attack	None	N
	Doors of enclosure not wider than 0,9 meter		N
	Doors with vertical hinges, preferably lift-off type		N
	Doors with opening angle of at least 95°		N
	Gaskets of doors, lids, covers and enclosures withstand the chemical effects of aggressive liquids, vapours or gases used on the machine	No such joints or gaskets	N
	Means used to maintain degree of protection of an enclosure of doors, lids and covers that require opening or removed for operational or maintenance shall:		–
	- be securely attached to either door, cover or enclosure		N
	- not deteriorate due to removal or replacement of door or cover and so impair degree of protection		N
	Where openings in enclosures are provided (for example, for cable access), including those towards the floor or foundation or to other parts of the machine, means be provided to ensure the degree of protection specified for the equipment.		N

	Openings for cable entries at enclosure to be easily re-opened on site		N
	Suitable opening in base of enclosure within the machine provided, as to enable drainage of moisture due to condensation		N
	No opening between enclosure containing electrical equipment and compartment containing coolant, lubricating or hydraulic fluids		N
	Holes in enclosure for mounting purposes not impair required degree of protection		N
	Equipment that could attain a surface temperature sufficient to cause a risk of fire or harmful effect to an enclosure material during normal or abnormal operation shall:		–
	- be located within an enclosure, that can withstand, without risk of fire or harmful effect, the heat emitted by the equipment or		N
	- be mounted and located at sufficient distance from adjacent equipment, so as to allow safe dissipation of heat or		N
	- be otherwise screened by material that can withstand, without risk of fire or harmful effect, the heat emitted by the equipment		N
11.5	Access to controlgear		–
	Doors in gangways and for access to electrical operating areas shall:		–
	- be at least 0.7 meter wide and 2.0 meter high;	None	N
	- open outwards	See above	N
	- have a means (for example panic bolts) to allow opening from the inside without the use of a key or tool	See above	N
	Enclosures which readily allow a person to fully enter provided with means to allow escape, for example panic bolts on the inside of doors.	See above	N
	Enclosures intended for such access, for example for resetting, adjusting, maintenance, have a clear width of at least 0,7 m and a clear height of at least 2,1 m	See above	N
	In cases where equipment is likely to be live during access and/or conducting parts are exposed, the clear width be at least 1,0 m.	See above	N
	In cases where such parts are present on both sides of the access way, the clear width be at least 1,5 m	See above	N
12	CONDUCTORS AND CABLES		–

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Clause	**Requirement – Test**	**Result – Remark**	**Verdict**
12.1	Conductors and cables selected so as to be suitable for operating conditions and external influences that are existing	Complied	P
	Requirements not applicable for integral wiring of assemblies, subassemblies and devices that are manufactured and tested acc. to their relevant standard	Cable or conductors were complied with relevant IEC standard.	P
12.2	Generally conductors shall be of copper	Only copper conductors	P
	If aluminium conductors are used, the min. cross-sectional area to be at least 16 mm2	See above	N
	To ensure adequate mechanical strength, the cross-sectional area of conductors not less than as shown in Table 5	Not less than as shown in Table 5	P
	Conductors with smaller cross-sectional areas or other constructions than shown in Table 5 used in equipment, provided adequate mechanical strength is achieved by other means and proper functioning is not impaired	See above	N
	Max. permitted conductor temperatures under normal-/ short circuit conditions will not exceed values given in table 5	According to table D.5, cable is designed to permitted temperature for short-circuit condition.	P
	Class 1 and class 2 conductors are primarily intended for use between rigid, non-moving parts	Complied	P
	All conductors which are subject to frequent movement to be of flexible stranded copper acc. to class 5 or class 6	No frequent movement	N
12.3	Types of insulation include: Polyvinyl chloride (PVC)	Insulation of internal wiring material is polyvinyl chloride (PVC) and has an appropriate flame-retardant rating.	P
	Rubber, natural and synthetic	See above	N
	Silicone rubber (SiR)	See above	N
	Mineral	See above	N
	Cross-linked Polyethylene (XLPE)	See above	N
	Ethylene Propylene Rubber compound (EPR)	See above	N
	Poly-Tetra-Fluor-Ethylene (PTFE)	See above	N
	Where insulation of conductors or cables can constitute hazards due to propagation of fire or emission of toxic/ corrosive fumes, guidance from cable supplier to be sought	Complied	P
	Special attention to integrity of a circuit having a	Complied	P

	safety-related function		
	Dielectric strength of insulation adequate for required test voltage with a min. of 2000VAC for cables operating with voltages >50VAC or >120 VDC	Cables > 50Vac or 120Vdc: 2kV~, 5 min;	P
	For PELV circuits, dielectric strength adequate for test voltage of 500VAC for a duration of 5 minutes (see IEC 60364-4-41, class III equipment)	No PELV connecting cables:	N
	Mechanical strength and thickness of insulation such that, insulation cannot be damaged during cable laying or in operation	No such damage likely at normal installation	P
12.4	Current-carrying capacities for PVC insulated wiring between enclosures and individual items of equipment under steady-state conditions according to values given in table 6	The conductor cross-sectional area complies with table 6.	P
12.5	Voltage drop from point of supply to load not exceeding 5% of nominal voltage under normal operating conditions	Voltage drop of supply is not exceeding 5% of nominal voltage.	P
12.6.1	Flexible cables have cl. 5 or cl. 6 conductors	None	N
	cables exposed to severe duties shall be of adequate construction to protect against:		
	abrasion due to mechanical handling and dragging across rough surfaces	See above	N
	kinking to operation without cable guides	See above	N
	stress resulting from guide rollers and forced guiding, being wound and re-wound on cable drums	See above	N
12.6.2	Cable handling system of machine designed such, as to keep tensile stress of conductors as low as practicable during machine operation	See above	N
	tensile stress for copper conductors not to exceed 15 N/mm2 of copper cross section area	See above	N
	where tensile stress of conductors is exceeding 15 N/mm2, cables of special design are used	See above	N
	maximum stress for flexible cables with material other than copper be within the cable manufacturer's specification	See above	N
12.6.3	Cables wound on drums selected such, as the maximum allowable conductor temperature is not exceeded	No cable drum	N
	cables for circular cross-section area, installed on drums, max. current-currying capacity in free air as declared acc. to table 7	See above	N
12.7.1	Conductor wires, conductor bars and slip-ring assemblies:		

	They shall be installed or enclosed in such way, that during normal access to the machine, protection against direct contact is achieved by application by one of the following protective measures:		
	- protection by partial insulation of live parts, or where this is not practicable;	No collector wires, collector bars and slip-ring assemblies	N
	- protection by enclosure or barriers provide a degree of protection of at least IP2X	Motor terminal box	P
	Horizontal top surfaces of barriers or enclosures which are readily accessible provide a degree of protection of at least IP4X	See above	N
	If required degree of protection is not achieved, protection by placing live parts out of reach in combination with emergency switching-off acc. to cl. 9.2.5.4.3 applied	See above	N
	Conductor wires and conductor bars placed and/or protected so 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;	See above	N
	- prevent damage from a swinging load	See above	N
12.7.2	Where conductor wires and conductor bars and slip-ring assemblies are installed as part of the PE-circuit, they do not carry current in normal operation	Complied	P
12.7.3	Protective conductors of current collectors have a shape or are designed such, so that they are not interchangeable with other current collectors of the sliding contact type	Complied	P
12.7.4	Removable current collectors with disconnector function are designed such, that PE-circuit is interrupted only after live conductors have been disconnected and the continuity of the PE-circuit is re-established before any live conductor is reconnected (see also 8.2.4)	See above	N
12.7.5	Clearances between respective conductors and between adjacent systems of conductor wires, conductor bars, slip-ring assemblies and their current collectors designed for for at least a rated impulse voltage of an overvoltage category III in accordance with IEC 60664-1	Complied	P
12.7.6	Creepage distances suitable for operation in the intended environment, for example open air (IEC 60664-1), inside buildings, protected by enclosures	Complied	P

	In abnormally dusty, moist or corrosive environments, following creepage distances apply:		
	- for unprotected conductor wires, bars and slip-ring assemblies equipped with insulators, the minimum creepage distance is 60 mm	See above	N
	- for enclosed conductor wires, insulated multipole conductor bars and insulated individual conductor bars, the minimum creepage distance is 30 mm	Complied	P
	Gradual reduction of insulation values due to unfavourable ambient conditions regarded	See above	N
12.7.7	Suitable design measures taken, in order to prevent energisation of adjacent sections by current collectors themselves	Complied	P
12.7.8	conductor wires, conductor bar systems and slip-ring assemblies used for power circuits kept separately from those used for control circuit applications	See above	N
	above systems capable of withstanding without damage to mechanical forces and thermal effects of short circuit currents	See above	N
	removable covers to above systems, laid underground or under floor, designed that they cannot be opened by one person without the use of a tool	See above	N
	Conductor bars which are installed in a common metal enclosure, the individual section of it bonded together and connected to a protective bonding conductor at several points depending upon their length	See above	N
	Metal covers of conductor bars laid underground or underfloor, bonded together and connected to a protective bonding conductor	See above	N
	The protective bonding circuit to include the covers or cover plates of metal enclosures or underfloor ducts. Where metal hinges form a part of the bonding circuit, their continuity be verified (see Clause 18).	See above	N
	Underground and under floor conductor bar ducts have drainage facilities	See above	N
13	WIRING PRACTICES		–
13.1.1	All connections, especially those of the protective bonding circuit, secured against accidental loosening	Complied	P

	Means of connection suitable for cross-sectional areas and nature of conductors being terminated	The incoming supply conductors (L1,L2, L3) and protective conductor terminated at the terminals in the motor terminal box.	P
	Connection of two or more conductors to one terminal only where terminal is designed for that purpose	None	N
	Only one PE-conductor connected to one terminal connecting point	Complied	P
	Soldered connections only, where terminals are provided which are suitable for soldering connections	None	N
	Terminals on terminal blocks plainly identified to correspond with markings on wiring diagrams	Complied	P
	Where an incorrect electrical connection (for example, arising from replacement of devices) can be a source of risk and it is not practicable to reduce the possibility of incorrect connection by design measures, the conductors and/or terminations be identified in accordance with 13.2.1.	Complied	P
	Installation of flexible conduits and cables such, that liquids are drained away from fittings and joints	No liquids drained likely from the fittings	N
	Means to retain stranded conductors together when terminating conductors at terminals/ devices provided	By tubing	P
	Solder not used for that purpose	Complied	P
	Shielded conductors terminated so, as to prevent fraying of strands and to permit easy disconnection	None	N
	Identification tags legible, permanent and appropriate for physical environment	Complied	P
	Terminal blocks mounted and wired so, that internal and external wiring does not cross over terminals	Complied	P
13.1.2	Conductors and cables runned from terminal to terminal without splices or joints	Complied	P
	Connections using plug/socket combinations with suitable protection against accidental disconnection are not considered to be joints for the purpose of this Subclause.	None	N

	Exception: Where it is impracticable to provide terminals in a junction box (for example on mobile machines, on machines having long flexible cables; cable connections exceeding a length which is not practical to be supplied by the cable manufacturer on one cable drum; repair of cable due to mechanical stresses during installation and operation), splices or joints may be used	Terminals in the terminal box	N
	Where it is necessary to connect or disconnect cables, sufficient extra length provided for that purpose	Complied	N
	Terminations of cables adequately supported to prevent mechanical stress at termination points of conductors	Complied	P
	Protective conductor (PE) placed close to associated conductors in order to decrease loop impedance	Complied	P
13.1.3	Conductors of different circuits laid side by side and occupy the same duct or be in same multiconductor cable, provided that such arrangement does not impair proper functioning of respective circuits	Complied	P
	Where circuits operate at different voltage levels, conductors separated by suitable barriers or insulated for maximum voltage to which any conductor within the same duct is subjected, for example line to line voltage for unearthed systems and phase to earth voltage for earthed systems	Single voltage level	N
13.1.4	Connection between pick-up and pick-up converter of an inductive power supply system		
	The cable between the pick-up and the pick-up converter as specified by the manufacturer of the inductive power supply shall be:		
	– as short as practicable;	None	N
	– adequately protected against mechanical damage.	See above	N
13.2	Identification of conductors:		
13.2.1	Conductors identifiable at each termination point acc. to technical documentation	Conductors are identified by tags at each termination in accordance with the electrical schematic.	P
	Identification of conductors by number, alphanumeric, colour (either solid or with one or more stripes), or a combination of colour and numbers or alphanumeric	Colour is used throughout the length of the conductor.	P

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Clause	**Requirement – Test**	**Result – Remark**	**Verdict**

	When numbers are used, they are Arabic; letters are Roman (either upper or lower case).	Complied	P
13.2.2	Protective conductor readily distinguishable by shape, location, marking or colour	Protective conductor is distinguished by colouring, numbering and symbol.	P
	Bicolour combination GREEN- AND- YELLOW used throughout the length of the conductor	Complied	P
	This colour identification is strictly reserved for the protective conductor, so that it can be easily identified by its shape	Complied	P
	Ends or accessible positions of a protective conductor clearly identified by graphical symbol IEC 60417-5019 (DB:2002-10) or by bicolour combination GREEN- AND- YELLOW	Bicolour combination green-and-yellow	P
13.2.3	Where a circuit includes a neutral conductor that is identified by colour alone, the colour used for this conductor is BLUE. In order to avoid confusion with other colours, it is recommended that an unsaturated blue be used, called here “light blue” (see 3.2.2 of IEC 60446).	None	N
	Where the selected colour is the sole identification of the neutral conductor, that colour not be used for identifying any other conductor where confusion is possible	See above	N
	Where bare conductors are used as neutral conductors and identification by colour is used, they either be coloured by a stripe, 15 to 100 mm wide in each compartment or unit, or at each accessible position or coloured throughout their length	See above	N
13.2.4	Identification by colour		–
	Where colour-coding is used for identification of conductors (other than the protective conductor (see 13.2.2) and the neutral conductor (see 13.2.3)), the following colours may be used: BLACK, BROWN, RED, ORANGE, YELLOW, GREEN, BLUE (including LIGHT BLUE), VIOLET, GREY, WHITE, PINK, TURQUOISE.	Complied	P
	If colour coding of conductors applies, conductors coded over its full length, either by colouring of insulation or coloured markers at regular intervals and at the ends or accessible location.	Complied	P

