TECHNICAL CONSTRUCTION FILE (TCF)

Project NO.: 96221559

Registration NO.: SP1001GZ1408764

According to the EC MD 2006/42/EC & LVD 2014/35/EU

Related to the

MULTI-POSITION THERMOFORMING MACHINE

Model:

FSCT820/650-3,FSCT820/650-3I,FSCT-770/570-B I, FSCT-770/570-B II,

Date of Report: May 9, 2022

Presented by

ZHEJIANG SAYEAH MACHINERY CO.,LTD.

SAPO CERTIFICATION & TESTING LABORATORY LIMITED

Contents

Test item particulars

- MULTI-POSITION THERMOFORMING MACHINE

Possible test case verdicts:
- Test case does not apply to the test object : N/A
- Test object does meet the requirement : P(Pass)
- Test object does not meet the requirement : F(Fail)

Testing

Date of receipt of test item : May 5, 2022
Date(s) of performance of tests : May 5, 2022～May 9, 2022

General remarks:

The test results presented in this report relate only to the object tested. This report shall not be reproduced, except in full, without the written approval of the issuing testing laboratory.

Details of applicant

Name : **ZHEJIANG SAYEAH MACHINERY CO.,LTD.**
ADD : **WANQUAN DISTRICT INDUSTRAL ZONE, WEST OF CHINA NATIONAL HIGHWAY 104, SUNLOU VILLAGE, WANQUAN TOWN PINGYANG COUNTY, ZHEJIANG PROVINCE**

Details of manufacturer

Name : **ZHEJIANG FUXINLONG MACHINERY CO.,LTD.**
ADD : **WANQUAN DISTRICT INDUSTRAL ZONE, WEST OF CHINA NATIONAL HIGHWAY 104, SUNLOU VILLAGE, WANQUAN TOWN PINGYANG COUNTY, ZHEJIANG PROVINCE**

Test product information:

Model : FSCT600/400-2,FSCT600/400-3,FSCT600/400-4,FSDT68/45-3,FSDT68/45-4, FSCT680/450-2,FSCT680/450-3,FSCT680/450-4,FSCT820/650-2,FSCT820/650-3, FSCT820/650-4

Same construction as basic model except enclosure

Testing Standards

EN ISO 12100:2010,EN 60204-1:2018/PRA1:2020,EN 12409:2008+A1:2011

Part I: General

1.1 General description introduced

Brief introduction

Lies in Feiyun River Industrial Zone, RUIAN SAYEAH MACHINE CO., LTD is a professional manafacturer of moulding machine of plastic sheet material. After more than ten years's cumulation, our company has professional technician and the ability of designing & developing the new product by ourselves. Presently, our main products are plastic sheet machine, moulding machine, computer control full-automatic plastic injection machine and whole set plastic packaging equipment. With the complete the specs and the advanced scheme, our company keeps ahead of the same product in domestic.

Our company possesses of strong technology force and perfect after sales service, as well as setting & debugging after sale, personnel training, mould making and offer the circumspect service for the client who has the special demand of spec equipment.

Pursuing the international advanced level and satisfying the client's expectation is SAYEAH enterprise's quality policy. Challenge ourselves and create excellent is SAYEAH enterprise's management idea. SAYEAH people welcome new and old customers in domestic and overseas to visit us for considering the business and developing together

1.2 Quality Management System Certificate
Part II: Assessment of Conformity
2.1 Essential health and safety requirements

Clause	Requirement - test	Verdict
1	**Essential health and safety requirements**	-
1.1	**General remarks**	-
1.1.1	Definitions	-
1.1.2	Principles of safety integration	-
a)	Machinery must be so constructed that it is fitted for its function, and can be adjusted and maintained without putting person at risk when these operations are carried out under the conditions foreseen by the manufacturer.	P
	The aim of measures taken must be to eliminate any risk of accident throughout the foreseeable lifetime of the machinery, including the phases of assembly and dismantling, even where risks of accident arise from foreseeable abnormal situations.	P
b)	In selecting the most appropriate methods, the manufacturer must apply the following principles, in the order given; -Eliminate or reduce risks as far as possible; -Eliminate or reduce risks as far as possible; -Take the necessary protection measure in relation to risks that can't be eliminated;	P
c)	When designing and constructing machinery, and when drafting the instructions, the manufacturer must uses which could reasonably be expected. The machinery must be designed to prevent abnormal use if such use would engender a risk. In other cases the instructions must draw the user's attention to ways which experience has shown might occur - in which the machinery should not be used.	P
d)	Under the intended conditions of use, the discomfort, fatigue and psychological stress faced by the operator must be reduced to the minimum possible taking ergonomic principles into account.	P
e)	When designing and constructing machinery, the manufacturer must taken account of the constraints to which the operator is subject as a result of the necessary or foreseeable use of personal protection equipment.	P
f)	Machinery must be supplied with all the essential special equipment and accessories to enable it to be adjusted, maintained and used without risk.	P

Clause	Requirement - test	Verdict
1.1.3	Materials and products	
	The materials used to construct machinery or products used and created during its use must not endanger exposed persons' safety or health In particular, where fluids are used, machinery must be designed and constructed for use without risks due to filling, use, recovery or draining.	P
1.1.4	Lighting - The manufacturer must supply integral lighting suitable for the operations concerned where its lack is likely to cause a risk despite ambient lighting of normal intensity. The manufacturer must ensure 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 due to the lighting provided by the manufacturer. Internal parts requiring frequent inspection, and adjustment and maintenance areas, must be provided with appropriate lighting.	N/A
1.1.5	Design of machinery to facilitate its handling -Machinery or each component part thereof must: -Be capable of being handle safely -Be packaged or designed so that it can be stored safely and without damage 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 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 in complete safety Special arrangement must be made for the handling of tools and/or machinery parts, even if lightweight, which could be dangerous.	P
1.2	**Controls**	-
1.2.1	Safety and reliability of control systems -Control systems must be designed and constructed so that they are safe and reliable, in a way that will prevent a dangerous situation arising. Above all they must be designed and constructed: - They can withstand the rigors of normal use and external	P

Clause	Requirement - test	Verdict
	It must be possible to start machinery only by voluntary actuation of a control provided for the purpose The same requirement applies: - When restarting the machinery after stoppage, whatever the cause - When effecting a significant change in the operating conditions Unless such restarting or change in operating conditions is without risk to exposed persons -This essential requirement doesn't apply to the restarting of the machinery or to the change in operating conditions resulting from the normal sequence of an automatic cycle	P
	Where machinery has several starting controls and the operators can therefore put each other in danger, additional devices must be fitted to rule out such risks It must be possible for automated plant functioning in automatic mode to be restarted easily after a stoppage once the safety conditions have been fulfilled	P
1.2.4	Stopping device	-
	Normal stopping	-
	Each machine must be fitted with a control whereby the machine can be brought safely to a complete stop	P
	Each workstation must be fitted with a control to stop some or all of the moving parts of the machinery, depending on the type of hazard, so that the machinery is rendered safe. The machinery's stop control must have priority over the start controls	P
	Once the machinery or its dangerous parts have stopped, the energy supply to the actuators concerned must be cut off Emergency stop - Each machinery must be fitted with one or more emergency stop devices to enable actual or impending danger to be averted The following exceptions apply: - Machines 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 - Hand-held portable machines and hand-guided machines The emergency stop device must: - - Have clearly identifiable, clearly visible and quickly accessible controls	P

Clause	Requirement - test	Verdict
	Stop the dangerous process as quickly as possible, without creating additional hazards	P
	Where necessary, trigger or permit the triggering of certain safeguard movements Once active operation of the emergency stop control 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 be possible to disengage the device only by an appropriate operation, and disengaging the device must not restart the machinery but only permit restarting. Complex installations. In the case of machinery or parts of machinery designed to work together, must so design and construct the machinery that the stop controls, including the emergency stop, can stop not only the machinery itself but also all equipment upstream and/or downstream if its continued operation can be dangerous	N/A
1.2.5	Mode selection The control mode selected must override all other control systems with the exception of the emergency stop If machinery has been designed and built to allow for its use in several control or operating modes presenting different safety levels, it must be fitted with a mode selector which can be locked in each position. Each position of the selector 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 its protection devices neutralized, the mode selector must simultaneously:	P
	- Disable the automatic control mode - Permit movements only by controls requiring sustained action - Permit the operation of dangerous moving parts only in enhanced safety conditions while preventing hazards from linked sequences	N/A
	- Prevent any movement liable to pose a danger by acting voluntarily or involuntarily on the machine's internal sensors	P
	In addition, the operator must be able to control operation of the parts he is working on at the adjustment point.	P

Clause	Requirement - test	Verdict
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	P
	In particular: - The machinery must not start unexpectedly The machinery must not be prevented from stopping if the command has already been given - No moving part of the machinery or piece held by the machinery must fall or be ejected - Automatic or manual stopping of the moving parts whatever they must be unimpeded - The protection devices must remain fully effective	P
1.2.7	Failure of the control circuit	-
	A fault in the control circuit, or failure of or damage to the control circuit must not lead to dangerous situations	P
	In particular - The machinery must not start unexpectedly - The machinery must not be prevented from stopping if the command has already been given - No moving part of the machinery or piece held by the machinery must fall or be ejected - Automatic or manual stopping of the moving parts whatever they may be must be unimpeded - The protection device must remain fully effective	P
1.2.8	Software Interactive software between the operator and the command or control system of a machine must be user-friendly	P
1.3	**Protection against mechanical hazards**	-
1.3.1	Stability Machinery, components and fittings thereof must be so designed and constructed that they are stable enough, under the foreseen operating conditions for use without risk of overturning, falling or unexpected movement If the shape of the machinery itself or its intended installation doesn't offer sufficient stability, appropriate means of anchorage must be incorporated and indicated in the instructions	P
1.3.2	Risk of break-up during operation The various parts of machinery and their linkages must be able to withstand the stress to which they are subject when used as.	P