	For safety reasons, colour GREEN or colour YELLOW not used where there is a possibility or confusion with the bicolour combination: GREEN – AND - YELLOW	Complied	P
	GREEN or YELLOW as a single code must not be used, except in bicolour combination GREEN-AND-YELLOW	Complied	P
	Where colour-coding is used for identification of conductors, it is recommended that they be colour-coded as follows:		
	– BLACK: a.c. and d.c. power circuits;	Complied	P
	– RED: a.c. control circuits;	None	N
	– BLUE: d.c. control circuits;	None	N
	– ORANGE: excepted circuits in accordance with 5.3.5.	None	N
	Exceptions: to the above are permitted where:		
	– insulation is used that is not available in the colours recommended; or	See above	N
	– multiconductor cable is used, but not the bicolour combination GREEN-AND-YELLOW.	None	N
13.3	Conductors inside enclosures supported where necessary to keep it in place	Complied	P
	Non-metallic ducts permitted only when they are of flame-retardant insulating material (see the IEC 60332 series)	None	N
	Electrical equipment mounted inside cabinets, designed to permit modification of wiring from front of cabinet (see cl. 11.2.1)	None	N
	Where that is not possible, access doors or swingout panels provided	None	N
	Connections to devices mounted on doors or to other movable parts made with flexible conductors (acc. to cl.12.2 and 12.6) to allow for frequent movement of those parts	None	N
	Conductors be anchored to the fixed part and the movable part, independently of the electrical connection (see also 8.2.3 and 11.2.1)	None	N
	Conductors and cables that do not run in ducts are adequately supported	None	N
	Terminal blocks or plug /socket combinations used for control wiring, that extends beyond the enclosure	None	N
	Power cables and cables for measuring-circuits are directly connected to terminals of field located	None	N

	devices		
13.4	Wiring outside enclosures:		
13.4.1	Introduction of cables- or ducts by means of individual glands, bushings etc. into an enclosure must not reduce degree of protection of it (see 11.3)	See manual	P
13.4.2	Conductors and their connections outside of the enclosure, are enclosed in suitable ducts as described in cl. 13.5	See above	P
	Where devices such as position switches or proximity switches are supplied with a dedicated cable, their cable need not be enclosed in a duct when the cable is suitable for the purpose, sufficiently short, and so located or protected, that the risk of damage is minimized.		N
	Fittings used with ducts or multiconductor cables are suitable for the physical environment		N
	Flexible conduit or flexible multiconductor cable is used for flexible connections to pendant push-button stations	No pendant control	N
	Weight of pendant stations is supported by other means than flexible conduits or flexible multicore cables	See above	N
13.4.3	Connections to frequently moving elements of the machine, designed acc. to cl. 12.2 and 12.6	None	N
	Flexible cables and conduits installed so, as to avoid excessive flexing and straining, particularly at the fittings	See above	N
	Cables exposed to movement supported in such way, as to prevent mechanical strain at connecting points	See above	N
	If this is achieved by provision of a loop, it has sufficient length to provide for a bending radius of at least 10 times the diameter of the cable	See above	N
	Flexible cables of machines installed or protected in such way, as to minimise the possibility of external damage due to factors, that include the following cable use or potential abuse:		
	– being runned over by the machine itself	See above	N
	– being runned over by vehicles or other machines	See above	N
	– coming into contact with the machine structure during movements	See above	N
	– running in and out of cable baskets or, on / off cable drums	See above	N

	– acceleration and wind forces on festoon systems or suspended cables	See above	N
	– excessive rubbing by cable collector	See above	N
	– exposure to excessive radiated heat	See above	N
	Cable sheath resistant to normal wear expected from normal movement and effects of atmospheric contaminants	See above	N
	Where cables are close to moving parts, space of at least 25mm maintained between moving parts and cables	See above	N
	Where that distance is not practicable, fixed barriers provided between cables and moving parts	See above	N
	Cable handling system designed such, that lateral cable angle does not exceed 5°, avoiding torsion at the cable when		
	– being wound on and off the cable drums and	See above	N
	– approaching and leaving cable guidance's	See above	N
	Measures taken to ensure that at least two turns of cable remain on the drum	See above	N
	Cable guides designed such, that the inner bending radius is not less than values given in table 8	See above	N
	Straight section between two bends at least 20 times the cable diameter	See above	N
	Construction and supporting means prevent damage to flexible cable under all operating conditions	See above	N
	No flexible conduit used for connections subject to rapid or frequent movements except when specifically designed for that purpose.	See above	N
13.4.4	In case where several sensors or control elements are connected in series, it is recommended to connect them via intermediate terminals	None	N
	Intermediate terminals are adequately protected	See above	N
	Intermediate terminals are indicated on the wiring diagram	See above	N
	This enables easy access for testing purposes	See above	N
13.4.5	Where plug/socket combinations are provided, they fulfill one or more of the following requirements as applicable:		
	Exception: 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.	None	N

	a) When installed correctly in accordance with f), plug/socket combinations of such type and installed in such way, as to prevent unintentional contact with live parts at any time , including during insertion or removal of the connectors	See above	N
	Min. degree of protection: IPXXB.	See above	N
	PELV circuits are excepted from this requirement	See above	N
	b) Have a first make last break protective bonding contact (earthing contact) (see also 6.3, 8.2.4) if used in TN- or TT-systems.	See above	N
	c) Plug/socket combinations intended to be connected or disconnected during load conditions have sufficient load-breaking capacity.	See above	N
	Plug/socket combinations rated at 30 A, or greater, are interlocked with a switching device so that the connection and disconnection is possible only when the switching device is in the OFF position.	See above	N
	d) Plug/socket combinations rated at more than 16 A have a retaining means to prevent unintended or accidental disconnection.	See above	N
	e) Where an unintended or accidental disconnection of plug/socket combinations can cause a hazardous situation, they have a retaining means.	See above	N
	The installation of plug/socket combinations fulfill the following requirements as applicable:		
	f) Min. degree of protection for the component which remains live after disconnection (except for PELV circuits): IP2X or IPXXB, taking into account the required clearance and creepage distances	See above	N
	g) Metallic housings of plug/socket combinations connected to the protective bonding circuit (except for PELV circuits)	See above	N
	h) Plug/socket combinations intended to carry power loads but not to be disconnected during load conditions have a retaining means to prevent unintended or accidental disconnection and are clearly marked that they are not intended to be disconnected under load.	See above	N
	i) Where more than one plug/socket combination is provided in the same electrical equipment, the associated combinations are clearly identifiable. It is recommended that mechanical coding be used to prevent incorrect insertion.	See above	N

	j) Plug/socket combinations used in control circuits fulfil the applicable requirements of IEC 61984. **Exception:** see item k).	See above	N
	k) No plug/socket combinations intended for household and similar general purposes used for control circuits.	See above	N
	In plug/socket combinations in accordance with IEC 60309-1, only those contacts are used for control circuits which are intended for those purposes.	See above	N
	Exception: The requirements of item k) do not apply to control functions using high frequency signals on the power supply.	See above	N
13.4.6	If wiring needs to be disconnected for shipment, terminals or plug/socket combinations are provided at the disconnecting points	See above	N
13.4.7	Additional wiring for maintenance or repair purposes provided	See above	N
13.5	Ducts, connection boxes and other boxes:		
13.5.1	Ducts provide a degree of protection suitable for the application (see IEC 60529)	None	N
	All sharp edges, flash, burrs, rough surfaces or threads which the insulation of conductors can come into contact, removed from ducts and conduits	See above	N
	In order to avoid confusion between conduits for electrical installation and those for oil, water or air, either physically separated or suitably identified	See above	N
	Ducts or cable trays rigidly supported and positioned at sufficient distance from moving parts	See above	N
	Ducts or cable trays mounted at least 2 meters above the working surface in areas where human passage is required	See above	N
	Ducts provided only for mechanical protection (see cl. 8.2.3)	See above	N
	Cable trays which are partially covered, not to serve as cable trays or installation trunking	See above	N
	Conductors and cables suitable for installation with or without the use of open cable trays or cable support means	See above	N
13.5.2	Cable trays dimensioned or located such, as to enable easy access for installation of additional conductors and cables	See above	N

	Consideration given on percentage of filling of such ducts.	See above	N
13.5.3	Rigid metal conduits or trays consist of galvanised steel or corrosion-resistant material, suitable for the environmental conditions.	See above	N
	Application of cable trays of different metal avoided, due to electrolytic corrosion	See above	N
	Installation conduits secured, held in place and supported at each end	See above	N
	Joints and fittings compatible with conduits and appropriate for its application	See above	N
	Conduit-bends fabricated such, as to avoid damage or reduction of internal cross-section	See above	N
13.5.4	Flexible metallic conduits and fittings consist of flexible metal tubing or wire mesh armour.	See above	N
	They are suitable for its application and environmental conditions	See above	N
13.5.5	Flexible non-metallic conduits are resistant to buckling and with similar characteristics as the sheath of multicore cables	See above	N
	They shall be suitable for its application and environmental conditions	See above	N
	Joints and fittings compatible with conduits and appropriate for its application	See above	N
13.5.6	Cable trunking systems outside of enclosures are rigidly supported and kept clear of moving and contaminating parts of the machine	See above	N
	Covers shaped to overlap the sides; gaskets permitted	See above	N
	Covers attached to cable trunking systems by suitable means	See above	N
	On horizontal cable trunking systems, no cover on the bottom unless specifically designed for such installation	See above	N
	Where the cable trunking system is furnished in sections, the joints between sections fit tightly but need not be gasketed.	See above	N
	The only openings permitted are those required for wiring or for drainage	See above	N
	Cable trunking systems not to have opened but unused knockouts	See above	N

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13.5.7	Installation of cables layed in cable trays with covers permitted within the machine-foundations, providing that they are completely closed and separated from coolant and lubrication systems (see cl. 13.5.6)	See above	N
13.5.8	Cable connection boxes and junction boxes used for wiring purposes are accessible for maintenance (see cl. 11.3)	See above	N
	They provide protection against ingress of solids or liquids, taking into account external influences during operation of the machine (see cl. 11.3)	See above	N
	Junction boxes not have openings for cable entries and are designed so, as to avoid ingress of entrained dust, lubricants and coolant	See above	N
13.5.9	Motor terminal boxes used for motor cable connection and for devices attached to the motor		P
14	ELECTRIC MOTORS AND ASSOCIATED EQUIPMENT		P
14.1	Electric motors are conform to EN 60034 series	In according to EN60034-1	P
	Electric motors and associated equipment protected against following risks:		
	overcurrent (see cl. 7.2)	See manual	P
	thermal overload (see cl. 7.3)	See manual	P
	overspeed (see cl. 7.6)		N
	Compliance ensured with the requirements stated (see clauses 5.3, 5.4, 5.5, 7.5, 7.6 and 9.4)		P
	Motor control equipment located and mounted acc. to cl. 11	No control	N
14.2	Selection of motor enclosure recommended acc. to EN 60034-5		P
	Degree of protection at least IP23	IP 55	P
	Incorporated motors mounted such, as to provide adequate protection against mechanical damage	Complied	P
14.3	Dimensions of motors conform to those given in EN 60072 series	Complied	P
14.4	Each motor with associated coupling, belt, pulley or chain mounted such, as to provide adequate protection and easy access for inspection, maintenance, adjustment or alignment, lubrication and replacement	Complied	P
	Motors mounted such, as to allow easy access to all terminal boxes	Complied	P
	Motors mounted such, as to ensure proper cooling Temperature rise to be within limits of relevant	Complied	P

	insulation class		
	Temperature rise within limits of relevant insulation class	Complied	P
	If possible, motor compartments stay clean and dry and when required, ventilated directly to the outside of the machine	Intended to be installed in an spacious area	N
	Motor-vents at an acceptable level and designed such, as to avoid ingress of swarf, dust or water spray	None	N
	No opening between motor compartment and any other compartment, which does not fulfil the requirement for motor compartments	Complied	P
14.5	Electric motors selected acc. to service and environmental conditions	Complied	P
	Design criteria for evaluation include:		
	– type of motor	See above	P
	– type of duty cycle (see IEC 60034-1)	Continues operation	P
	– fixed speed or variable speed operation	Fixed speed	P
	– mechanical vibrations	Considered	P
	– type of motor control	No control	N
	– influence of the harmonic spectrum of voltage and/or current when supplied from static converter on the temperature rise	Complied	P
	– method of starting and possible influence of inrush current	Complied	P
	– variation of counter torque load with time and speed	Complied	P
	– influence of loads with large inertia	Complied	P
	– influence of constant torque or constant power operation	Complied	P
	– possible need of inductive reactors between motor and converter	Complied	P
14.6	Operation of overload or overcurrent protective devices for mechanical brake-actuators initiate simultaneous de-energisation(release) of associated machine actuators	No mechanical brake.	N
15	ACCESSORIES AND LIGHTING		P
15.1	Where the machine or its associated equipment is provided with socket-outlets for auxiliary equipment, the following will apply:		
	socket-outlets are conform to regulations	None	N
	if not possible, they are clearly marked with voltage and current ratings	See above	N

	EN 60204-1:2018		
Clause	**Requirement – Test**	**Result – Remark**	**Verdict**
	continuity of protective bonding circuit to be ensured except where protection is provided by PELV	See above	N
	all unearthed conductors connected to socket-outlets, protected against overcurrent	See above	N
	when required, protection against overload in accordance with cl. 7.2 and cl. 7.3 separately from protection of other circuits	See above	N
	if power supply to socket-outlets is not disconnected, than requirements of cl.5.3.5 apply	See above	N
15.2	Local lighting of the machine and equipment		
15.2.1	Connection to PE-circuit acc. to cl. 8.2.2	No local lighting	N
	ON-OFF switch not incorporated in lampholder or in flexible connecting cord	See above	N
	Stroboscopic effects from lights avoided	See above	N
	If fixed lighting is provided in an enclosure, electromagnetic compatibility (EMC) taken into account	See above	N
	Application of EMC requirements acc. to principles stated in cl. 4.4.2	See above	N
15.2.2	If higher voltages are applied, value not exceeding 250 V between conductors	See above	N
	Nominal voltage of local lighting circuits not exceeding 50 V	See above	N
	Lighting circuits supplied from one of the following sources:		
	– from a dedicated isolating transformer connected to load side or	See above	N
	– overcurrent protection provided in secondary circuit or	See above	N
	– a dedicated isolating transformer connected to line side provided or (see also 5.3.5 and 13.1.3)	See above	N
	– source permitted for maintenance purpose or	See above	N
	– lighting circuits placed in control enclosures only or	See above	N
	– overcurrent protection provided in secondary circuit or	See above	N
	– from a machine-circuit with dedicated overcurrent protection or	See above	N
	– from an isolating transformer connected to line side of supply disconnecting device, when a dedicated primary disconnecting means and a secondary overcurrent protection are provided or	See above	N

	– for an externally supplied lighting circuit, which is only permitted in a control enclosures	See above	N
	Exception: Where fixed lighting is out of reach for operator during normal operations, provisions of this subclause do not apply	See above	N
15.2.3	local lighting circuits protected	See above	N
15.2.4	adjustable lighting fittings suitable for the physical environment provided	See above	N
	lampholders in accordance with relevant IEC-publications and	See above	N
	designed of an insulating material protecting the lamp cap, as to prevent unintentional contact	See above	N
	reflectors supported by a bracket and not by the lampholder	See above	N
	Exception: Where fixed lighting is out of reach for operator during normal operations, provisions of this subclause do not apply	See above	N
16	MARKING, WARNING SIGNS AND REFERENCE DESIGNATIONS		
16.1	Warning signs, nameplates, markings- and identification plates of sufficient durability to withstand the physical environment involved	Complied	P
16.2	Warning signs		
16.2.1	Electric shock hazard		
	Enclosures that do not otherwise clearly show that they contain electrical equipment that can give rise to a risk of electric shock, are marked with the graphical symbol IEC 60417-5036 (DB:2002-10)	On the terminal box	P
	Warning sign plainly visible on the enclosure, door or cover-plate	Complied	P
	The warning sign may be omitted for (see also 6.2.2 b)):		
	– an enclosures equipped with a supply disconnecting device or	See above	N
	– an operator - machine interface or for a control-station or	See above	N
	– a single device with its own enclosure	See above	N
16.2.2	Where the risk assessment shows the need to warn against the possibility of hazardous surface temperatures of the electrical equipment, the graphical symbol IEC 60417-5041 (DB:2002-10) is used	None	N
16.3	Control devices, visual indicators and displays (particularly those related to safety) clearly and	None	N

	durably marked with regard to their functions either on, or adjacent to it		
	such markings as agreed between user and supplier	See above	N
	preference given to the use of standard symbols given in IEC 60417- DB:2002 and ISO 7000.	See above	N
16.4	Marking of equipment		
	Equipment (for example controlgear assemblies) legibly and durably marked so that it is plainly visible after equipment installation	Complied	P
	Nameplates attached to enclosures adjacent to each incoming supply shall contain the following information:		
	– name or trade mark of supplier and	Complied	P
	– certification mark, when required and	CE mark	P
	– serial number, where applicable and	Complied	P
	– rated voltage and	, 230V	P
	– number of phases and		P
	– frequency (if AC) and	50 Hz	P
	– full-load current for each supply	Complied	P
	– short-circuit interrupting capacity of overcurrent protective device, where furnished as part of device of equipment	See installation instructions	N
	– main document number (see IEC 62023)		N
	Full-load current shown on nameplate not less than the running currents of all motors and other electrical loads, that are in operation at the same time under normal conditions	Complied	P
	if a single motor controller is used, that information provided instead, on the machine nameplate	No controller	N
16.5	All enclosures, assemblies, control devices and components plainly identified with the same reference designation as shown in technical documentation	Complied	P
17	TECHNICAL DOCUMENTATION		
17.1	Information necessary for installation, operation and maintenance of electrical equipment for a machine supplied by means of drawings, wiring diagrams, charts, tables and instruction manuals	Complied	P
	Information provided in an agreed language	English	P
17.2	Information provided with electrical equipment shall include:		
	a) A main document (parts list or list of documents);		P
	b) Complementary documents including:		

	1) a clear, comprehensive description of the equipment, installation and mounting instructions and information regarding connection to the electrical supply(ies)	Complied	P
	2) electrical supply requirements	Complied	P
	3) information about the physical environment	Complied	P
	4) overview (block) diagram(s)		N
	5) circuit / wiring diagram(s)		N
	6) information about:		
	software program documentation/ listing	No software	N
	sequence of operation(s)	Complied	P
	frequency of inspection	Complied	P
	frequency and method of functional testing	Complied	P
	guidance on the adjustment, maintenance and repair, particularly of the protective devices and circuits	Complied	P
	recommended spare parts list; and	Complied	P
	list of tools supplied.		N
	7) description of safeguards, interlocking func tions and interlocking of separating safeguards for dangerous movements of co-ordinated operating machines		N
	8) description of safeguards and means provided for applications with to suspend the safeguards		N
	9) instructions on the procedures for securing the machine for safe maintenance; (see also 17.8);	Complied	P
	10) information on handling, transportation and storage;	Complied	P
	11) information regarding load currents, peak starting currents and permitted voltage drops, as applicable;	Complied	P
	12) information on the residual risks due to the protection measures adopted, indication of whether any particular training is required and specification of any necessary personal protective equipment.		N
17.3	Requirements applicable to all documentation		
	Unless otherwise agreed between manufacturer and user:		
	– documentation to be in accordance with relevant parts of IEC 61082	Complied	P
	– reference designation system to be in accordance with relevant parts of IEC 61346	Complied	P
	– instructions/manuals to be in accordance with	Complied	P

	IEC 62079.		
	– parts lists where provided to be in accordance with IEC 62027, class B.	Complied	P
	For referencing to different documents, the supplier has to select one of following methods:		
	– where the documentation consists of a small number of documents (for example less than 5), each of the documents carry a cross-reference with document numbers of all other documents belonging to the electrical equipment or		N
	– for single level main documents only (see IEC 62023), all documents to be listed with document numbers and titles in a drawing or document list		N
	– all documents of a certain level (see IEC 62023) of the document structure shall be listed, with document numbers and titles, in a parts list belonging to the same level.		N
17.4	The installation diagram provides all necessary information regarding preliminary work for the setting-up of the machine (including commissioning)	Complied	P
	In complex cases, it is necessary to refer to the assembly drawings for details	Complied	P
	Recommended routing, type and cross-sectional areas for the conductors of the supply cables installed on site clearly indicated	Complied	P
	Necessary data or choosing type, characteristics, rated currents and setting for the overcurrent protective devices for the supply conductors stated (see cl. 7.2.2)	Complied	P
	Detailed information provided about size, purpose and location of any cable ducts within the foundation, that are provided by the user	Complied	P
	Detailed information provided about size, type and purpose of cable ducts, trays or supports between machine and associated equipment	Complied	P
	Diagram to indicate where space is required for removal or servicing of electrical equipment	Complied	P
	Where appropriate, an interconnection diagram or table provided	Complied	P
17.5	Where necessary an overview diagram provided for explanation of the principle of operation		N
	Overview diagram symbolically represents the electrical equipment with its functional		N

	interrelationships without showing all the interconnections		
	The function diagram used as either part of or addition to the block diagram		N
17.6	Circuit diagrams show the electrical circuits on the machine and its associated electrical equipment		N
	Any graphical symbol not shown in IEC 60617-DB:2001 must be separately shown and described on the wiring diagrams or supporting documents		N
	The symbols and identification of components consistent throughout all documents and on the machine		N
	Where appropriate, a diagram provided, showing the interface terminals and connections		N
	The diagram shows a reference to the detailed circuit diagram of each unit		N
	Switch symbols shown on the circuit diagrams with all supplies turned off and with the machine and its electrical equipment ready for a normal start		N
	Conductors identified acc. to cl.13.2		N
	Characteristics relating to the function of the control device and components which are not evident from their symbolic representation, included on the diagrams adjacent to the symbol or referenced to a footnote		N
17.7	Technical documentation containing an operating manual, outlining proper procedures for set-up and use of electrical equipment	Complied	P
	Particular attention given to safety measures provided	Complied	P
	Detailed information provided on methods for equipment programming, program verification and additional safety procedures	Complied	P
17.8	Technical documentation to contain a maintenance manual, detailing proper procedures for adjustment, servicing or preventive inspection and repair	Complied	P
	Recommendations regarding maintenance or service intervals and records are part of it	Complied	P
	Methods for the verification of proper operation provided	Complied	P
17.9	The parts list, where provided, comprises as a minimum information for ordering of spares or	Complied	P

	replacement of parts which are required for preventive or corrective maintenance and recommended spares		
18	VERIFICATION		P
18.1	The extent of verification will be given in the dedicated product standard for a particular machine.	Complied	P
	Where there is no dedicated product standard for the machine, the verifications always include the items a), b) and f) and may include one or more of the items c) to e):		
	a) verification, that electrical equipment is in compliance with the technical documentation	Complied	P
	b) in case of protection against indirect contact by automatic disconnection, conditions for protection by automatic disconnection to be verified according to 18.2;	Verified according to 18.2	P
	c) insulation resistance test (see 18.3);	Complied	P
	d) voltage test (see 18.4);	Complied	P
	e) protection against residual voltage (see 18.5);	No capacitor	N
	f) functional tests (see 18.6).	Complied	P
	When these tests are performed, the sequence listed above recommended	Complied	P
	When the electrical equipment is modified, the requirements stated in 18.7 apply	See 18.7	N
	For tests in accordance with 18.2 and 18.3, measuring equipment in accordance with the EN 61557 series	Complied	P
	The results of the verification to be documented.	Complied	P
18.2	Verification of conditions for protection by automatic disconnection of supply		
18.2.1	General		
	The conditions for automatic disconnection of supply (see 6.3.3) verified by tests.	Verified at installation	N
	For TN-systems, those test methods are described in 18.2.2;		N
	Their application for different conditions of supply are specified in 18.2.3.	See above	N
	For TT and IT systems, see IEC 60364-6-61	TN power system	N
18.2.2	Test methods in TN-systems		
	TEST 1 – Verification of the continuity of the protective bonding circuit		
	The resistance between the PE terminal (see 5.2 and Figure 3) and relevant points measured with a current 0,2 A to 10 A	10 A	P
	No use of a PELV supply recommended since such	No PELV	N

	supplies can produce misleading results in this test.		
	The resistance measured to be in the expected range according to the length, the cross sectional area, and the material of the related protective bonding conductor(s)	(see Appendix C.1)	P
	TEST 2 – Fault loop impedance verification and suitability of the associated overcurrent protective device		
	Connections of power supply and of incoming external protective conductor to the PE terminal of the machine verified by inspection	This machine is supplied to site whole and whose cables do not exceed certain lengths which are at least 28m.	N
	Conditions for the protection by automatic disconnection of supply in accordance with 6.3.3 and Annex A verified by both:		
	1) verification of the fault loop impedance by:		
	– calculation, or	See above	N
	– measurement in accordance with A.4, and	See above	N
	2) confirmation that the setting and characteristics of the associated overcurrent protective device are in accordance with the requirements of Annex A	See above	N
18.2.3	Application of the test methods for TN-systems		
	Test 1 of 18.2.2 carried out on each protective bonding circuit of a machine	See above	N
	When Test 2 of 18.2.2 is carried out by measurement, it is always to be preceded by Test 1.	See above	N
	The tests that are necessary for machines of different status are specified in Table 9.	See above	N
	Table 10 can be used to enable determination of the machine status.	See above	N
18.3	Insulation resistance measured with 500VDC between power circuit conductors and protective bonding circuit is to be ≥ 1.0 MΩ	Complied	P
	Test made on individual sections of complete electrical installation	Test in complete electrical installation.	P
	For certain parts of the electrical equipment, a lower minimum insulation value is permitted, but not less than 50 kΩ	>> 1.0 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	None	N
	– reduce the test voltage to a value lower than the voltage protection level of the surge protection devices, but not lower than the peak value of the	See above	N

	upper limit of the supply (phase to neutral) voltage.		
18.4	When voltage tests are performed, test equipment in accordance with IEC 61180-2	Complied	P
	Test voltage at a nominal frequency of 50Hz or 60Hz,	60Hz	P
	Maximum test voltage at a value of twice the rated supply voltage of the equipment or 1000 VAC (or 1414 VDC), whichever is the greater	1000 VAC	P
	Maximum test voltage applied between the power circuit conductors and the protective bonding circuit for a period of approximately 1 s.	Complied	P
	Requirements are satisfied if no disruptive discharge occurs.	Complied	P
	Components not rated to withstand these test voltage are disconnected during testing	Complied	P
	Components and devices that have been voltage tested in accordance with their product standards are disconnected during testing.	None	N
18.5	Tests for protection against residual voltages are performed to ensure compliance with cl. 6.2.4	No capacitor	N
18.6	Function tests of the electrical equipment performed, particularly those related to function of circuits for electrical safety (for example earth fault detection)	Power on/off test	P
18.7	Where a portion of the machine and its associated equipment is changed or modified, that portion is reverified and retested as appropriate (see cl. 18.1)	Brand new product	N

Photos

* THE END *

TEST REPORT

Report No.: HA2307-116EMC

Jinan Handa Machinery Co., Ltd.

Workshop 4-B-4 Zhongdianjian Energy Industrial Park, No. 5577 North Gongye Road, Jinan City,
Shandong Province, China

EMC TEST REPORT

EN 61000-6-2:2019
ELECTROMAGNETIC COMPATIBILITY (EMC) -- PART 6-2: GENERIC STANDARDS - IMMUNITY FOR INDUSTRIAL ENVIRONMENTS
EN 61000-6-4:2019
ELECTROMAGNETIC COMPATIBILITY (EMC) -- PART 6-4: GENERIC STANDARDS - EMISSION STANDARD FOR INDUSTRIAL ENVIRONMENTS

Report reference No......:	HA2307-116EMC
Applicant's Name.....:	Jinan Handa Machinery Co., Ltd.
Address.....:	Workshop 4-B-4 Zhongdianjian Energy Industrial Park, No. 5577 North Gongye Road, Jinan City, Shandong Province, China
Manufacturer.....:	Same as applicant
Address.....:	
Trademark.....:	/
Product description.....:	Welding Rotator
Model and/or type reference.....:	HDTR-1000, HDTR-3000, ZT-5, ZT-10, ZT-20, ZT-30, ZT-40, ZT-50, ZT-60, ZT-100, KT-5, KT-10, KT-20, KT-40, KT-60, KT-80, KT-100
Electrical ratings.....:	220~230V 50/60Hz
Test specification	
Standard.....:	EN 61000-6-2:2019, EN 61000-6-4:2019
Test procedure.....:	EMC
Result.....:	PASS
Non-standard test method.....:	N.A
Tested by (printed name and signature).....:	Zhenjie Wang
Approved by (printed name and signature).....:	Chen Jian
Date of issue.....:	18.07.2023

济南焊达机械有限公司 JINAN HANDA MACHINERY CO., LTD

CONTENTS

1. SUMMARY

This chapter presents an overview of standards and results. Refer to the next chapters for details of measured test results and applied test levels.