Clause	Requirement - test	Verdict
	foreseen by the manufacturer 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	P
	The manufacturer must indicate in the instructions the type and frequency of inspection and maintenance required for safety reasons, where appropriate, indicate the parts subject to wear and the criteria for replacement Where a risk of rupture or disintegration remains despite the measures taken the moving parts must be mounted and positioned in such a way that in case of rupture their fragments will be contained 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 against all manner of external stresses and strains; precaution must be taken to ensure that no risk is posed by a rupture Where the material to be processed is fed to the tool automatically, the following conditions must be fulfilled to avoid risks to the persons exposed: - When the work piece comes into contact with the tool the later must have attained its normal working conditions - When the tool starts and/or stops the feed movement and the tool movement must be coordinated	P
1.3.3	Risks due to falling or ejected objects Precautions must be taken to prevent risks from falling or ejected objects	P Warning label has been given.
1.3.4	Risks due to surfaces, edges or angles In so far 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 Where the machinery is intended to carry out several different operations with the manual removal of the piece between each operation, 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 danger or risk for the exposed person For this purpose, it must be possible to start and stop separately and elements that are not protected	P

Clause	Requirement - test	Verdict
1.3.6	Risks relating to variations in the rotational speed of tools When the machine is designed to perform 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	Prevention of risks related to moving parts - The moving parts of machinery must be designed, built and laid out to avoid hazards or, where hazards persist, fixed with guards or protective devices in such a way as to prevent all risk of contact which could lead to accidents	P
	All necessary steps must be taken to prevent accidental blockage of moving parts involved in the work	P
	In cases where, despite the precautions taken, a blockage is likely to occur, specific protection devices or tools, the instruction handbook and possibly a sign on the machinery. should be provided by the manufacturer to enable the equipment to be safely unblocked	P
1.3.8	Choice of protection against risks related to moving parts 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	P
	The following guidelines must be used to help make the choice A. Moving transmission parts. Guards designed to protect exposed persons against the risks associated with moving transmission parts must be:	-
	- Either fixed, complying with requirements 1.4.1 and 1.4.2.1 or - Movable, complying with requirements 1.4.1 and 1.4.2.2.A	P
	B. Moving parts directly involved in the process guards or protection devices designed to protect exposed persons against the risks associated with moving parts contributing to the work must be:	-
	Wherever possible fixed guards complying with requirements 1.4.1 and 1.4.2.1 - Otherwise, movable guards complying with requirements 1.4.1 and 1.4.2.2.B or protection devices such as sensing devices, remote-hold protection devices, or protection devices intended automatically to prevent all or part of the operator's body from encroaching to the danger zone in accordance with requirements 1.4.1 and 1.4.3	P

Clause	Requirement - test	Verdict
	However, when certain moving parts directly involved in the process can't be made completely or partially inaccessible during operation owing to operations requiring near-by operator intervention, where technically possible such parts must be fitted with:	-
	Fixed guards, complying with requirements 1.4.1 and 1.4.2.1 preventing access to those sections of the parts that are not used in the work	N/A
	- Adjustable guards, complying with requirements 1.4.1 and 1.4.2.3 restricting access to those sections of the moving parts that are strictly for the work	P
1.4	**Required characteristics of guards and protection devices**	-
	Guards and protection devices must: - Be of robust construction - Not give rise to any additional risk - Not be easy to bypass or render non-operational - Be located at an adequate distance from the danger zone - Cause minimum obstruction to the view of the production process - Enable essential work to be carried out on installation and/or replacement of tools and also for maintenance by restricting access only to the area where the work has to be done, if possible without the guard or protection device having to be dismantled	P
1.4.2	Special requirements for guards	-
1.4.2.1	Fixed guards Fixed guard must be securely held in place They must be fixed by system that can be opened only with tools Where possible, guards must be unable to remain in place without their fixings	P
1.4.2.2	Movable guards - A. Type A movable guards must: - As far as possible remain fixed to the machinery when open - Be associated with a locking device to prevent moving parts starting up as long as these parts can be accessed and to give a stop command whenever they are no longer closed B. Type B movable guards must be designed and incorporated into the control system so that	N/A
	- Moving parts can't start up while they are within the operator's reach - The exposed person can't reach moving parts once they have started up	P

Clause	Requirement - test	Verdict
	They can be adjusted only by means of an intentional action, such as the use of a tool, etc.	N/A
	The absence or failure of one of their components prevents starting or stops the moving parts.	P
	Protection against any risk of ejection is provided by means of an appropriate barrier	N/A
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 according to the type of work involved - Be readily adjustable without the use of tools - Reduce as far as possible the risk of ejection	P
1.4.3	Special requirements for protection devices Protection devices must be designed and incorporated into the control system so that:	-
	- Moving parts can't start up while they are within the operator's reach - The exposed person can't reach moving parts once they have started up - They can be adjusted only by means of an intentional action, such as the use of a tool, etc. - The absence or failure of one of their components prevents starting or stops the moving parts	P
1.5	**Protection against other hazards**	-
1.5.1	Electricity supply Where machinery has an electricity supply it must be designed, constructed and equipped so that all hazards of an electrical nature are or can be prevented. The specific rules in force relating to electrical equipment designed for use within certain voltage limits must apply to machinery which is subject to those limits	P See brochure
1.5.2	Static electricity Machinery must be so designed and constructed as 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 Where machinery is powered by an energy other than electricity, it must be so designed, constructed and equipped as to avoid all potential hazards associated with these types of energy.	P

Clause	Requirement - test	Verdict
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 of such parts or, failing this, by information on moving parts and/or their housings where the direction of movement must be known to avoid a risk	P
	Any further information that may be necessary must be given in the instructions	P See the instruction manual in detail.
	Where a faulty connection can be the source of risk, incorrect fluid connections, including electrical conductors, must be made impossible by the design or, failing this, by information given on the pipes, cables, etc. and/or connectors blocks	P
1.5.5	Extreme temperatures Step must be taken to eliminate any risk of injury caused by contact with or proximity to machinery parts or materials at high or very low temperatures. The risk of hot or very cold materials being ejected should be assessed where this risk exists, the necessary steps must be taken to prevent it or, if this is not technically possible, to render it non-dangerous	P
1.5.6	Fire - Machinery must be designed and constructed to avoid all risk of fire or overheating posed by the machinery itself or by gases, liquids, dusts, vapors or the other substances produced or used by the machinery	P
1.5.7	Explosion - Machinery must be designed and constructed to avoid any risk of explosion posed by the machinery itself or by gases, liquids, dusts, vapors or other substances produced or used by the machinery	P
	To that end the manufacturer must take steps to: - Avoid a dangerous concentration of products - Prevent combustion of the potentially explosive atmosphere - Minimize any explosion which may occur so that it doesn't endanger the surroundings	N/A
	The same precautions must be taken if the manufacturer	P
	foresees the use of the machinery in potentially explosive atmosphere. Electrical equipment forming part of the machinery must conform, as far as the risk from explosion is concerned, to the provision of the specific Directive in force	N/A

Clause	Requirement - test	Verdict
1.5.8	Noise Machinery must be so designed and constructed that risks resulting from the emission of airborne noise are reduced to the lowest level taking accounting of technical progress and the availability of means of reducing noise, in particular at source	P
1.5.9	Vibration - Machinery must be so designed and constructed 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	P
1.5.10	Radiation Machinery must be so designed and constructed that any emission of radiation is limited to the extent necessary for its operation and that the effects on exposed persons are nonexistent or reduced to non-dangerous proportions	N/A
1.5.11	External radiation Machinery must be so designed and constructed that external radiation doesn't interfere with its operation	P
1.5.12	Laser equipment Where laser equipment is used, the following provisions should be taken into account; - Laser equipment on machinery must be designed and constructed so as to prevent any accidental radiation - Laser equipment on machinery must be protected so that effective radiation, radiation produced by reflection or diffusion and secondary radiation don't damage health - Optical equipment for the observation or adjustment of laser equipment on machinery must be such that no health risk is created by the laser rays	N/A
1.5.13	Emission of dust, gases, etc. Machinery must be so designed, constructed and/or equipped that risks due to gases, liquids, dust, vapors and other waste materials which it produces can be avoided	P
	Where a hazard exists, the machinery must be so equipped that the said substances can be contained and/or evacuated	N/A
	Such isolators must be clearly identified	P
	They must be capable of being locked if reconnection could endanger exposed persons	N/A