1.1 Applied standards

Standard	Year	Title
EN 61000-6-4	2019	Generic standards — Emission standard for industrial environments
EN 61000-6-2	2019	Generic standards — Immunity for industrial environments

1.2 Overview of results

Emission tests	**Result**
Conducted Emission(Mains Ports)	**PASS**
Conducted Emission(Telecommunication Ports)	**N/A**
Radiated Emission	**PASS**
Harmonic current emission	**PASS**
Voltage fluctuations and flicker	**PASS**

Immunity tests	**Result**
Electrostatic discharge	**PASS**
Radio frequency electromagnetic field	**PASS**
Electrical fast transients	**PASS**
Surges	**PASS**
Radio-frequency continuous conducted	**PASS**
Power frequency magnetic field	**PASS**
Voltage dips and interruptions	**PASS**

2. ENVIRONMENTAL CONDITIONS

Tests have been performed in a controlled environment, where the environmental conditions are maintained within the applicable ranges.

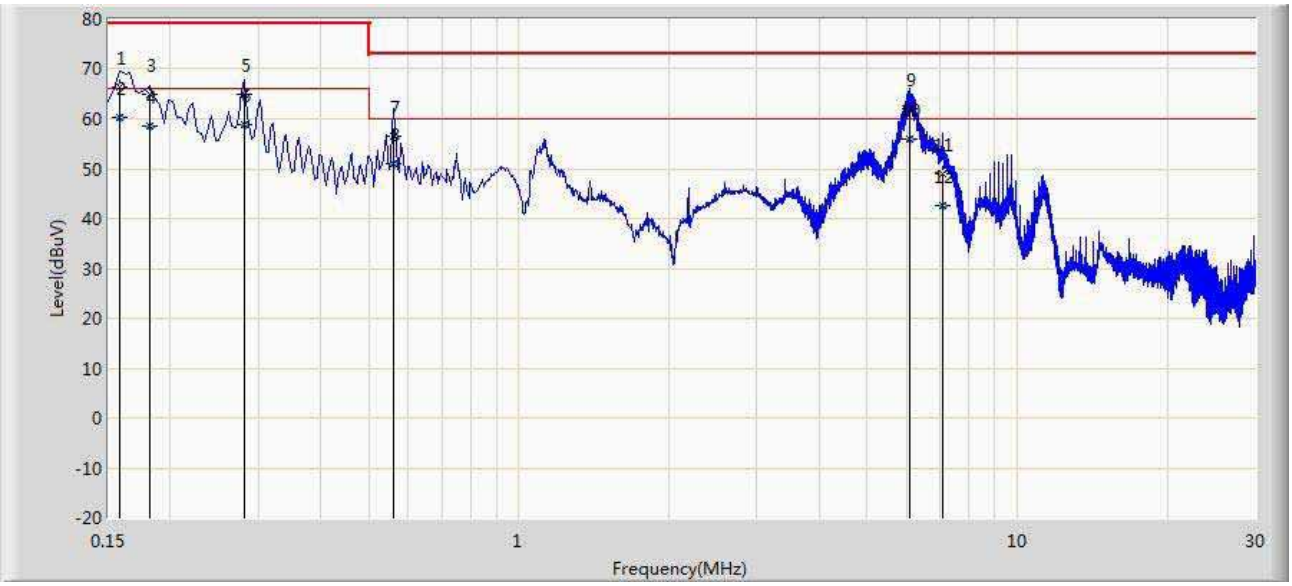
Ambient temperature	15℃--35℃
Relative Humidity air	30%~60%

3. EMISSION TEST RESULTS

Conducted emission（Main Ports）

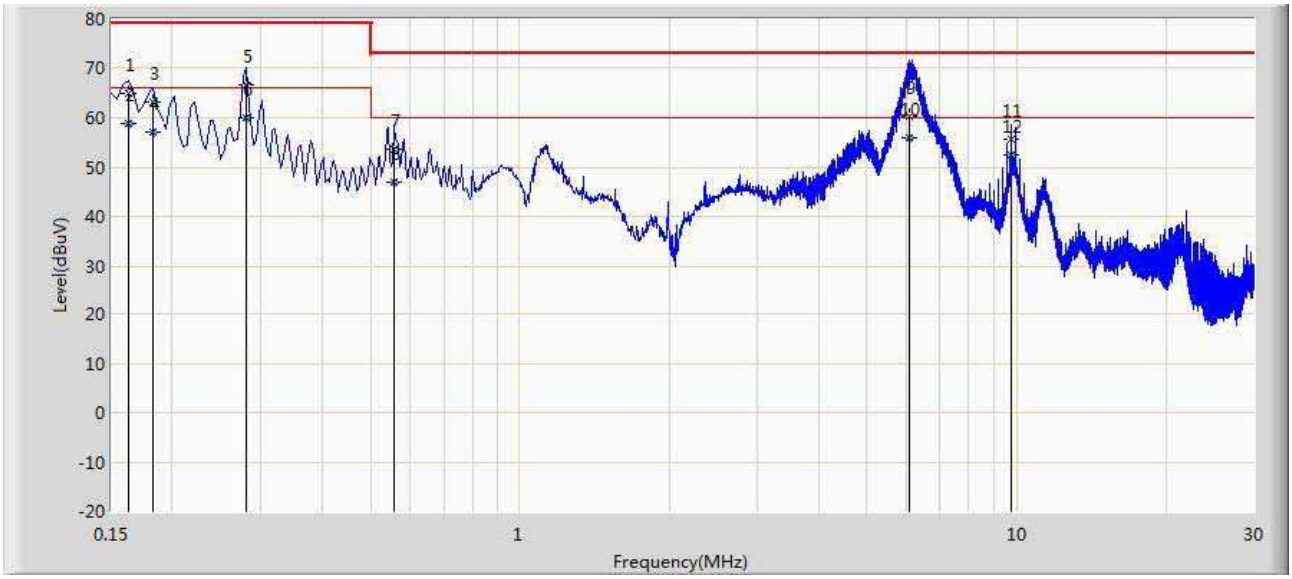
Limits for conducted disturbance at Low voltage AC mains port		
Frequency range MHz	Limits dB(μV)	
	Quasi-peak	Average
0.15 to 0.50	78	65
0.50 to 30	74	61
NOTE: The lower limit shall apply at the transition frequency.		

Test Result
Line1



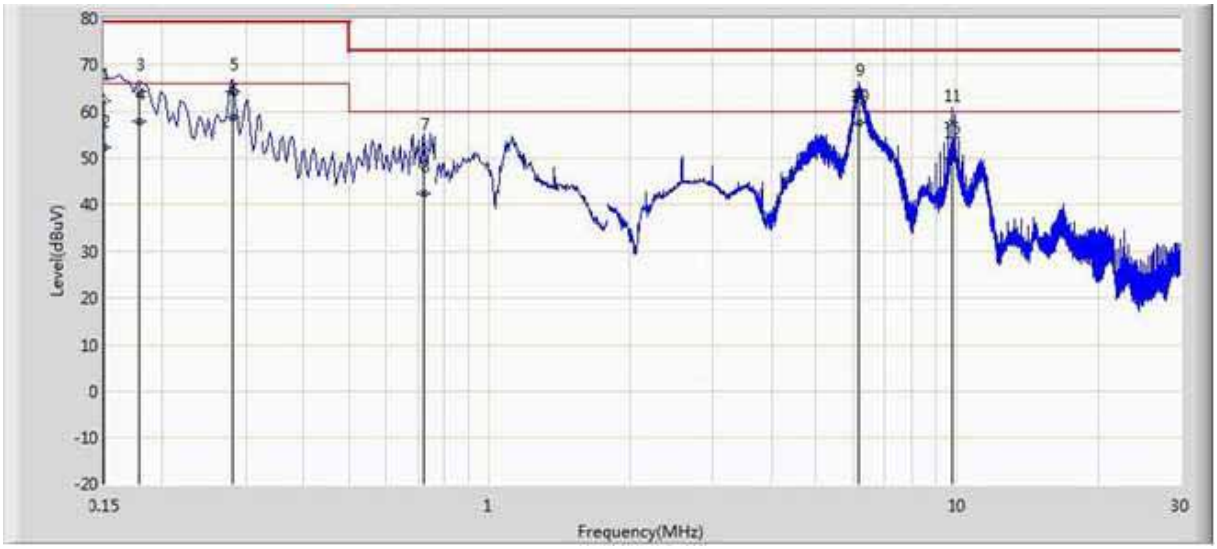
No	Mark	Frequency (MHz)	Measure Level (dBuV)	Reading Level (dBuV)	Over Limit (dB)	Limit (dBuV)	Probe (dB)	Cable (dB)	Amp (dB)	Type
1		0.181	66.091	57.161	-12.207	80.000	0.040	10.401	0.000	QP
2		0.181	61.989	51.962	-5.307	67.000	0.040	10.401	0.000	AV
3		0.205	64.618	54.590	-13.680	80.000	0.039	10.401	0.000	QP
4		0.205	59.451	48.423	-6.847	67.000	0.039	10.401	0.000	AV
5		0.305	65.685	54.655	-13.611	80.000	0.040	10.402	0.000	QP
6		0.305	59.521	48.491	-6.777	67.000	0.040	10.402	0.000	AV
7		0.585	57.350	46.316	-15.946	74.000	0.043	10.405	0.000	QP
8		0.585	51.708	42.671	-8.590	61.000	0.043	10.405	0.000	AV
9		6.086	62.856	53.597	-10.442	74.000	0.120	10.552	0.000	QP
10		6.086	56.764	47.502	-3.534	61.000	0.120	10.552	0.000	AV
11		7.116	49.807	38.520	-23.491	74.000	0.135	10.559	0.000	QP
12		7.114	43.420	32.136	-16.878	61.000	0.135	10.559	0.000	AV

Line2



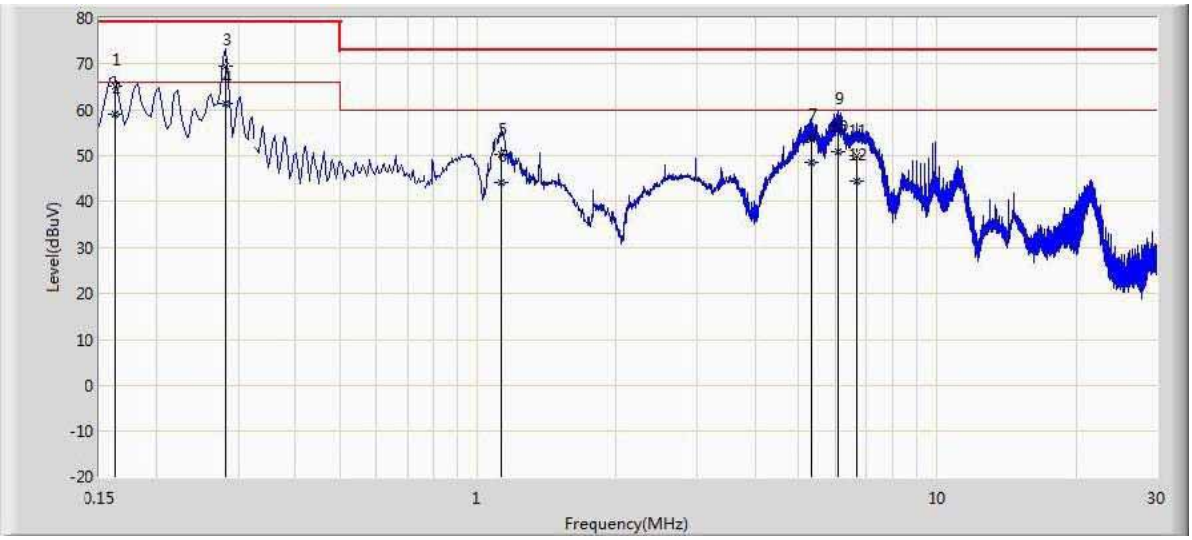
No	Mark	Frequency (MHz)	Measure Level (dBuV)	Reading Level (dBuV)	Over Limit (dB)	Limit (dBuV)	Probe (dB)	Cable (dB)	Amp (dB)	Type
1		0.184	59.743	49.713	-6.554	67.000	0.041	10.401	0.000	AV
2		0.204	64.004	53.975	-15.293	80.000	0.040	10.401	0.000	QP
3		0.204	57.887	47.858	-8.410	67.000	0.040	10.401	0.000	AV
4		0.304	67.570	57.539	-11.727	80.000	0.041	10.402	0.000	QP
5		0.304	60.817	50.786	-5.480	67.000	0.041	10.402	0.000	AV
6		0.580	54.342	44.299	-18.955	74.000	0.044	10.411	0.000	QP
7		0.580	47.759	37.716	-12.538	61.000	0.044	10.411	0.000	AV
8		6.104	61.049	50.795	-12.248	74.000	0.130	10.536	0.000	QP
9		6.104	56.829	46.575	-3.468	61.000	0.130	10.536	0.000	AV
10		9.764	56.438	46.045	-16.859	74.000	0.194	10.612	0.000	QP
11		9.764	53.190	42.797	-7.107	61.000	0.194	10.612	0.000	AV
12		0.184	59.743	49.713	-6.554	67.000	0.041	10.401	0.000	AV

Line3



No	Mark	Frequency (MHz)	Measure Level (dBuV)	Reading Level (dBuV)	Over Limit (dB)	Limit (dBuV)	Probe (dB)	Cable (dB)	Amp (dB)	Type
1		0.172	63.067	53.034	-16.230	80.000	0.044	10.401	0.000	QP
2		0.172	52.967	42.935	-13.330	67.000	0.044	10.401	0.000	AV
3		0.200	65.232	55.201	-14.065	80.000	0.042	10.401	0.000	QP
4		0.200	58.689	48.658	-7.608	67.000	0.042	10.401	0.000	AV
5		0.304	65.158	55.124	-14.139	80.000	0.043	10.402	0.000	QP
6		0.304	59.517	49.483	-6.780	67.000	0.043	10.402	0.000	AV
7		0.744	52.444	42.388	-20.853	74.000	0.051	10.417	0.000	QP
8		0.744	43.159	33.103	-17.138	61.000	0.051	10.417	0.000	AV
9		6.184	64.037	53.772	-9.260	74.000	0.137	10.540	0.000	QP
10	*	6.184	58.483	48.219	-1.814	61.000	0.137	10.540	0.000	AV
11		9.752	58.418	48.010	-14.879	74.000	0.204	10.616	0.000	QP
12		9.752	50.727	40.319	-9.570	61.000	0.204	10.616	0.000	AV

Neutral



No	Mark	Frequency (MHz)	Measure Level (dBuV)	Reading Level (dBuV)	Over Limit (dB)	Limit (dBuV)	Probe (dB)	Cable (dB)	Amp (dB)	Type
1		0.184	66.141	56.112	-13.156	80.000	0.040	10.401	0.000	QP
2		0.184	60.017	49.988	-6.280	67.000	0.040	10.401	0.000	AV
3		0.304	70.374	60.343	-8.923	80.000	0.040	10.402	0.000	QP
4	*	0.304	62.212	52.181	-4.085	67.000	0.040	10.402	0.000	AV
5		1.148	50.898	40.817	-22.399	74.000	0.055	10.438	0.000	QP
6		1.148	44.857	34.776	-15.440	61.000	0.055	10.438	0.000	AV
7		5.344	54.201	43.942	-19.096	74.000	0.119	10.551	0.000	QP
8		5.344	49.116	38.858	-11.181	61.000	0.119	10.551	0.000	AV
9		6.084	57.713	47.442	-15.584	74.000	0.132	10.552	0.000	QP
10		6.084	51.552	41.280	-8.745	61.000	0.132	10.552	0.000	AV
11		6.712	50.718	40.448	-22.579	74.000	0.143	10.539	0.000	QP
12		6.712	45.189	34.919	-15.108	61.000	0.143	10.539	0.000	AV

3.1 Conducted Emissions (Telecommunication Ports)

Limits of conducted common mode (asymmetric mode) disturbance at telecommunication ports in the frequency range 0.15MHz to 30 MHz				
Frequency range MHz	Voltage Limits dB(μV)		Current limits dB(μA)	
	Quasi-peak	Average	Quasi-peak	Average
0.15 to 0.50	97 to 86	84 to 73	54 to 43	40 to 30
0.50 to 30	86	73	42	30
NOTE 1: The limits decrease linearly with the logarithm of the frequency in the range 0.15MHz to 0.5MHz. NOTE 2: The current and voltage disturbance limits are derived for use with an impedance stabilization network (ISN) which presents a common mode (asymmetric mode) impedance of 150Ω to the telecommunication port under test (conversion factor is 20 $\log_{10}$150 / I = 44dB).				

Test Result

The EUT does not contain the wired network port, so it needs not to perform this test item.

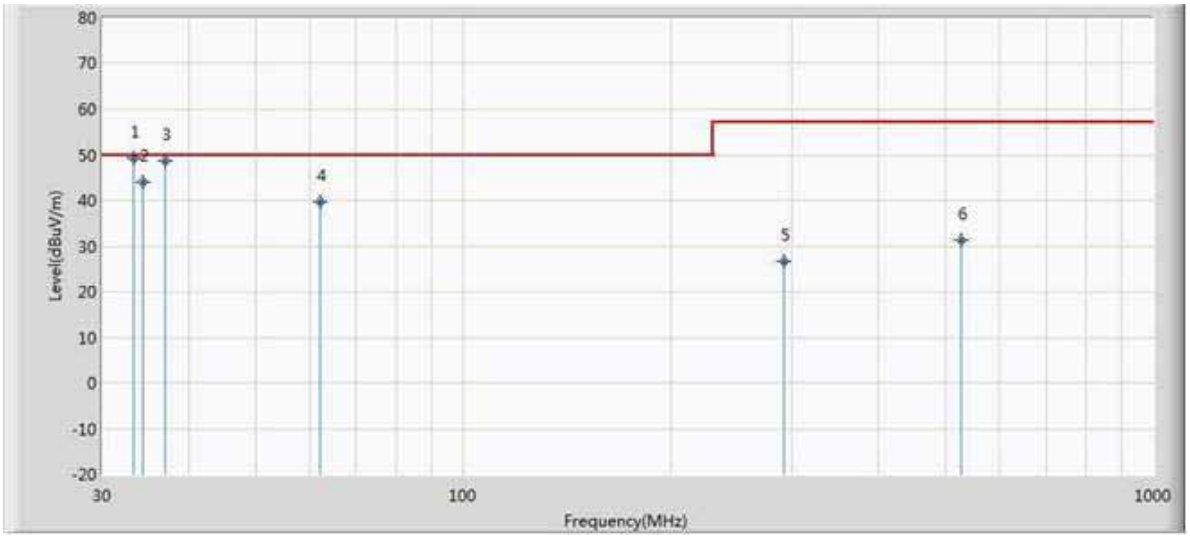
3.2 Radiated Emission

Limits for radiated disturbance at a measuring distance of 3m	
Frequency range MHz	Quasi-peak limits dB(μV/m)
30 to 230	50
230 to 1000	56
NOTE 1: The lower limit shall apply at the transition frequency. NOTE 2: Additional provisions may be required for cases where interference occurs.	

Limits for radiated disturbance at a measuring distance of 3m		
Frequency range GHz	Average limit dB(μV/m)	Peak-peak dB(μV/m)
1 to 3	56	76
3 to 6	60	80
NOTE: The lower limit applies at transition frequency.		

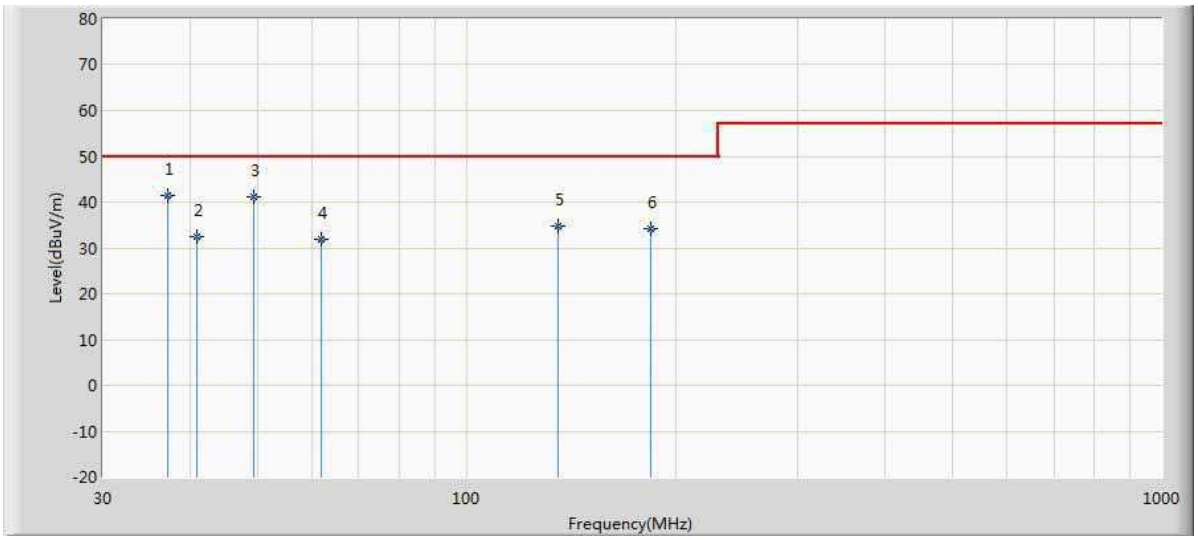
Test Result of Below 1GHz

Horizontal



No	Mark	Frequency (MHz)	Measure Level (dBuV/m)	Reading Level (dBuV)	Over Limit (dB)	Limit (dBuV/m)	Probe (dB/m)	Cable (dB)	Amp (dB)	Ant Pos (cm)	Table Pos (deg)	Type
1	*	35.332	49.936	33.205	-0.361	51.000	16.141	1.002	0.000	200	90	QP
2		36.352	44.948	28.825	-5.349	51.000	15.533	1.002	0.000	200	90	QP
3		38.972	49.467	34.825	-0.830	51.000	14.051	1.003	0.000	200	90	QP
4		64.092	40.593	34.505	-9.704	51.000	5.489	1.011	0.000	200	90	QP
5		294.462	27.358	13.805	-29.939	58.000	12.836	1.130	0.000	200	90	QP
6		529.812	32.104	13.105	-25.193	58.000	18.001	1.410	0.000	200	90	QP

Vertical



No	Mark	Frequency (MHz)	Measure Level (dBuV/m)	Reading Level (dBuV)	Over Limit (dB)	Limit (dBuV/m)	Probe (dB/m)	Cable (dB)	Amp (dB)	Ant Pos (cm)	Table Pos (deg)	Type
1	*	39.242	42.296	27.805	-8.001	50.000	13.900	0.523	0.000	200	90	QP
2		43.032	33.162	20.705	-17.135	50.000	11.865	0.524	0.000	200	90	QP
3		51.542	41.860	33.205	-8.437	50.000	8.060	0.527	0.000	200	90	QP
4		63.722	32.697	26.605	-17.600	50.000	5.493	0.531	0.000	200	90	QP
5		137.792	35.572	23.605	-14.725	50.000	11.340	0.559	0.000	200	90	QP
6		186.282	35.019	25.605	-15.278	50.000	8.764	0.582	0.000	200	90	QP

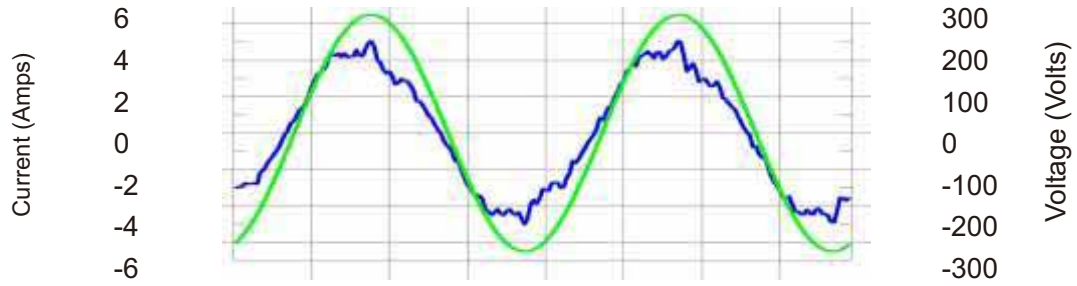
3.3 Harmonic current emissions

Standard	EN61000-3-2≤16A EN61000-3-11 >16A and ≤75A

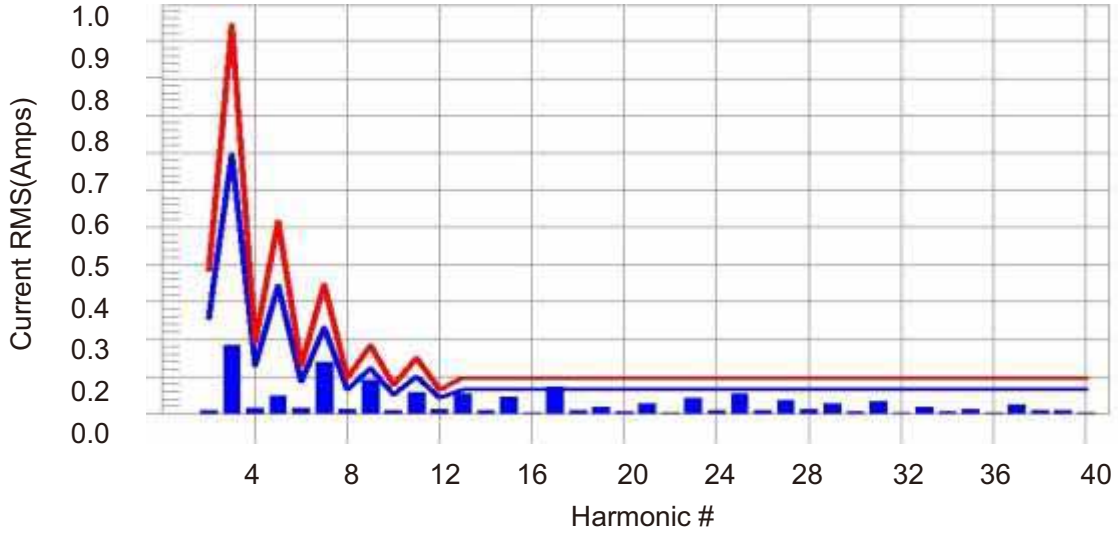
Class A	All apparatus not classified as Class B, C or D
Class B	Portable tools
Class C	Lighting equipment
Class D	Personal computers, television receivers

Results and limits

Current & voltage waveforms



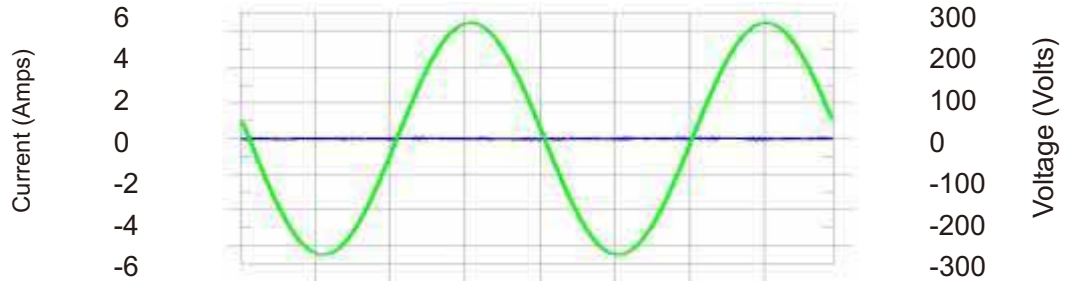
Harmonics and Class A limit line European Limits