Clause	Requirement - test	Verdict
	In the case of machinery supplied with electricity through a plug capable of being plugged into a circuit, separation of the plug is sufficient The isolator must be capable of being locked also where an operator is unable, from any of the points to which he has access, to check that the energy is still cut off. 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 exposed persons As an exception to the above requirements, certain circuits may remain connected to their energy source in order, for example, to hold parts, protect information, light interiors, etc. In this case, special steps must be taken to ensure operator safety	P
1.6.4	Operator intervention Machinery must be so designed, constructed and equipped that the need for operator intervention is limited If operator intervention can't be avoided, it must be possible to carry it out easily and in safety	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 absolutely impossible to avoid entering the machinery, the manufacturer must take steps during its construction to allow cleaning to take place with the minimum of danger	P
1.7	**Indicators**	-
1.7.0	Information devices The information needed to control machinery must be Unam biguous and easily understood It must not be excessive to the extent of overloading the operator	P
	Where the health and safety of exposed persons may be endangered by a fault in the operation of unsupervised machinery, the machinery must be equipped to give an appropriate acoustic or light signal as a warning	N/A
1.7.1	Warning devices 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 directives concerning colors and safety signals must be complied with	P

Clause	Requirement - test	Verdict
1.7.2	Warning of residual risks Where risks remain despite all the measures adopted or in the case of potential risks which are not evident, the manufacturer must provide warnings Such warnings should preferably use readily understandable pictograms and/or be drawn up in one of the languages of the country in which the machinery is to be used, accompanied, on request, by the languages understood by the operators	P
1.7.3	Marking All machinery must be marked legibly and indelibly with the following minimum particular:	-
	- Name and address of the manufacturer - CE mark, which includes the year of construction - Designation of series or type - Serial number, if any	P
	Furthermore, where the manufacturer constructs machinery intended for use in a potentially explosive atmosphere, this must be indicated on the machinery	N/A
	Machinery must also bear full information relevant to its type and essential to its safe use	P
	Where a machine part must be handled during use with lifting equipment, its mass must be indicated legibly, indelibly and unambiguously	N/A
	The interchangeable equipment referred to in article 1 (2), third subparagraph, must bear the same information	P
1.7.4	Instructions - a) All machinery must be accompanied by instructions including at least the following: - A repeat of the information with which the machinery is marked, except the serial number, together with any appropriate additional information to facilitate maintenance - Foreseen use of the machinery within the meaning of 1.1.2 (c) - Workstation(s) likely to be occupied by operators - Instructions for safe - Putting into service - Use	P
	- Handling, giving the mass of the machinery and its various parts where they are regularly to be transported separately	N/A
	- Installation	P
	- Assembling, dismantling	P
	- Adjustment	P
	- Maintenance (servicing and repair)	P
	- Where necessary, training instructions	N/A

Clause	Requirement - test	Verdict
	- Where necessary, the essential characteristics of tools which may be fitted to the machinery	P
	Where necessary, the instructions should draw attention to ways in which the machinery should not be used	P
	b) The instructions must be drawn up in one of the community languages by the manufacturer or his authorized representative established in the community	P
	On being put into service, all machinery must be accompanied by a translation of the instructions in the language or languages of the country in which the machinery is to be used and by the instructions in the original language	P
	This translation must be done either by the manufacturer or his authorized representative established in the Community or by the person introducing the machinery into the language area in question	P
	By way of derogation from this requirement, the maintenance instructions for use by the specialized personnel employed by the manufacturer or his authorized representative established in the community may be drawn up in only one of the community languages understood by that personnel	P
	c) The instructions must contain the drawing and diagrams necessary for putting into service, maintenance, inspection, checking of correct operation and, where appropriate, repair of the machinery and all useful instructions in particular with regard to safety	P
	d) Any literature describing the machinery must not contradict the instructions as regards safety aspects The technical documentation describing the machinery must give information regarding the airborne noise emission referred to in (f) and, in the case of hand-held and/or hand-guided machinery, information regarding vibrations as referred to in 2.2	P
	e) Where necessary, the instructions must give the requirements	N/A
	relating to installation and assembly for reducing noise or vibration f) The instructions must give the following information concerning airborne noise emission by the machinery, either the actual value or a value established on the basis of measurements made on identical machinery:	-

Clause	Requirement - test	Verdict
	- Equivalent continuous A-weighted pressure level at workstations, where this exceeds 70 dB (A); where this level doesn't exceed 70 dB (A), this fact must be indicated	P See the instruction manual in detail.
	- Peak C-weighted instantaneous sound pressure value at workstations, where this exceeds 63 Pa (130 dB in relation to 20 MPa)	P
	- Sound power level emitted by the machinery where the equivalent continuous A-weight sound pressure level at workstations exceeds 85 dB (A)	P See the instruction manual in detail.
	In the case of very large machinery, instead of the sound power level, the equivalent continuous sound pressure levels at specified positions around the machinery may be indicated	P
	Where the harmonized standards are not applied, sound levels must be measured using the most appropriate method for the machinery	P
	The manufacturer must indicate the operating conditions of the machinery during measurement and what methods have been used for the measurement	P
	Where the workstation(s) are undefined or can't be defined, sound pressure levels must be measured at a distance of 1 meter from the surface of the machinery and at a height of 1.60 meters from the floor or access platform	P
	The position and value of the maximum sound pressure must be indicated	P
	g) If the manufacturer foresees that the machinery will be used in a potentially explosive atmosphere, the instructions must give all the necessary information	N/A
	h) In the case of machinery which may also be intended for use by non-professional operators, the wording and layout of the instructions for use, whilst respecting the other essential requirements mentioned above, must take into account the level of general education and acumen that can reasonably be expected from such operators	N/A
2	**Essential health and safety requirements for certain categories of machinery**	-
2.1	**Agri-foodstuffs machinery**	

Clause	Requirement - test	Verdict
	Where machinery is intended to prepare and process foodstuffs, it must be so designed and constructed as to avoid any risk of infection, sickness or contagion and the following hygiene rules must be observed: a) Materials in contact, or intended to come into contact, with the foodstuffs must satisfy the conditions set down in the relevant Directives The machinery must be so designed and constructed that these materials can be clean before each use b) All surfaces including their jointing must be so smooth, and must have neither ridges nor crevices which could harbor organic materials c) Assemblies must be designed in such a way as to reduce projections, edges and recesses to a minimum They should preferably by made by welding or continuous bonding Screws, screw heads and rivets may not be used except where technically unavoidable d) All surfaces in contact with the foodstuffs must be easily cleaned and disinfected, where possible after removing easily dismantled parts. The inside surfaces must have curves of a radius sufficient to allow through cleaning e) Liquid deriving from foodstuffs as well as cleaning, disinfecting and rinsing fluids should be able to be discharged from the machine without impediment f) Machinery must be so designed and constructed as to prevent any liquids or living creatures, in particular insects, entering, or any organic matter accumulating in areas that can't be cleaned g) Machinery must be so designed and constructed that no ancillary substances can come into contact with foodstuffs. Where necessary, machinery must be designed and constructed so that continuing compliance with this requirement can be checked	N/A
	Instructions In addition to the information required in Section 1, the instructions must indicate recommended products and methods for cleaning, disinfecting and rinsing (not only for easily accessible areas but also where areas to which access is impossible or inadvisable, such as piping, have to be cleaned in situ)	N/A
2.2	**Portable hand-held and/or hand-guided machinery**	-
	Portable hand-held and/or hand-guided machinery must conform to the following essential health and safety requirements:	-

Clause	Requirement - test	Verdict
	According to the type of machinery, it must have a supporting surface of sufficient size and have a sufficient number of handles and supports of an appropriate size and arranged to ensure the stability of the machinery under the operating conditions foreseen by the manufacturer	P
	Except where technically impossible or where there is an independent control, in the case of handles which can't be released in complete safety, it must be fitted with start and stop controls arranged in such a way that the operator can operate them without releasing the handles	N/A
	It must be designed, constructed or equipped ton eliminate the risks of accidental starting and/or continued operation after the operator has released the handles	N/A
	Equivalent steps must be taken if the requirement is not technically feasible	N/A
	Portable hand-held machinery must be designed and constructed to allow, where necessary, a visual check of the contact of the tool with the material being processed	N/A
	Instructions The instructions must give the following information concerning vibrations transmitted by hand-held and handguided machinery	-
	The weighted root mean square value to which the arms are subjected, if it exceeds 2.5 m/s2 as determined by the appropriate test code	N/A
	Where the acceleration doesn't exceed 2.5 m/s2, this must be mentioned	N/A
	If there is no applicable test code, the manufacturer must indicate the measurement methods and conditions under which measurements were made	N/A
2.3	**Machinery for working wood and analogous materials**	-
	Machinery for working wood and machinery for working materials with physical and technology characteristics similar to those of wood, such as cork, bone, hardened rubber, hardened plastic material and other similar stiff material must conform the following essential health and safety requirements	-
	a) The machinery must be designed, constructed or equipped so that the piece being machined can be placed and guided in safety; where the piece is hand-held on a work - bench the later must be sufficiently stable during the work and must not impede the movement of the piece	N/A

Clause	Requirement - test	Verdict
	b) Where the machinery is likely to be used in conditions involving the risk of ejection of pieces of wood, it must be designed, constructed or equipped to eliminate this ejection, or, if this is not the case, so that the ejection doesn't engender risks for the operator and/or exposed persons	N/A
	c) The machinery must be equipped with an automatic brake that stops the tool in a sufficiently short time if there is a risk of contact with the tool whilst it runs down	N/A
	d) Where the tool is incorporated into a non-fully automated machine, the latter must be so designed and constructed as eliminate or reduce the risk of serious accidental injury	N/A
3	Essential health and safety requirements to offset the particular hazards due to the mobility machinery	-
4	Essential health and safety requirements to offset the particular hazards due to a lifting operation	-
5	Essential health and safety requirements for machinery intended for underground work	-
6	Essential health and safety requirements to offset the particular hazards due to the lifting or moving of persons	-

2.2 EN ISO 12100:2010 Risk assessment

Ⅰ.Introduction.