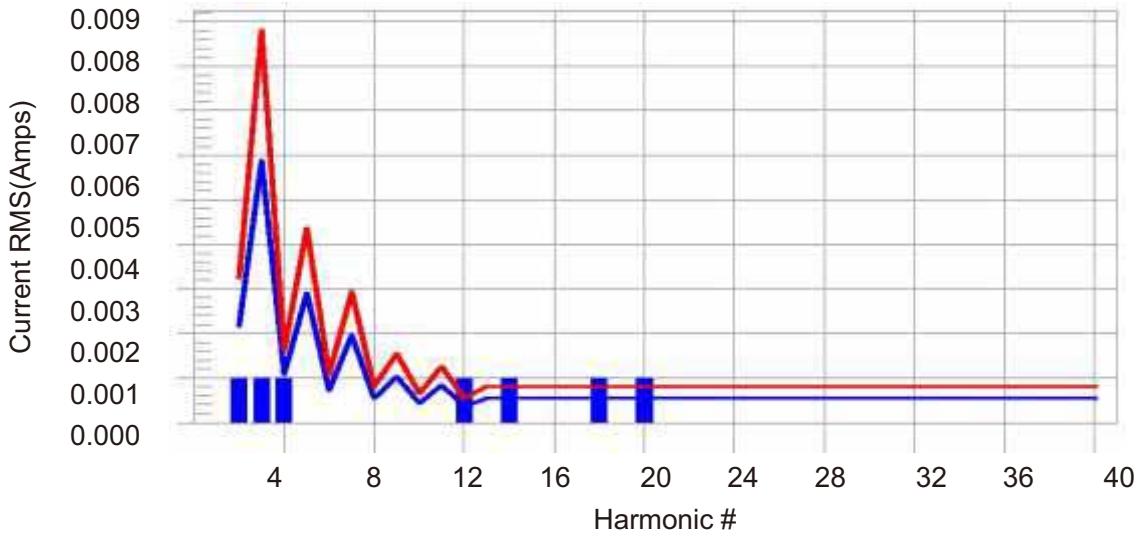
Test Result: Pass Source qualification: Normal
I-THC(%): 9.2 Limit(%): 23.0 PWHC(%): 19.8 PWHC Limit(%): 23.0
Highest parameter values during test:
V_RMS (Volts): 230.11 Frequency(Hz): 50.00
I_Peak (Amps): 5.496 I_RMS (Amps): 3.263
I_Fund (Amps): 3.203 Crest Factor: 1.698
Power (Watts): 731 Power Factor: 0.974

Harm#	Harms(avg)	100%Limit	%of Limit	Harms(max)	150%Limit	%of Limit	Status
2	0.012	0.279	4.900	0.015	0.408	4.600	Pass
3	0.186	0.717	27.600	0.189	1.065	19.000	Pass
4	0.017	0.151	12.400	0.018	0.215	9.500	Pass
5	0.051	0.366	15.300	0.053	0.539	10.900	Pass
6	0.016	0.108	17.100	0.017	0.151	12.900	Pass
7	0.140	0.254	60.400	0.144	0.370	42.100	Pass
8	0.015	0.086	22.000	0.018	0.119	17.800	Pass
9	0.091	0.144	74.300	0.101	0.205	55.300	Pass
10	0.009	0.073	14.400	0.012	0.099	13.500	Pass
11	0.060	0.122	59.000	0.064	0.172	42.300	Pass
12	0.014	0.065	28.300	0.019	0.086	27.300	Pass
13	0.055	0.086	82.900	0.058	0.119	58.900	Pass
14	0.012	N/A	N/A	0.015	N/A	N/A	N/A
15	0.046	N/A	N/A	0.049	N/A	N/A	N/A
16	0.005	N/A	N/A	0.008	N/A	N/A	N/A
17	0.075	N/A	N/A	0.077	N/A	N/A	N/A
18	0.010	N/A	N/A	0.013	N/A	N/A	N/A
19	0.021	N/A	N/A	0.025	N/A	N/A	N/A
20	0.008	N/A	N/A	0.010	N/A	N/A	N/A
21	0.028	N/A	N/A	0.032	N/A	N/A	N/A
22	0.006	N/A	N/A	0.009	N/A	N/A	N/A
23	0.045	N/A	N/A	0.050	N/A	N/A	N/A
24	0.009	N/A	N/A	0.013	N/A	N/A	N/A
25	0.056	N/A	N/A	0.067	N/A	N/A	N/A
26	0.011	N/A	N/A	0.017	N/A	N/A	N/A
27	0.037	N/A	N/A	0.050	N/A	N/A	N/A
28	0.013	N/A	N/A	0.018	N/A	N/A	N/A
29	0.030	N/A	N/A	0.039	N/A	N/A	N/A
30	0.007	N/A	N/A	0.010	N/A	N/A	N/A
31	0.035	N/A	N/A	0.042	N/A	N/A	N/A
32	0.006	N/A	N/A	0.008	N/A	N/A	N/A
33	0.021	N/A	N/A	0.024	N/A	N/A	N/A
34	0.007	N/A	N/A	0.011	N/A	N/A	N/A
35	0.014	N/A	N/A	0.019	N/A	N/A	N/A
36	0.006	N/A	N/A	0.009	N/A	N/A	N/A
37	0.025	N/A	N/A	0.034	N/A	N/A	N/A
38	0.009	N/A	N/A	0.011	N/A	N/A	N/A
39	0.012	N/A	N/A	0.014	N/A	N/A	N/A
40	0.005	N/A	N/A	0.006	N/A	N/A	N/A

Current & voltage waveforms



Harmonics and Class A limit line European Limits



Test Result: Pass Source qualification: Normal

I-THC(%): 11.0 Limit(%): 23.0 PWHC(%): 33.6 PWHC Limit(%): 23.0

Highest parameter values during test:

V_RMS (Volts): 230.20 Frequency(Hz): 50.00

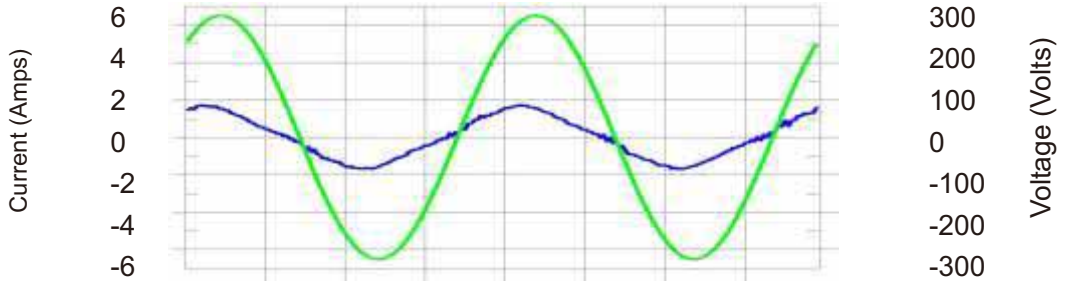
I_Peak (Amps): 0.103 I_RMS (Amps): 0.028

I_Fund (Amps): 0.007 Crest Factor: 3.777

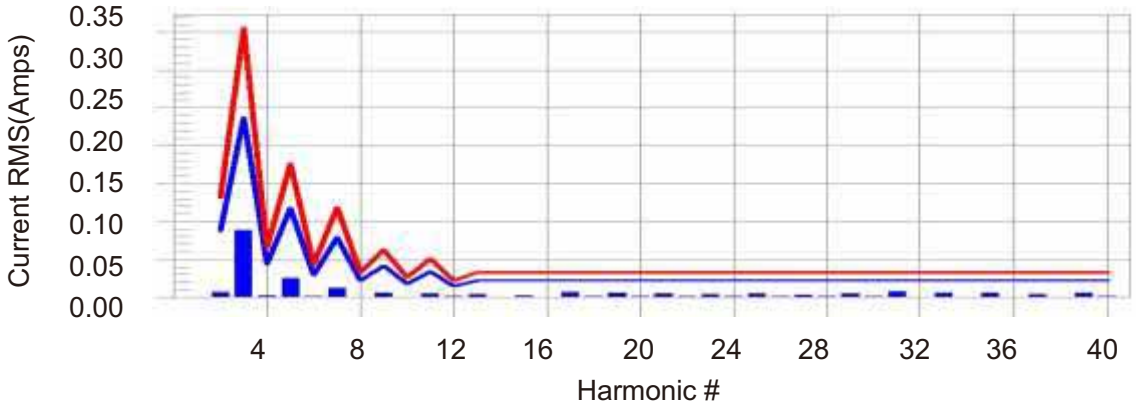
Power (Watts): 0 Power Factor: -0.054

Harm#	Harms(avg)	100%Limit	%of Limit	Harms(max)	150%Limit	%of Limit	Status
2	0.001	0.001	N/A	0.001	0.002	N/A	Pass
3	0.001	0.005	N/A	0.001	0.006	N/A	Pass
4	0.001	0.001	N/A	0.001	0.002	N/A	Pass
5	0.000	0.007	N/A	0.001	0.005	N/A	Pass
6	0.000	0.001	N/A	0.001	0.001	N/A	Pass
7	0.000	0.002	N/A	0.001	0.003	N/A	Pass
8	0.000	0.001	N/A	0.000	0.001	N/A	Pass
9	0.000	0.006	N/A	0.000	0.003	N/A	Pass
10	0.000	0.000	N/A	0.000	0.001	N/A	Pass
11	0.000	0.001	N/A	0.000	0.001	N/A	Pass
12	0.001	0.000	N/A	0.001	0.001	N/A	Pass
13	0.000	0.001	N/A	0.000	0.001	N/A	Pass
14	0.001	N/A	N/A	0.002	N/A	N/A	N/A
15	0.000	N/A	N/A	0.000	N/A	N/A	N/A
16	0.000	N/A	N/A	0.001	N/A	N/A	N/A
17	0.000	N/A	N/A	0.000	N/A	N/A	N/A
18	0.001	N/A	N/A	0.003	N/A	N/A	N/A
19	0.000	N/A	N/A	0.001	N/A	N/A	N/A
20	0.001	N/A	N/A	0.002	N/A	N/A	N/A
21	0.000	N/A	N/A	0.000	N/A	N/A	N/A
22	0.000	N/A	N/A	0.000	N/A	N/A	N/A
23	0.000	N/A	N/A	0.000	N/A	N/A	N/A
24	0.000	N/A	N/A	0.000	N/A	N/A	N/A
25	0.001	N/A	N/A	0.001	N/A	N/A	N/A
26	0.000	N/A	N/A	0.000	N/A	N/A	N/A
27	0.000	N/A	N/A	0.001	N/A	N/A	N/A
28	0.001	N/A	N/A	0.000	N/A	N/A	N/A
29	0.000	N/A	N/A	0.000	N/A	N/A	N/A
30	0.001	N/A	N/A	0.001	N/A	N/A	N/A
31	0.000	N/A	N/A	0.000	N/A	N/A	N/A
32	0.000	N/A	N/A	0.000	N/A	N/A	N/A
33	0.000	N/A	N/A	0.000	N/A	N/A	N/A
34	0.000	N/A	N/A	0.000	N/A	N/A	N/A
35	0.000	N/A	N/A	0.000	N/A	N/A	N/A
36	0.000	N/A	N/A	0.001	N/A	N/A	N/A
37	0.000	N/A	N/A	0.000	N/A	N/A	N/A
38	0.001	N/A	N/A	0.000	N/A	N/A	N/A
39	0.001	N/A	N/A	0.000	N/A	N/A	N/A
40	0.000	N/A	N/A	0.001	N/A	N/A	N/A

Current & voltage waveforms



Harmonics and Class A limit line European Limits



Test Result: Pass Source qualification: Normal
I-THC(%): 8.7 Limit(%): 23.0 PWHC(%): 9.4 PWHC Limit(%): 23.0
Highest parameter values during test:
V_RMS (Volts): 230.09 Frequency(Hz): 50.00
I_Peak (Amps): 1.821 I_RMS (Amps): 1.099
I_Fund (Amps): 1.091 Crest Factor: 1.661
Power (Watts): 241 Power Factor: 0.955

Harm#	Harms(avg)	100%Limit	%ofLimit	Harms(max)	150%Limit	%of Limit	Status
2	0.008	0.110	8.600	0.010	0.132	6.200	Pass
3	0.089	0.259	36.300	0.092	0.355	25.500	Pass
4	0.003	0.066	N/A	0.004	0.066	N/A	Pass
5	0.026	0.139	22.500	0.028	0.176	14.800	Pass
6	0.002	0.051	N/A	0.003	0.044	N/A	Pass
7	0.013	0.101	15.500	0.015	0.118	10.800	Pass
8	0.001	0.044	N/A	0.003	0.033	N/A	Pass
9	0.007	0.064	14.600	0.008	0.062	9.600	Pass
10	0.001	0.040	N/A	0.003	0.026	N/A	Pass
11	0.006	0.056	N/A	0.007	0.051	N/A	Pass
12	0.002	0.037	N/A	0.003	0.022	N/A	Pass
13	0.005	0.044	N/A	0.006	0.033	N/A	Pass
14	0.001	N/A	N/A	0.003	N/A	N/A	N/A
15	0.003	N/A	N/A	0.004	N/A	N/A	N/A
16	0.001	N/A	N/A	0.002	N/A	N/A	N/A
17	0.008	N/A	N/A	0.009	N/A	N/A	N/A
18	0.002	N/A	N/A	0.003	N/A	N/A	N/A
19	0.007	N/A	N/A	0.009	N/A	N/A	N/A
20	0.002	N/A	N/A	0.003	N/A	N/A	N/A
21	0.006	N/A	N/A	0.008	N/A	N/A	N/A
22	0.002	N/A	N/A	0.003	N/A	N/A	N/A
23	0.005	N/A	N/A	0.006	N/A	N/A	N/A
24	0.002	N/A	N/A	0.003	N/A	N/A	N/A
25	0.006	N/A	N/A	0.008	N/A	N/A	N/A
26	0.002	N/A	N/A	0.003	N/A	N/A	N/A
27	0.004	N/A	N/A	0.005	N/A	N/A	N/A
28	0.002	N/A	N/A	0.003	N/A	N/A	N/A
29	0.006	N/A	N/A	0.008	N/A	N/A	N/A
30	0.002	N/A	N/A	0.003	N/A	N/A	N/A
31	0.009	N/A	N/A	0.010	N/A	N/A	N/A
32	0.001	N/A	N/A	0.003	N/A	N/A	N/A
33	0.007	N/A	N/A	0.008	N/A	N/A	N/A
34	0.001	N/A	N/A	0.003	N/A	N/A	N/A
35	0.007	N/A	N/A	0.008	N/A	N/A	N/A
36	0.001	N/A	N/A	0.003	N/A	N/A	N/A
37	0.005	N/A	N/A	0.006	N/A	N/A	N/A
38	0.001	N/A	N/A	0.003	N/A	N/A	N/A
39	0.007	N/A	N/A	0.008	N/A	N/A	N/A
40	0.002	N/A	N/A	0.003	N/A	N/A	N/A

3,4 Voltage fluctuations and flicker

Standard	EN 61000-3-3 ⩽16A EN 61000-3-12 ＞16A and ⩽75A

Equipment intended to be connected to 230/400 VAC 50 Hz supply systems may not produce voltage fluctuations in the supply systems due to variation of the input current above the limits as stated below.

P_{ST}	1
P_{LT}	0.66
Tmax	500ms
d_C	3.2%
d_{MAX}	4%

Results

Relative voltage change characteristic Tmax	0,0 ms
Maximum voltage change d_{MAX}	-0.05%
Relative Voltage change d_C	0.00%
Short term flicker P_{ST}	0.241
Long term flicker P_{LT}	0.104

4 IMMUNITY TEST RESULTS

4.1 Electrostatic discharge immunity

Electrostatic discharges (ESD) are the result of persons or objects that accumulate static electricity due to for instance walking on synthetic carpets. The ESD can influence the operation of equipment or damage its electronics, either by a direct discharge or indirectly by coupling or radiation. Both effects are simulated during the tests.

Environmental phenomenon	Test specification	Units	Performance criterion
Enclosure port			
Electrostatic discharge	±4 (Contact discharge) ±8 (Air discharge)	kV (Charge voltage) kV (Charge voltage)	B

Performed tests

Air discharges		2 kV		4 kV	√	8 kV		
Contact discharges		2 kV	√	4 kV		8 kV		
Via coupling planes	√	Horizontal			√	Vertical		
Polarity	√	Positive			√	Negative		
Set-up		Table-top			√	Floor standing		
Ambient temperature	24 °C							
Relative Humidity air	48 %							
Mode	Normal Operation							

Observations

During the test no loss of performance was observed. After the test the EUT functioned as intended. No unacceptable loss of performance was observed.

4.2 Radio frequency electromagnetic field

During the test it is verified if the equipment under test has sufficient immunity against radiated electromagnetic fields. Walkie-talkies, radio transmitters, television transmitters, and telecommunication equipment including cellular telephones and other emitting devices, like industrial electromagnetic sources can generate these fields.

Item	Environmental Phenomena	Units	Test Specification	Performance Criteria
Enclosure port				
	Radio-Frequency Electromagnetic Field Amplitude Modulated (See Note a,b,c,d)	MHz V/m (Un-modulated, rms) % AM (1kHz)	80 – 1000 10 80	A
	Radio-Frequency Electromagnetic Field Amplitude Modulated (See Note a,b,c,d)	MHz V/m (Un-modulated, rms) % AM (1kHz)	1400 - 6000 3 80	A
Note : a. IEC 61000-4-20 may be used for small EUTs as defined in IEC 61000-4-20 b. A fully anechoic room (FAR) as described in IEC 61000-4-22 may also be used as a test site for radio-frequency immunity test c. A reverberation chamber (RVC) as described in IEC 61000-4-21 may also be used. The forward power injected into a reverberation chamber Pinput is given by the required test electric-field strength Etest as follows: d. For information regarding situations with a high concentration of mobile transmitters, see for example IEC TR 61000-2-5:2011, 9.3				

All the scanning conditions are as follows:

	Condition of Test	Remarks
1.	Field Strength	10V/m, 3V/m, 1V/m
2.	Radiated Signal	AM 80% Modulated with 1kHz
3.	Scanning Frequency	80 - 1000MHz, 1400 - 2000MHz, 2000 - 2700MHz
4.	Dwell Time	3 Seconds
5.	Frequency Step Size Δf	1%

Performed tests

Frequency range	80 - 1000MHz, 1400 - 2000MHz, 2000 - 2700MHz
Tested Field strength	10V/m, 3V/m,1V/m
Dwell time	3 seconds
Test set-up	Floor standing
Mode	Normal Operation

Observations

During the test no loss of performance was observed. After the test the EUT functioned as intended. No unacceptable loss of performance was observed.

4.3 Fast transients common mode

The EFT immunity test simulates disturbances by bursts of very short transients caused for example by switching off loads such as an AC motor or bouncing relay contacts. The transients are likely to disturb electronics but less likely to cause damage.

Environmental phenomenon	Test specification	Units	Performance criterion
Input a.c. power ports			
Fast transients	±2 5/50 5	kV (open circuit test voltage) Tr/Th (ns) Repetition frequency (kHz)	B
Input d.c. power ports			
Fast transients	±1 5/50 5	kV (open circuit test voltage) Tr/Th (ns) Repetition frequency (kHz)	B
Signal ports and telecommunication ports (See Note 1)			
Fast transients	±1 5/50 5	kV (open circuit test voltage) Tr/Th (ns) Repetition frequency (kHz)	B
NOTE 1：Applicable only to ports interfacing with cables whose total length according to the manufacturer's functional specification may exceed 3 m.			

Performed tests

Tested Voltage	2 kV; AC input power port 1 kV; Signal ports			
Mode	Normal Operation			
Injection method	√	CDN	√	Capacitive clamp
Polarity	√	Positive	√	Negative
Set-up		Table-top	√	Floor standing

Observations

During the test no loss of performance was observed. After the test the EUT functioned as intended. No unacceptable loss of performance was observed.

4.4 Surge

The surge transient immunity test simulates the surges that are caused by over voltages due to indirect (induced) lightning transients. The pulse is a slow transient with high-energy contents and due to its long duration may cause damage to an unprotected EUT.

Environmental phenomenon	Test specification	Units	Performance criterion
Input a.c. power ports			
Surges	1.2/50 (8/20) ±1 line to line ±2 line to earth (ground)	Tr/Th (us) kV (open circuit test voltage) kV (open circuit test voltage)	B
Input d.c. power ports (See Note 1)			
Surges	1.2/50 (8/20) ±0.5 line to line ±1 line to earth (ground)	Tr/Th (us) kV (open circuit test voltage)	B
Signal ports and telecommunication ports (See Note 2, 3)			
Surges Line to Ground	1.2/50 (8/20) ±1	Tr/Th (us) kV (open circuit test voltage)	B
NOTE: 1. Not applicable to input ports intended for connection to a battery or a rechargeable battery which must be removed or disconnected from the apparatus for recharging. Apparatus with a DC power input port intended for use with an AC–DC power adaptor shall be tested on the AC power input of the AC- DC power adaptor specified by the manufacturer or, where none is so specified, using a typical AC–DC power adaptor. The test is applicable to DC power input ports intended to be connected permanently to cables longer than 3 m. 2. Applicable only to ports interfacing with cables whose total length according to the manufacturer's functional specification may exceed 30 m. 3. Where normal functioning cannot be achieved because of the impact of the CDN on the EUT, this test is not required.			

Performed tests

Tested Voltage; Port	1 kV; AC input power port (Line to line) 2 kV; AC input power port (Line to Ground)			
Mode	Normal Operation			
Polarity	√	Positive	√	Negative

Observations

During the test no loss of performance was observed. After the test the EUT functioned as intended. No unacceptable loss of performance was observed.

4.5 Radio frequency common mode

During this test the immunity of the equipment for induced or conducted electromagnetic fields is checked. Fields generated by radio and other transmitters cause RF voltages in long cables like the mains network. This test reproduces these induced disturbing voltages by injecting them to the EUT via the cabling.

Environmental phenomenon	Test specification	Units	Performance criterion
Input a.c. power ports (See Note 1,2)			
Radio-frequency continuous conducted	0.15 - 80 10 80	MHz V (unmodulated, r.m.s) % AM (1kHz)	A
Input d.c. power ports (See Note 1,2)			
Radio-frequency continuous conducted	0.15 - 80 10 80	MHz V (unmodulated, r.m.s) % AM (1kHz)	A
Signal ports and telecommunication ports (See Note 1,2,3)			
Radio-frequency continuous conducted	0.15 - 80 10 80	MHz V (unmodulated, r.m.s) % AM (1kHz)	A
NOTE: 1. The test level can also be defined as the equivalent current into a 150 Ω load. 2. Except for the ITU broadcast frequency band 47 MHz to 68 MHz, where the level shall be 3 V. 3. Applicable only to ports interfacing with cables whose total length according to the manufacturer's functional specification may exceed 3 m.			

All the scanning conditions are as follows:

	Condition of Test	Remarks
1.	Field Strength	10V
2.	Radiated Signal	AM 80% Modulated with 1kHz
3.	Scanning Frequency	0.15 - 80MHz
4.	Dwell Time	3 Seconds
5.	Frequency Step Size Δf	1%

Performed tests

Tested level; Port	10 V; AC input power port 10 V; Signal ports			
Mode	Normal Operation			
Frequency range	0,15 – 80 MHz			
Dwell time	3 seconds			
Injection method	√	CDN-M3	√	EM clamp

Observations

During the test no loss of performance was observed. After the test the EUT functioned as intended. No unacceptable loss of performance was observed.

4.6 Power-frequency magnetic field

Environmental phenomenon	Test specification	Units	Performance criterion
Enclosure port(See Note 1,2)			
Power-frequency magnetic field	50,60 30	Hz A/m (r.m.s)	A
NOTE: 1. Applicable only to apparatus containing devices susceptible to magnetic fields. 2. For CRTs, the acceptable jitter depends upon the character size and is calculated for a test level of 1 A/m as follows: $J \leq \frac{(3C+1)}{40}$ where jitter J and character size C are in millimetres. As jitter is linearly proportional to the magnetic field strength, tests can be carried out at other test levels extrapolating the maximum jitter level appropriately.			

Performed tests

Tested level	30 A/m					
Mode	Normal Operation					
Frequency	50 Hz					
Dwell time	3 seconds					
Test Coil Position	√	X Axis	√	Y Axis	√	Z Axis

Observations

During the test no loss of performance was observed. After the test the EUT functioned as intended. No unacceptable loss of performance was observed.

4.7 Voltage dips and interruptions

Environmental phenomenon	Test specification		Units	Performance criterion
Input a.c. power ports(See Note 1,2)				
Voltage dips	0 1		% residual Period	B
	40 10/12 at 50/60Hz	70 25/30 at 50/60Hz	% residual Periods	C
Voltage interruptions	0 250/300 at 50/60Hz		% residual Periods	C
NOTE: 1. Applicable only to input ports. 2. For electronic power converters, the operation of protective devices is allowed.				

Performed tests

Tested voltage		AC input power port				
Mode		Normal Operation				
Item	Voltage % residual	Test Duration (cycle)	Performance criterion	Test Result criterion	Result	Observation
Voltage Dips	0	1	B	A	Pass	Note 1
	40	10	C	A	Pass	Note 1
	70	25	C	A	Pass	Note 1
Voltage Interruption	0	250	C	C	Pass	Note 2

Note 1: During the test no loss of performance was observed. After the test the EUT functioned as intended. No unacceptable loss of performance was observed.

Note 2: The system shut down during the test, but can be restored by the user.

Photos

* THE END *

EC DECLARATION OF CONFORMITY

CE

MANUFACTURER:

NAME: JINAN HANDA MACHINERY CO., LTD.

ADDRESS: WORKSHOP 4-B-4 ZHONGDIANJIAN ENERGY INDUSTRIAL PARK, NO. 5577 NORTH GONGYE ROAD, JINAN CITY, SHANDONG PROVINCE, CHINA

THE TECHNICAL DOCUMENTATION WAS COMPLIED BY:

NAME: JINAN HANDA MACHINERY CO., LTD.

ADDRESS: WORKSHOP 4-B-4 ZHONGDIANJIAN ENERGY INDUSTRIAL PARK, NO. 5577 NORTH GONGYE ROAD, JINAN CITY, SHANDONG PROVINCE, CHINA

HEREBY DECLARES THAT THE PRODUCT DESCRIBED BELOW:

PRODUCT NAME: WELDING ROTATOR

MODEL: HDTR-1000, HDTR-3000, ZT-5, ZT-10, ZT-20, ZT-30, ZT-40, ZT-50, ZT-60, ZT-100, KT-5, KT-10, KT-20, KT-40, KT-60, KT-80, KT-100

DATE: 07, 2023

COMPLIES WITH THE PROVISIONS OF FOLLOWING EUROPEAN DIRECTIVES:

2006/42/EC MACHINERY DIRECTIVE

2014/35/EU LOW VOLTAGE DIRECTIVE

2014/30/EU ELECTROMAGNETIC COMPATIBILITY DIRECTIVE

COMPLYIES WITH THE PROVISIONS OF THE FOLLOWING HARMONIZED STANDARDS:

BS EN ISO 12100:2010 SAFETY OF MACHINERY - GENERAL PRINCIPLES FOR DESIGN - RISK ASSESSMENT AND RISK REDUCTION

BS EN 60204-1:2018 SAFETY OF MACHINERY- ELECTRICAL EQUIPMENT OF MACHINES - PART 1: GENERAL REQUIREMENTS

BS EN 61000-6-2:2019 ELECTROMAGNETIC COMPATIBILITY (EMC) -- PART 6-2: GENERIC STANDARDS - IMMUNITY FOR INDUSTRIAL ENVIRONMENTS

BS EN 61000-6-4:2019 ELECTROMAGNETIC COMPATIBILITY (EMC) -- PART 6-4: GENERIC STANDARDS - EMISSION STANDARD FOR INDUSTRIAL ENVIRONMENTS

DONE AT (PLACE): JINAN CITY, SHANDONG PROVINCE, CHINA

WE DECLARE UNDER OUR SOLE RESPONSIBILITY THAT THE ABOVE PRODUCTS ARE CONFIRMED TO COMPLY WITH THE REQUIREMENTS SET OUT IN THE EC DIRECTIVES AND THEIR INTERRELATED STANDARDS.