In general this risk assessment report for the ***MULTI-POSITION THERMOFORMING MACHINE***, model ***FSCT600/400-2,FSCT600/400-3,FSCT600/400-4,FSDT68/45-3,FSDT68/45-4,FSCT680/450-2,FSCT680/450-3,FSCT680/450-4,FSCT820/650-2,FSCT820/650-3,FSCT820/650-4*** Types and its variants made by ***ZHEJIANG SAYEAH MACHINERY CO.,LTD.*** was carried out in accordance with the requirements of Machinery Directive and the standards of EN ISO 12100, in which an explicit risk level is evaluated with 4 factors described in next clause. After the first assessment, some measures to eliminate the risks are given for the modification of machine or of relative documents with taking into account the explicit C-type EN standard or related B-type standard. While taking appropriate provisions for the existing risks, the procedures and principles to eliminate the risk according to the most general B-type standard for any kind of machine:

- First step: consider the possibility of eliminating risk at design stage.
- Second step: if impossible, protect the dangerous zone with appropriate design of safety guard or safety device.
- Third step: If above impossible, give warning signs to draw attention of operators about the residual risks.

In addition, some check list drawn from the explicit C-type EN standards, which are found suitable for or near the characteristic of this machine, are used to help developing the provisions for the elimination of the risks. Finally the risk assessment was carried out again to ensure this machine and its relative documents are totally compliance with the Machinery Directive.

Ⅱ. Risk assessment Methodology

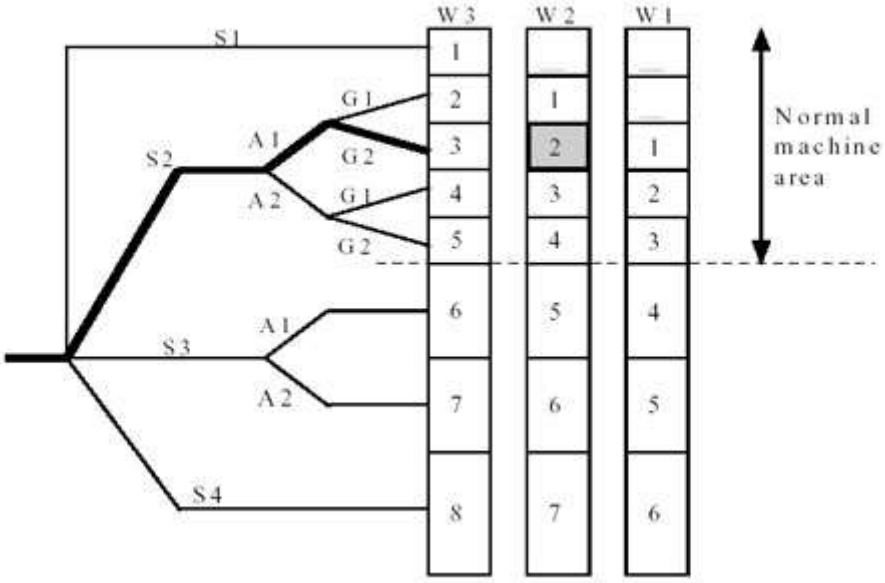
This risk assessment report is based on the methods mentioned in the EN ISO 12100:2010 standards, and the 4 factors S-A-G-W have been used for evaluating the level of risks.

(a) 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

(b) A: Frequency and duration of exposure
- A1: Seldom to very often
- A2: Frequent to continuous

(c) G: Possibilities of avoidance
- G1: Possible
- G2: Impossible

(d) 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, and add both guard and warning sign
4: Consider another two designs, choose the best one, and add both guard and warning sign
5: Consider another three designs, choose the best one, and add both guard and warning sign

EN ISO 12100 SAFETY OF MACHINERY
—Principles for risk assessment

NO.	Hazards Source	S	A	G	W	Level
1	**Mechanical hazards due to:**					
	a) shape; b) relative location; c) mass and stability (potential energy of elements which may move under the effect of d) mass and velocity (lunetic energy of elements in controlled or uncontrolied motion); e) inadequacy of mechanicaì strength; gravity); - 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 hazard	S2	A1	P1	W1	2
1.2	Shearing hazard					N.A.
1.3	Cutting or severing hazard	S2	A1	P1	W1	N.A.
1.4	Entanglement hazard					N.A.
1.5	Drawing-in or trapping hazard					N.A.
1.6	Impact hazard	S2	A1	P1	W1	N.A.
1.7	Stabbing or puncture hazard					N.A.
1.8	Friction or abmion hazard					N.A.
1.9	High pressure fluid injection or ejection hazard	S2	A1	P1	W1	N.A.
2	**Electrical hazards due to:**					
2.1	Contact of persons with live parts (direct contact)					N.A.
2.2	Contact of persons with parts which have become live under faulty conàitions (indirect contact)					N.A.
2.3	Approach to live parts under high voltage					N.A.
2.4	Electrostatic phenomena					N.A.
2.5	Thermal radiation or other phenomena such as the projection of molten pasticles and chemical effects from short circuits, overloads, etc.					N.A.

NO.	Hazards Source	S	A	G	W	Level
3	**Thermal hazards, resulting in:**					
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					N.A.
3.2	Damage to health by hot or cold working environment					N.A.
4	**Hazards generated by noise, resulting in:**					
4.1	Hearing loss (deafness), other physiological disorders (e.g. loss of balance, loss of awareness)	S2	A1	G1	W1	-
4.2	Interference with speech communication,					N.A.
5	**Hazards generated by vibration**					
5.1	Use of hand-held machines resulting in a variety of neurological and vascular dicordm	S2	A1	G1	W1	-
5.2	Whole body vibration, particularly when combined with poor postures					N.A.
6	**Hazards generated by radiation**					
6.1	Low frequency, radio frequency radiation, micro waves					N.A.
6.2	Infrared, visible and ultraviolet light					N.A.
6.3	Xandgammarays					N.A.
6.4	Alpha, beta rays, electron or ion beams, neutsons					N.A.
6.5	Lasers					N.A.
7	**Hazards generated by materials and substances (and their constituent elements) processed or used by the machinery**					
7.1	Hazards from contact with or inhalation of harmful fluids, gases, mists, fumes, and dusts	S1		G1	W1	-
7.2	Fire or explosion hazard					N.A.
7.3	Biological or microbiological (vid or bacterial) hazards					N.A.
8	**Hazards generated by neglecting ergonomic principles in machinery designas, e.g. hazards from:**					
8.1	Unhealthy postures or excessive effort	S1		G1	W1	-
8.2	Inadequate consideration of hand-arm or foot-lea anatomy					N.A.

NO.	Hazards Source	S	A	G	W	Level
8.3	Neglected use of personal protection equipment	S1	-	-	W1	-
8.4	Inadequate local lighting					N.A
8.5	Mental overload and underload, stress					N.A
8.6	Human error, human behaviour	S1	-	-	W1	-
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**					
10	**Unexpected start-up, unexpected over-rudover-speed (or any similar malfunction) nom:**					
10.1	Fdureídisorder of the control system					N.A
10.2	Restoration of energy supply after an intemmtion					N.A
10.3	External influences on electrical equipment					-
10.4	ther external influences (gravil, wind etc.)					N.A
10.5	Errors in the software					N.A
10.6	Errors made by the operater (due to mismatch of machinery with human of 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**	S1	-	-	W1	-
14	**Failure of the control circuit**	S1	-	-	W1	-
15	Errors of fitting					N.A
16	Break-up during operation					N.A
17	Faiiing 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 hazardous events due to mobility						
20	**Relating to the traveling function**					

NO.	Hazards Source	S	A	G	W	Level
20.1	Movement when starting the engine	S1	A1	G1	W1	1
20.2	Movement without a driver at the driving position	S2	A1	G1	W1	2
20.3	Movement without all parts in a safe position	S2	A1	G1	W1	2
20.4	Excessive speed of pedestrian controlled machinery	S2	A1	G1	W1	2
20.5	Excessive oscillations when moving	S2	A1	G1	W1	2
20.6	Insufficient ability of machinery to be slowed down, stopped and immobilised	S1	A1	G1	W1	1
21	**Linked to the work position (including driving station) on the machine**					
21.1	Fall of persons during access to (or at/from) the work position	S1	A1	G1	W1	-
21.2	Exhaust gases/lack of oxygen at the work position					N.A
21.3	Fire (flammability of the cab, lack of extinguishing means)					N.A
21.4	Mechanical hazards at the work position: a) contact with the wheels; b) rollover; c) fall of objects, penetration by objects; d) break-up of parts rotating at high speed; e) contact of persons with machine parts or tools (pedestrian controlled machines).	S2	A1	G1	W1	-
21.5	Insufficient visibility from the work positions	S1	A1	G1	W1	1
21.6	Inadequate lighting	S1	A1	G1	W1	1
21.7	Inadequate seating					N.A
21.8	Noise at the work position	S1	A1	G1	W1	1
21.9	Vibration at the work position	S1	A1	G1	W1	1
21.10	Insufficient means for evacuation /emergency exit					N.A
Due to the control system						
22.1	Inadequate location of manual controls					N.A
22.2	Inadequate design of manual controls and their mode of operation	S1	A1	G1	W1	1

NO.	Hazards Source	S	A	G	W	Level
From handling the machine (lack of stability)						
23	From handling the machine (lack of stability)	S1	A1	G1	W1	1
Due to the power source and to the transmission of power						
24.1	Hazards from the engine and the batteries					N.A
24.2	Hazards from transmission of power between machines					N.A
24.3	Hazards from coupling and towing					N.A
From/to third persons						
25.1	Unauthorized start-up/use					N.A
25.2	Drift of a part away from its stopping position					N.A
25.3	Lack or inadequacy of visual or acoustic warning means	S1			W1	-
Insufficient instructions for the driver/operator						
26	Insufficient instructions for the driver/operator	S1			W1	-
Additional hazards, hazardous situations and hazardous events due to lifting						
27	Mechanical hazards and hazardous events					
27.1	From load falls, collisions, machine tipping caused by:					
27.1.1	Lack of stability	S1			W1	-
27.1.2	Uncontrolled loading - overloading – overturning moments exceeded					N.A
27.1.3	Uncontrolled amplitude of movements	S1			W1	-
27.1.4	Unexpected/unintended movement of loads					N.A
27.1.5	Inadequate holding devices / accessories					N.A
27.1.6	Collision of more than one machine					N.A
27.2	From access of persons to load support					N.A
27.3	From derailment					N.A
27.4	From insufficient mechanical strength of parts	S1	A1	G1	W1	-
27.5	From inadequate design of pulleys, drums					N.A

NO.	Hazards Source	S	A	G	W	Level
27.6	From inadequate selection of chains, ropes, lifting and accessories and their inadequate integration into the machine	S2	A1	G1	W2	1
27.7	From lowering of the load under the control of friction brake					N.A
27.8	From abnormal conditions of assembly/testing/use/maintenance	S2	A1	G1	W2	1
27.9	From the effect of load on persons (impact by load or counter weight)					N.A
Electrical hazards						
28.1	From lightning					N.A
Hazards generated by neglecting ergonomic principles						
29.1	Insufficient visibility from the driving position	S1	A1	G1	W1	-
Additional hazards, hazardous situations and hazardous events due to underground work						
30	Mechanical hazards and hazardous events due to:					N.A
30.1	Lack of stability of powered roof supports	S1	A1	G1	W1	-
30.2	Failing accelerator or brake control of machinery running on rails	S1	A1	G1	W1	-
30.3	Failing or lack of deadman's control of machinery running on rails					N.A
31	Restricted movement of persons	S1	A1	G1	W1	-
32	Fire and explosion					N.A
33	Emission of dust, gases etc.	S2	A1	G1	W2	1
Additional hazards, hazardous situations and hazardous events due to the lifting or moving of persons						
34	Mechanical hazards and hazardous events due to:					-
34.1	Inadequate mechanical strength - inadequate working coefficients	S2	A1	G1	W2	1
34.2	Failing of loading control	S2	A1	G1	W2	1
34.3	Failing of controls in person carrier (function, priority) Overspeed of person carrier	S2	A1	G1	W2	1
35	Falling of person from person carrier					N.A
36	Falling or overturning of person carrier	S1	A1	G1	W1	1
37	Human error, human behavior	S2	A1	G1	W2	1

This list is not fully complete compared to the list presented in EN ISO 12100:2010. Especially those hazards connected to events such as lifting and the using of mobile equipments are excluded. (1. of 2. amendment of the Machinery directive)
Id. NO gives reference to the hazard listed in EN ISO 12100:2010.
NOTE: "N/A" means that the hazard is not required to assess.

NO.	Hazards Source	S	A	G	W	Level
1.1	Crushing/Squeezing	S2	A1	G1	W1	1
Where	Between the platform and vehicle floors					
When	Machine is running.					
Improvement result						
Method		**S**	**A**	**G**	**W**	**Level**
By means of adopting two hand control.		S1	A1	G1	W1	-

10.3	**External influences on electrical equipment**	-	-	-	-	N.A
Where	machine					
When	Machine is running.					
Improvement result						
Method		**S**	**A**	**G**	**W**	**Level**
By means of adopting two hand control.		S1	A1	G1	W1	-

13	**Failure of the power supply**	S1	-	-	W1	-
Where	Machinery working area.					
When	Operation.					
Improvement result						
Method		**S**	**A**	**G**	**W**	**Level**
Appropriate conditions specified in the instruction manual. Use approved power.		S2	A1	G1	W1	-

NO.	Hazards Source	S	A	G	W	Level
14	**Failure of the control circuit**	S1	-	-	W1	-
Where	Machinery working area.					
When	Operation.					
Improvement result						
Method		**S**	**A**	**G**	**W**	**Level**
Use approved control circuit components.		S2	A1	G1	W1	-

25.1	**Unauthorized start-up/use**	S1	-	-	W1	-
Where	Machinery working area.					
When	Operation.					
Improvement result						
Method		**S**	**A**	**G**	**W**	**Level**
Must use key to start-up		S1	-	-	W1	-

26	**Insufficient instructions for the driver/operator**	S1	-	-	W1	-
Where	Machinery working area.					
When	Operation.					
Improvement result						
Method		**S**	**A**	**G**	**W**	**Level**
mprove the instructions.		S1	-	-	W1	-

NO.	Hazards Source	S	A	G	W	Level
26	**Insufficient instructions for the driver/operator**	S1	-	-	W1	-
Where	Machinery working area.					
When	Operation.					
Improvement result						
Method		**S**	**A**	**G**	**W**	**Level**
mprove the instructions.		S1	-	-	W1	-

27.8	**From abnormal conditions of assembly/testing/use/maintenance**	S2	A1	G1	W1	1
Where	Machinery working area.					
When	Operation.					
Improvement result						
Method		**S**	**A**	**G**	**W**	**Level**
Specific the conditions in the instruction manual.		S1	-	-	W1	-

34.1	**Inadequate mechanical strength - inadequate working coefficients**	S2	A1	G1	W2	1
Where	Machinery working area.					
When	Operation.					
Improvement result						
Method		**S**	**A**	**G**	**W**	**Level**
Specific the rated capacity in the instruction manual. The working coefficients complied with the standards.		S1	-	-	W1	-

Part III: Test report

3.1 EN ISO 12100:2010 test report

3.2 EN 60204-1:2018/prA1:2020 test report

3.3 EN 12409:2008+A1:2011

3.4 Earthing continuity test report

3.5 Insulation resistance test report

3.6 Withstand voltage test report

3.7 Airborne noise test report

TEST REPORT

MD DIRECTIVE 2006/42/EC &LVD DIRECTIVE 2014/35/EU
PROJECT NO. 96221559-1

EN ISO 12100:2010

Safety of machinery — General principles for design — Risk assessment and risk reduction

ZHEJIANG SAYEAH MACHINERY CO.,LTD.

MULTI-POSITION THERMOFORMING MACHINE

3.1 EN ISO 12100:2010 test report

Test item particulars - **MULTI-POSITION THERMOFORMING MACHINE**
Possible test case verdicts: - Test case does not apply to the test object : N(.A.) - Test object does meet the requirement : P(Pass) - Test object does not meet the requirement : F(Fail)
Testing EN ISO 12100:2010 Safety of machinery — General principles for design — Risk assessment and risk reduction
General remarks: The test results presented in this report relate only to the object tested. This report shall not be reproduced, except in full, without the written approval of the issuing testing laboratory.
Test product information: **Model : FSCT820/650-3** **Parameters : Voltage : 380VAC** **Power: 82kW** **Frequency: 50Hz** Same construction as basic model except enclosure.

AUDIT INFORMATION:		
Description of Test	Standard No.	EN ISO 12100:2010
Test Engineer by	MICHEAL	Signature: Michael
Reviewer by	Jack .H	Signature:
Test Result	**Pass**	**May 9, 2022**
SAPO CERTIFICATION & TESTING LABORATORY LIMITED		

Clause	Requirement - test	Verdict
0	Introduction	-
1	Scope	-
2	Normative references	-
3	Risk reduction by design	-
4	Inherently safe design measures	-
4.1	General Inherently safe design measures are the first and most important step in the risk reduction process because protective measures inherent to the characteristics of the machine are likely to remain effective, whereas experience has shown that even well- designed safeguarding may fail or 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 of the machine itself and/or interaction between the exposed persons and the machine.	P
4.2	Consideration of geometrical factors and physical aspects	-
4.2.1	Geometrical factors	-
	Such factors can be, e.g.: - designing the shape of machinery to maximize direct visibility of the working areas and hazard zones from the control position, e.g. reducing blind spots, and choosing and locating means of indirect vision where necessary (e.g. mirrors) so as to take account the characteristics of human vision, particularly when safe operation requires permanent direct control by the operator, e.g.:	P
	- the traveling 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.	N/A
	- the shape and the relative location of the mechanical component parts; for instance, crushing and shearing hazards component 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 13852, ISO 13854);	P