JINAN HANDA MACHINERY CO., LTD.

NAME OF SIGNATORY GUO GUIZHEN

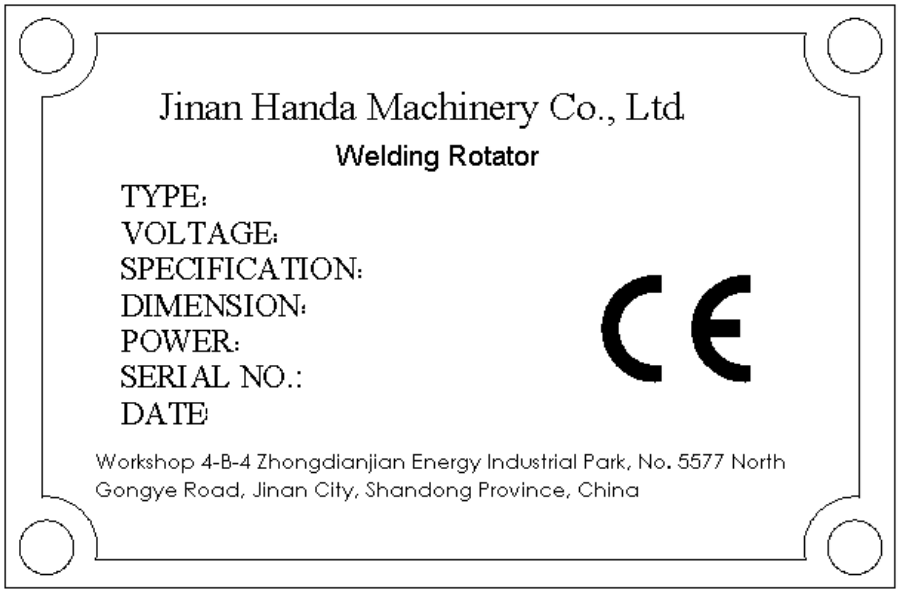
SIGNATURE: Guo Guizhen

DATE: 2023.07

QUALIFICATION: GENERAL MANAGER

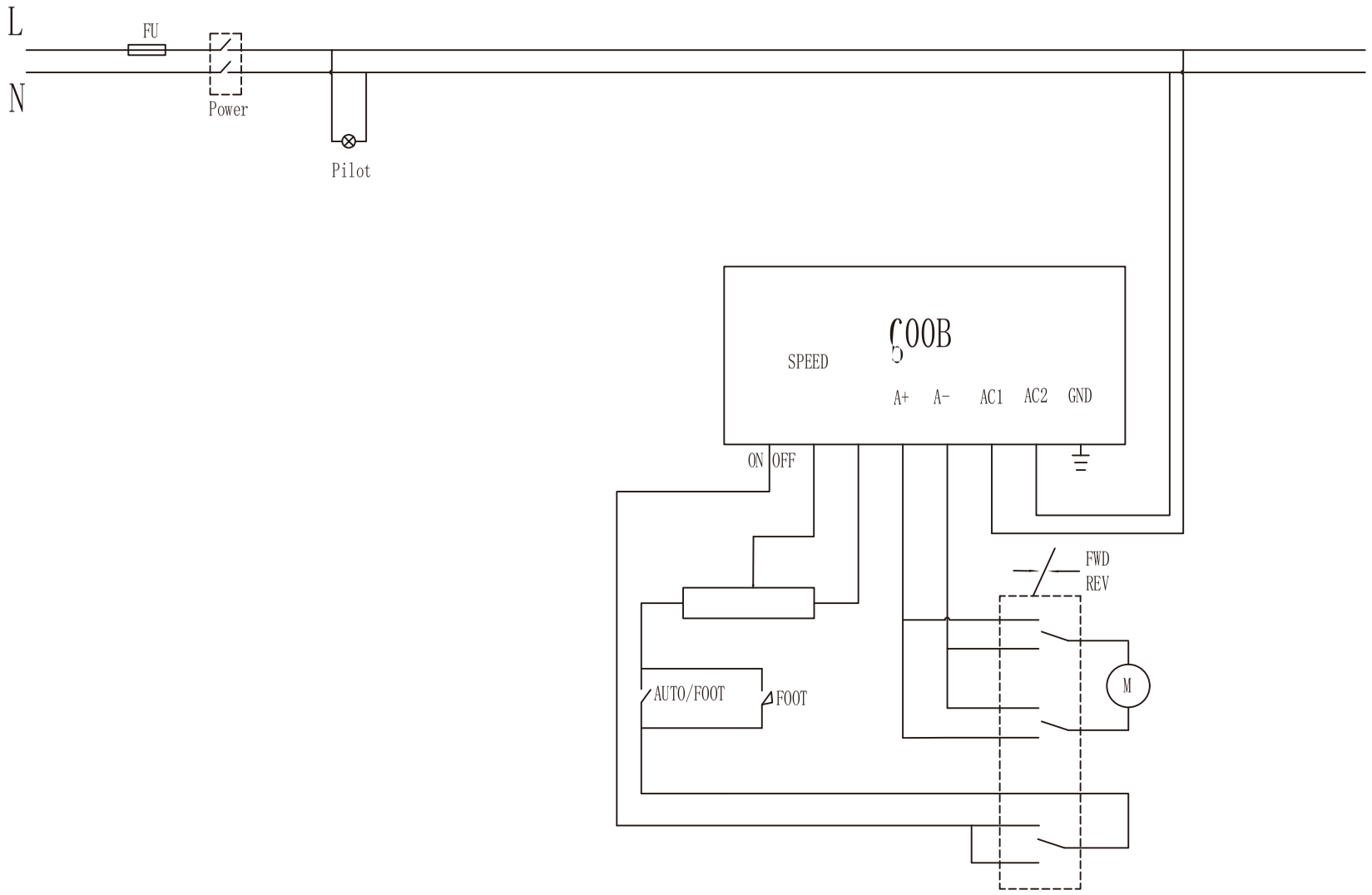
济南焊达机械有限公司 JINAN HANDA MACHINERY CO.,LTD

A2 NAMEPLATE



A3 MAIN PARTS LIST

1	Motor
2	Reducer
3	Pc board
4	Polyurrthane roller
5	bearing
6	Sheet metal bracket
7	Screw standard parts
8	Foot pedal
9	Power cord
10	Friction wheel



								济南焊达技术部
标记	处数	分区	更改文件号	签 字	年、月、日			
设 计			标准化			阶段标记	重量	比例
审 核								
工 艺			批准			共 张 第 张		

IMPORTANT: Read these instructions before installing, operating, or servicing this product.

HDTR—1000、3000

TURNING ROLL

OWNER'S MANUAL

INTRODUCTION

WARNING : A procedure, which, if not properly followed, may cause injury to the operator or others in the operating area.

Equipment Identification	The identification number specification or model, and serial number of this unit usually appears on a nameplate attached to the control panel, record these numbers for future reference.

Receipt of Equipment

When you receive the equipment, check it against the shipping documents, Make sure it is complete and inspect the equipment for possible damage during shipping, if there is any damage, notify the carrier immediately to file a claim

Furnish complete information concerning damage claims or mistake(s) in shipment to our company. Include the equipment identification number along with a description of the parts in question

Move the equipment to the installation site before uncrating the unit. Use care to avoid damaging the equipment when using bars, hammers, etc. to uncrate the unit

LIMITED WARRANTY

1、Warrants all new equipment to be free from defects in material and workmanship for one year, provided that the equipment is installed operated according to instructions in this manual.

2、 Obligation under this warranty policy is expressly limited to the replace or repair, at its option, of the defected part only. Our option to repair or replacement of a defected part under this warranty shall be based on the sale contract between both sides.

3、We shall not be liable for any loss or consequential damage or express accruing directly or indirectly from the use of equipment covered by this

warranty.

4、This warranty supersedes all previous our warranties and exclusive with no other guarantees or warranties expressed or implied.

5、This warranty excludes the consumable parts that are used in normal operation.

SPECIFICATION

MODEL	**HDTR-1000**
Input Power	AC110V/230V, 50/60Hz
Load Capacity	1,000kg
Speed Range	80 ~ 1600mm/min
Diameter Range	Φ20 ~ Φ700mm
Drive Motor	DC Motor, 230V、120W
Roller Type	50mm(W)×Φ250mm
Drive Dimension (Include control box)	580(L)×360(W)×350(H)mm

Slave Dimension	450(L)×200(W)×350(H)mm
MODEL	**HDTR-3000**
Input Power	1 Phase AC220V, 50/60Hz
Load Capacity	3,000kg
Speed Range	80 ~ 1600mm/min
Diameter Range	Φ40 ~ Φ1400mm
Drive Motor	AC Motor, 1 Phase 220V 375 W
Roller Type	50mm(W)×Φ200mm
Drive Dimension (Include control box)	800(L)×370(W)×450(H)mm
Slave Dimension	800(L)×265(W)×450(H)mm

CONTROL PANEL

HDTR-1000：

1、Front Panel

PL: Power Pilot

S1: Power ON/OFF Switch

S2: Start/Stop Switch(When use FOOT switch,the S2 should on STOP.)

S3: Forward/Reverse Switch

VR: Speed Adjustment

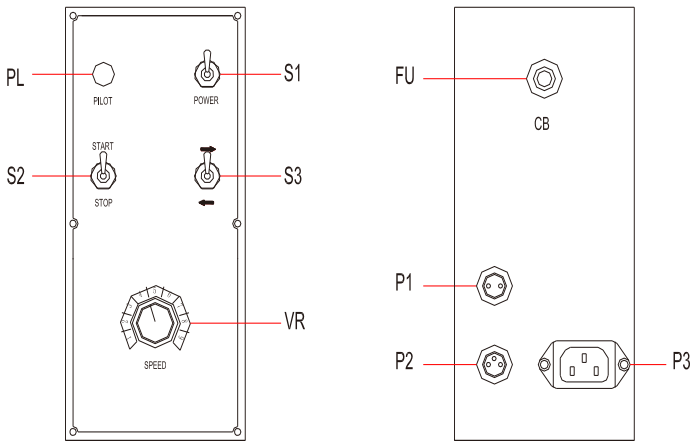
2、Real Panel

FU: Fuse (CB)

P1: Motor Connector (2Pin)

P2: Foot Switch Connector (3Pin)

P3: Input Power Connector



CONTROL PANEL

HDTR-3000 :

1、Front Panel

PL: Power Pilot

S1: Power ON/OFF Switch

P1: Input Power Connector

P2: Small control box Connector

2、Real Panel

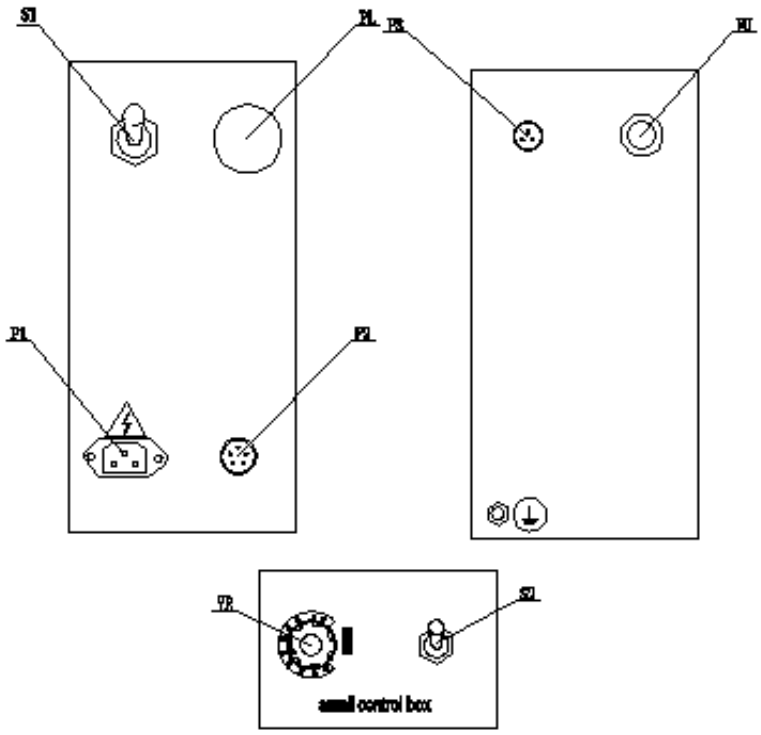
FU: Fuse (CB)

P3: Motor Connector (3Pin)

3、Small control box

VR : Speed Sdjustment

S2 : Forward/Reverse Switch



TROUBLE SHOOTINGTROUBLE SHOOTING GUIDE____

NO.	SYMPTOM	POSSIBLE CAUSE	REMEDY
1	Power pilot does not lit	1. Power fuse is burnt. 2. LED burnt. 3. Power switch is burnt. 4. No power input.	1. Replace a new fuse. 2. Replace LED. 3. Replace switch. 4. Check the switch or replace.

2	Speed Adjustment no Motion.	1.Damaged potentiometer. 2. Motor control PCB no output.	1. Check if potentiometer is 10K Ω , otherwise replace. 2. Replace a new motor control PCB.
3	Foot switch no motion	Foot switch is damaged.	Check the foot switch or replace.
4	Forward/Reverse no output	Forward/Reverse switch is damaged.	Check the switch or replace.
5	Motor no motion	1. Motor has power input but no motion. 2. Motor control PCB has no power input Motor control PCB is damaged.	1. Replace a new motor. 2. Check the transformer or replace. 3. Replace control PCB.
6	Motor no motion	3. Motor has power input but no motion. 4. AC driver has no power input 5. AC driver is damaged.	2. Replace a new motor. 2. Check the transformer or replace. 3. Replace AC driver

Certificate of approval

Name Of production	TURNING ROLL
Model	HDTR-1000 ( ) HDTR-3000 ( )
No.	
Date of production	
Inspector	

The product accords with the technical criteria and is allowed to sell.