Clause	Requirement - test	Verdict
	- 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 may "trap" parts of the body or clothing. In particular, sheet metal edges shall be deburred, flanged or trimmed, open ends of tubes which may cause a "trap" shall be capped;	**P**
	- designing the shape of the machine to achieve a proper working position and accessibility of manual controls (actuators).	**P**
4.2.2	Physical	**-**
	Such aspects can be, e.g.: - limited the actuating force to a sufficiently low value so that the actuated part does not generate a mechanical hazard; - limiting the emissions by acting on the characteristics of the source; - measures for reducing noise emission at source (see ISO/TR 11688-1); - measures for reducing the emission of vibration at source include e.g. redistribution or addition of mass and change of process parameters, e.g. frequency and/or amplitude of movements (for hand-held and hand-guided machinery, see CR 1030-1);	**P**
	- measures for reducing the emission of hazardous substances include e.g. use of less hazardous substances or use of dust reducing processes; - measures for reducing radiation emissions include e.g. 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 the reduction of emission of non-ionizing radiation are given in 5.4.5 (see also EN 12198-1 and -3).	**N/A**
4.3	Taking into account the general technical knowledge regarding machine design	**P**
	This general technical knowledge can be derived from technical specifications for design (e.g. standards, design codes, calculation rules). These should be used to cover:	**P**
a)	Mechanical stresses,	-
	- stress limitation by implementation of correct calulation, - construction and fastening methods as regards, e.g. bolted assemblies, welded assemblies;	**P**

Clause	Requirement - test	Verdict
	- stress limitation by overload prevention, (e.g. "fusible" pressure-limiting valves, breakage points, torque-limiting devices); - avoiding fatigue in elements under variable stresses (notably cyclic stresses); - static and dynamic balancing of rotating elements;	**P**
b)	Materials and their properties, e.g.:	
	- resistance to corrosion, ageing, abrasion and wear;	**P**
	- hardness, ductility, brittleness;	**P**
	- homogeneity;	**P**
	- toxicity;	**N/A**
	- flammability.	**N/A**
c)	Emission values for:	-
	- noise;	**P**
	- vibration;	**P**
	- hazardous substances;	**N/A**
	- radiation.	**N/A**
	When the reliability of particular components or assemblies is critical for safety (e.g. ropes, chains, lifting accessories for lifting loads or persons), stress values shall be multiplied by appropriate working coefficients.	**N/A**
4.4	Choice of an appropriate technology One or more hazards can be eliminated or risks reduced by choice of the technology to be used in certain applications, e.g.:	-
a)	On machines intended for use in explosive atmospheres: - fully pneumatic or hydraulic control system and machine actuators; - "intrinsically safe" electrical equipment (see EN 50020);	**N/A**
b)	For particular products to be processed such as a solvent: equipment assuring that the temperature will remain far below the flash point.	**N/A**
c)	Alternative equipment to avoid high noise level, e.g.:	**N/A**
	- electrical instead of pneumatic equipment; - in certain conditions, water cutting instead of mechanical equipment.	**N/A**
4.5	Applying the principle of the positive mechanical action of a component on another component	**N/A**

Clause	Requirement - test	Verdict
	If a moving mechanical component inevitably moves another component along with it, either by direct contact or via rigid elements, these components are connected in the positive mode. An example of this is positive opening operation of switching devices in an electrical circuit (see IEC 60947-5-1 and ISO 14119:1998,5.7).	**N/A**
4.6	Provisions for stability	**-**
	Machines shall be designed to have sufficient stability to allow to be used safely in their specified conditions of use.	**P**
	Factors to be taken into account include: - geometry of the base; - weight distribution, including loading; - dynamic forces due to movements of parts of the machine, of the machine itself, or of elements held by the machine which may result in an overturning moment; - vibration;	**P**
	- oscillations of the supporting surface in case of traveling or - installation on different sits (e.g. ground conditions, slope); - characteristics of the supporting surface in case of traveling or installation on different sites (e.g. ground conditions, slope); - external forces (e.g. wind pressure, manual forces).	**N/A**
	Stability shall be considered in all phases of the life of the machine, including handling, traveling, installation, use, de- commissioning and dismantling.	**P**
	Other protective measures for stability relevant to safeguarding are given in 5.2.6.	**P**
4.7	Provisions for maintainability	-
	When designing a machine, the following maintainability factors shall be into account: - 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**
4.8	Observing ergonomic principles	-
4.8.1	Ergonomic principles shall be taken into account in designing machinery to reduce mental or physical stress and strain of the operator. These principles shall be considered when allocating functions of operator and machine (degree of automation) in the basic design.	**P**

Clause	Requirement - test	Verdict
	Account shall be taken of body sizes likely to 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, signaling or data display elements, shall be designed to be easily understood so that clear and unambiguous interaction between the operator and the machine is possible.	**P**
	(see EN 614-1, ISO 6385, EN 13861 and IEC 61310-1).	**-**
	Designers' attention is especially drawn to following ergonomic aspects of machine design:	**P**
4.8.2	Avoiding stressful postures and movements during use of the machine (e.g. by providing facilities to adjust the machine to suit the various operators).	**P**
4.8.3	Designing machines and more especially hand-held and mobile machines to enable them to be operated easily taking into account human effort, actuation of controls and hand, arm and leg anatomy.	**P**
4.8.4	Avoiding as far as possible noise, vibration, thermal effects (e.g. extreme temperatures).	**P**
4.8.5	Avoiding linking the operator's working rhythm to an automatic succession of cycles.	
4.8.6	Providing local lighting on or in the machine for the illumination of the working area and of adjusting, setting-up, and frequent maintenance zones when the design features of the machine and/or its guards render the ambient lighting inadequate. Flicker, dazzling, shadows and stroboscopic effects shall be avoided if they can cause a risk. If the position of the lighting source has to be adjusted, its, location shall be such that it does not cause any risk to persons making the adjustment.	**N/A**
4.8.7	Selecting, locating and identifiable manual controls (actuators) so that: - they are clearly visible and identifiable and appropriately marked where necessary (see 5.4); - they can be safely operated without hesitation or loss of time and without ambiguity (e.g. a standard layout of controls reduces the possibility of error when an operator changes from a machine to another one of similar type having the same pattern of operation); - their location (for push-buttons) and their movement (for levers and handwheels) are consistent with their effect (see IEC 61310-3); - their operation cannot cause additional risk.	**P**
	See also EN 894-3.	**-**
	Where a control is designed and constructed to perform several different actions, namely where there is no one-to-one	**P**

Clause	Requirement - test	Verdict
	correspondence (e.g. 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. Constrains due to the necessary or foreseeable use of personal protective equipment (such as footwear, gloves) shall be taken into account.	P
4.8.8	Selecting, designing and locating 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; - the operator is able to perceive them from the control position.	P
4.9	Preventing electrical hazard	-
	For the design of the electrical equipment of machines IEC 60204-1:2005 gives general provisions, especially in clause 6 for protection against electric shock. For requirements related to specific machines, see corresponding IEC standards (e.g. series of IEC 61029, IEC 60745, IEC 60335).	P
4.10	Preventing hazards from pneumatic and hydraulic equipment Pneumatic and hydraulic equipment of machinery shall be designed so that: - the maximum rated pressure cannot be exceeded in the circuits (e.g. by means of pressure limiting devices); - no hazard results from pressure surges or rises, pressure losses or losses of vacuum; - no hazardous fluid jet or sudden hazardous movement of the hose (whiplash) result from leakage or component failures; - air receivers, air reservoirs or similar vessels (e.g. in gas loaded accumulators) comply with the design rules for these elements; - all elements of the equipment, and especially pipes and hoses, be protected against harmful external effects; - all far as possible, reservoirs and similar vessels (e.g. in gas loaded accumulators) are automatically depressurized when isolating the machine from its power supply (see 5.5.4) and, if it is not possible, means are provided for their isolation, local depressurizing and pressure indication (see also ISO 14118:2000, clause 5);	P

Clause	Requirement - test	Verdict
	- all elements which remain under pressure after isolation of themachine from its power supply be provided with clearlyidentified exhaust devices, and warning label drawing attention to the necessity of depressurizing those elements before anysetting or maintenance activity on the machine.	P
	See also ISO 4413 and ISO 4414.	N/A
4.11	Applying inherently safe design measures to control system	P
4.11.1	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).	P
	The correct design of machine control systems can avoid unforeseen and potentially hazardous machine behaviour.	P
	Typical causes of hazardous machine behaviour are:	-
	- an unsuitable design or modification (accidental or deliberate) of the control system logic;	P
	- a temporary or permanent defect or a failure of one or several components of the control system;	N/A
	- a variation or a failure in the power supply of the control system; - inappropriate selection, design and location of the control devices;	P
	Typical examples of hazardous machine behaviour are:	-
	- unintended/unexpected start-up (see ISO 14118);	P
	- uncontrolled speed change;	N/A
	- failure to stop moving parts;	P
	- dropping or ejection of a mobile part of the machine or of a workpiece clamped by the machine;	N/A
	- machine action resulting from inhibition (defeating of failure) of protective devices.	N/A
	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 4.11 and in 4.12. These principles and methods shall be applied singly or in combination as appropriate to the circumstances (see ISO 13849-1 and IEC 60204-1:2005, clauses 9 to 12).	P
	Control systems shall be designed to enable the operator to interact with the machine safely and easily; this requires one or several of the following solutions:	-

Clause	Requirement - test	Verdict
	- systematic analysis of start and stop conditions; - provision for specific operating modes (e.g. start-up after normal stop, restart after cycle interruption or after emergency stop, removal of the workpieces contained in the machine, operation of a part of the machine in case of a failure of a machine element); - clear display of the faults; - measures to prevent accidental generation of unexpected start commands (e.g. shrouded start device) likely to cause dangerous machine behaviour (see ISO 14118:2000, figure 1); - maintained stop commands (e.g. interlock) to prevent restarting that could result in dangerous machine behaviour (see ISO 14118:2000, figure 1).	**P**
	An assembly of machines may be divided into several zones for emergency stopping, for stopping as a result of protective devices and/or for isolation and energy dissipation. 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 (e.g. 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.	**P**
	Control systems shall be designed to limit the movements of parts of the machinery, the machine itself, or workpieces and/or loads held by the machinery, to the safe design parameters (e.g. range, speed, acceleration, deceleration, load capacity). Allowance shall be made for dynamic effects (e.g. the swinging of loads).	**P**
	For example: - the traveling speed of mobile pedestrian controlled machinery other than remote-controlled shall be compatible with walking speed;	**P**
	- 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.	**N/A**
	When machinery is designed to use synchronously different elements which can also be used independently, the control system shall be designed to prevent risks due to lack of synchronization.	**N/A**
4.11.2	Starting of an internal power source/switching on an external power supply	

Clause	Requirement - test	Verdict
	Starting of an internal power source or switching on an external power supply shall not result in starting of working parts (e.g. starting the internal combustion engine shall not lead to movement of a mobile machine, connection to mains electricity supply shall not result in starting of working parts of an electrical machine; see IEC 60204-1:2005,7.5).	P
4.11.3	Starting/stopping of a mechanism	-
	The primary action for starting or accelerating the movement of a mechanism should be performed by application or increase of voltage or fluid pressure, or, if binary logic elements are considered, by passage from state 0 to state 1 (if state 1 represents the highest energy state).	P
	The primary action for stopping or slowing down should be performed by removal or reduction of voltage or fluid pressure, or, if binary logic elements are considered, by passage from state 1 to state 0 (if state 1 represents the highest energy state).	P
	When, in order for the operator to maintain permanent control of deceleration, this principle is not observed (e.g. a hydraulic braking devices of a self-propelled mobile machine), the machine shall be equipped with a means of slowing and stopping in case of failure of the main braking system.	N/A
4.11.4	Restart after power interruption	-
	If it may generate a hazard, the spontaneous restart of a machine when it is re-energized after power interruption shall be prevented (e.g. by use of a self-maintained relay, contactor or valve).	P
4.11.5	Interruption of power supply	-
	Machinery shall be designed to prevent hazardous situations resulting from interruption or excessive fluctuation of the power supply.	P
	At least the following requirements shall be met:	-
	- the stopping function of the machinery shall remain;	P
	- all devices whose permanent operation is required for safety shall operate in an effective way to maintain safety (e.g. locking, clamping devices, cooling or heating devices, power- assisted steering of self-propelled mobile machinery);	P
	- parts of machinery or work pieces and/or loads held by machinery which are liable to move as a result of potential energy shall be retained for the time necessary to allow them to be safely lowered.	N/A

Clause	Requirement - test	Verdict
4.11.6	Use of automatic monitoring	-
	Automatic monitoring is intended to ensure that a safety function(s) implemented by a protective measure do(es) not fail to be performed if the ability of a component or an element to perform its function is diminished, or if the process conditions are changed in such a way that hazards are generated.	N/A
	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 intiated immediately or delayed until a specific event occurs (e.g. the beginning of the machine cycle).	N/A
	The protective measures may be, e.g.: - the stopping of the hazardous process; - preventing the re-start of this process after the first stop following the failure; - the triggering of an alarm.	N/A
4.11.7	Safety functions implemented by programmable electronic control systems	N/A
4.11.7.1	General	-
	A control system including programmable electronic equipment (e.g. programmable controllers) can be used to implement safety functions at machinery. Where a programmable electronic control system is used it is necessary to consider its performance requirements in relation to the requirements for the safety functions.	N/A
	The design of the programmable electronic control system shall be such that the probability of random hardware failures and the likelihood of systematic failures that can adversely affect the performance of the safety-related control function (s) are sufficiently low. Where a programmable electronic control system performs a monitoring function, the system behaviour on detection of a fault shall be considered (see also IEC 61508 series for further guidance).	N/A
	The programmable electronic control system should be installed and validated to ensure that the specified performance (e.g. safety integrity level (SIL) in IEC 61508 series) for each safety function has been achieved. Validation comprises testing and analysis (e.g. static, dynamic or failure analysis) to show that all parts interact correctly to perform the safety function and that unintended functions do not occur.	P
4.11.7.2	Hardware aspects	-
	The hardware (including e.g. sensors, actuators, logic solvers) shall be selected (and/or designed) and installed to meet both the functional and performance requirements of the safety function(s) to be performed, in particular, by means of:	-

Clause	Requirement - test	Verdict
	- architectural constraints (e.g. the configuration of the system, its ability to tolerate faults, its behaviour on detection of a fault); - selecting (and/or designing) equipment and devices with an appropriate probability of dangerous random hardware failure; - Incorporating measures and techniques within the hardware toavoid systematic failures and control systematic faults.	**P**
4.11.7.3	Software aspects	**-**
	The software (including internal operating software (or systemsoftware) and application software) shall be designed so as to satisfy the performance specification for the safety functions (see also IEC 61508-3).	**P**
4.11.7.4	Application software	**-**
	Application software should not be re-programmable by the user. This may be achieved by use of embedded software in a non re-programmable memory (e.g. micro-controller, application specific integrated circuit (ASIC)).	**N/A**
	When the application requires reprogramming by the user, the access to the software dealing with safety functions should be restricted e.g. by: - locks; - passwords for the authorized persons.	**N/A**
4.11.8	Principles relating to manual control	**-**
a)	Manual control devices shall be designed and located according to the relevant ergonomic principles given in 4.8.7.	**P**
b)	A stop control device shall be placed near each start control device. Where the start/stop function is performed by means of a hold-to-run control, a separate stop control device shall be provided when a risk can result from the hold-to-run control device failing to deliver a stop command when released.	**P**
c)	Manual controls shall be located out of reach of the danger zones (see IEC 61310-3:1999, clause 4), except for certain controls where, of necessity, they are located within a danger zone, such as emergency stop or teach pendant.	**P**
d)	Whenever possible, control devices and control positions shall be located so that the operator is able to observe the working area or hazard zone.	**P**
	The driver of a ride-on mobile machine shall be able to actuate all control devices required to operate the machine from the driving position, except for functions which can be controlled more safely from other positions.	**P**

Clause	Requirement - test	Verdict
	On machinery intended for lifting persons, controls for lifting and lowering and, if appropriate, for moving the carrier, shall generally be located in the carrier. If safe operation requires controls to be situated outside the carrier, the operator in the carrier shall be provided with the means of preventing hazardous movements.	**N/A**
e)	If it possible to start the same hazardous element by means of several controls, the control circuit shall be so arranged that only one control is effective at a given time. This applies especially to machines which can be manually controlled by means among others of a portable control unit (teach pendant, for instance), with which the operator may enter danger zones.	**N/A**
f)	Control actuators shall be designed or guarded so that their effect, where a risk is involved, cannot occur without intentional operation (see ISO 9355-1 and ISO 447).	**N/A**
g)	For machine functions whose safe operation depends on permanent, direct control by the operator, measures shall be taken to ensure the presence of the operator at the control signals are not received, including loss of communication (see IEC 60204-1:2005, 9.2.7).	**N/A**
4.11.9	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 the operator shall be achieved using a specific control mode which simultaneously:	**P**
	- disables all other control modes;	**P**
	- permits operation of the hazardous elements only by continuous actuation of an enabling device, a hold-to-run control device or a two-hand control device;	**P**
	- permits operation of the hazardous elements only in reduced risk conditions (e.g. reduced speed, reduced power/force, step-by-step operation, e.g. with a limited movement control device).	**N/A**
	This control mode shall be associated with one or more of following measures:	**-**
	- restriction of access to the danger zone as far as possible; - - emergency stop control within immediate reach of the operator;	**P**
	- portable control unit (teach pendant) and/or local controls allowing sight of the controlled elements. (see IEC 60204-1:2005,9.2.4).	**N/A**
4.11.10	Selection of control and operating modes	**-**

Clause	Requirement - test	Verdict
	If machinery has been designed and built to allow for its use in several control or operating modes requiring different protective measures and/or work procedures (e.g. to allow for adjustment, setting, maintenance, inspection), it shall be fitted with a mode selector which can be locked in each position. Each position of the selector shall be clearly identifiable and shall exclusively allow one control or operating mode.	P
	The selector may be replaced by another selection means which restricts the use of certain functions of the machinery to certain categories of operators (e.g. access codes for certain numerically controlled functions).	P
4.11.11	Applying measures to achieve electromagnetic compatibility (EMC)	-
	For guidance on electromagnetic compatibility, see IEC 60204-1:2005, 4.4.2 and IEC 61000-6 series.	N/A
4.11.12	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
4.12	Minimizing the probability of failure of safety functions	-
	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.	P
	The continued operation of the safety functions is essential for the safe use of the machine. This can be achieved by:	-
4.12.1	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 4.13).	P
4.12.2	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 such a failure leads to a non- hazardous alteration of the machine function.	P
	The use of such components should always be considered, particularly in case where redundancy is not employed.	P

Clause	Requirement - test	Verdict
4.12.3	Duplication (or redundancy) of components or subsystems	-
	In the design of safety-related parts of the machine, duplication (or redundancy) of components may be used so that, if one component fails, another component (or other components) continue(s) to perform its (their) function, thereby ensuring that the safety function remains available.	P
	Diversity of design and/or technology can be used to avoid common cause failures (e.g. from electromagnetic disturbance) or common mode failures.	P
4.13	Limiting exposure to hazards through reliability of equipment	-
	Increased reliability of all component parts of machinery reduces the frequency of incidents requiring rectification, thereby reducing exposure to hazards.	P
	This applies to power systems (operative part) as well as to control systems, to safety functions as well as to other functions of machinery.	P
	Safety-critical components (as, e.g. certain sensors) with a known reliability shall be used. The elements of guards and of protective devices shall be particularly reliable, as their failure can expose persons to hazards, and also as poor reliability would encourage attempts to defeat them.	P
4.14	Limiting exposure to hazards through mechanization or automation of loading (feeding)	P
	Mechanization and automation of machine loading/unloading operations and more generally of handling operations (of workpieces, materials, substances) limit the risk generated by these operations by reducing the exposure of persons to hazards at the operating points.	P
	Automation can be achieved e.g. by robots, handling devices, transfer mechanisms, air blast equipment. Mechanization can be achieved, e.g. by feeding slides, push rods, hand-operated indexing tables.	P
	While automatic feeding and removal devices have much to offer in preventing accidents to machine operators, they can create danger when any faults are being rectified. Care shall be taken to ensure that the use of these devices does not introduce further hazards (e.g. trapping, crushing) between the devices and parts of the machine or workpieces/materials being processed. Suitable safeguards (see clause 5) shall be provided if this cannot be ensured.	P
	Automatic feeding and removal devices with their own control systems and the control system of the associated machine shall be interconnected after thoroughly studying how all safety functions are performed in all control and operation modes of the whole equipment.	P

Clause	Requirement - test	Verdict
4.15	Limiting exposure to hazards through location of the setting and maintenance points outside of danger zones	-
	The need for access to danger zones shall be minimized by locating maintenance, lubrication and setting points outside these zones.	P
5	Safeguarding and complementary protective measures	-
5.1	General	-
	Guards and protective devices shall be used to protect persons whenever inherently safe design does not reasonably make it possible either to remove hazards or to sufficiently reduce risks. Complementary protective measures involving additional (e.g. emergency stop equipment) may have to be taken (see ISO 12100-1:2003,5.4).	P
	The different kinds of guards and protective devices are defined in ISO 12100-1:2003,3.25 and 3.26.	P
	Certain safeguards may be used to avoid exposure to more than one hazard (e.g. a fixed guard preventing access to a zone where a mechanical hazard is present being used to reduce noise level and collect toxic emissions).	P
5.2	Selection and implementation of guards and protective devices	-
5.2.1	General	-
	This subclause give guidelines for the selection and implementation of guards and protective devices the primary purpose of which is to protect persons against hazards generated by moving parts, according to the nature of those parts (see figure 1) and to the need for access to the danger zone(s).	P
	The exact choice of a safeguard for a particular machine shall be made on the basis of the risk assessment for that machine.	P
	In selecting an appropriate safeguard for a particular type of machinery or hazard zone, it shall be borne in mind that a fixed guard is simple and shall be used where access of an operator to the danger zone is not required during normal operation (operation without any malfunction) of the machinery.	P
	As the need for frequency of access increases this inevitably leads to the fixed guard not being replaced. This requires the use of an alternative measure (movable interlocking guards, sensitive protective equipment).	N/A
	A combination of safeguards may sometimes be required. For example, where, in conjunction with a fixed guard, a mechanical loading (feeding) device is used to feed a work piece into a machine, thereby removing the need for access to the primary hazard zone, a trip device may be required to protect against the secondary drawing-in or shearing hazard between the mechanical loading (feeding) device, when reachable, and the fixed guard.	P

Clause	Requirement - test	Verdict
	Consideration shall be given to the enclosure of control positions or intervention zones to provide combined protection against several hazards which may include: - hazards from falling or ejects (e.g. falling object protection structure); - emission hazards (e.g. protection against noise, vibration, radiation, harmful substances); - hazards due to the environment (e.g. protection against heat, cold, foul weather); - hazards due to tipping over or rolling over of machinery (e.g. roll-over or tip-over protection structure).	**N/A**
	The design of such enclosed work stations (e.g. cabs and cabins) shall take into account ergonomic principles concerning visibility, lighting, atmospheric conditions, access, posture.	**P**
5.2.2	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:	**-**
a)	Fixed guard (see also ISO 14120);	**P**
b)	Interlocking guard with or without guard locking (see also ISO 14119, ISO 14120 and 5.3.2.3 of this standard);	**P**
c)	Self-closing guard (see ISO 14120:2002,3.3.2);	**P**
d)	Sensitive protective equipment, e.g. electro-sensitive protective equipment (see IEC 61496-1, IEC 61496-2) or pressure sensitive mat (see ISO 13856-1).	**P**
5.2.3	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 guard with or without guard locking (see also ISO 14119, ISO 14120 and 5.3.2.3 of this standard);	**P**
b)	Sensitive protective equipment, e.g. electro-sensitive equipment (see IEC 61496-1, IEC 61496-2);	**P**
c)	Adjustable	**N/A**
d)	Self-closing guard (see ISO 14120:2002,3.3.2);	**N/A**
e)	Two-hand control device (see ISO 13851);	**N/A**
f)	Interlocking guard with a start function (control guard) (see 5.3.2.5 of this standard).	**P**

Clause	Requirement - test	Verdict
5.2.4	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 may ensure also the protection of personnel in change of setting, teaching, process changeover, fault finding, cleaning or maintenance without hindering them in performing their task. Such tasks shall be identified and considered in the risk assessment as parts of the use of the machine (see ISO 12100- 1:2003,5.3).	**P**
5.2.5	Selection and implementation of sensitive protective equipment1)	-
5.2.5.1	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 applications. The following provisions are intended to provided the designer with criteria for selecting, for each application, the most suitable device(s).	-
	Types of sensitive protective equipment include, e.g.: - light curtains; - scanning devices s , e.g. , laser scanners; - pressure sensitive mats; - trip bars, trip wires.	**N/A**
	Sensitive protective equipment can be used: - for tripping purposes; - for presence sensing; - for both tripping and presence sensing; - to re-initiate machine operation, a practice which is subject to stringent conditions.	**N/A**
	The following characteristics of the machinery, among others, can preclude the sole use of sensitive protective equipment: - 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.	**N/A**
5.2.5.2	Implementation	**-**
a)	Consideration should be given to:	**-**
	size, characteristics and positioning of the detection zone (see ISO 13855, which deals with the positioning of some types of sensitive protective equipment);	**P**

Clause	Requirement - test	Verdict
	- reaction of the device to fault conditions (see IEC 61496-1, IEC 61496-2 for electro-sensitive protective equipment); - possibility of circumvention; - detection capability and its variation over the course of time (e.g. as a result of its susceptibility to different environmental conditions such as the presence of reflecting surfaces, other artificial light sources, sunlight or impurities in the air).	**N/A**
b)	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 detected does not, by itself, restart the hazardous machine function(s); therefore, the command given by the sensitive protective protective equipment shall be maintained by the control system until a new command is given;	**P**
	- restarting the hazardous machine function(s) results from the voluntary actuation, by the operator, of a control device placed outside the hazard zone, where this zone can be observed by the operator;	**N/A**
	- while the detection function of the sensitive protective equipment is interrupted the machine cannot operate, except during muting phases;	**N/A**
	- the position and the shape of the detection field prevents, possibly together with fixed guards, a person or part of a person from entering the hazard zone, or being present in it, without being detected.	**N/A**
5.2.5.3	Additional requirements for sensitive protective equipment when used for cycle initiation	**-**
	In this exceptional application, starting of the machine cycle is initiated by the withdrawal of a person or of the detected part of a person from the sensing field of the sensitive protective equipment, without any additional start command, hence deviating from the general requirement given in the 2nd dash of 5.2.5.2.b). 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. For cycle initiation by a sensitive protective equipment, only active opto- electronic protective devices (AOPDs) complying with IEC 61496 series shall be used, provided that:	**N/A**
	The requirements for an AOPD used as a tripping and presence- sensing device (see IEC 61496-2) are satisfied (in particular: location, minimum distance (see ISO 13855), detection capability, reliability and monitoring of control and braking systems);	**N/A**

Clause	Requirement - test	Verdict
b)	The cycle time of machine is short and the facility to re-initiate the machine upon clearing of the sensing field is limited to a period commensurate with a single normal cycle;	**N/A**
c)	Entering the sensing field of the AOPD(s) or opening interlocking guards is the only to enter the hazard zone;	**N/A**
d)	If there are more than one AOPD safeguarding the machine, only one of them is capable of cycle re-initiation;	**N/A**
e)	With regard to the higher risk resulting from automatic cycle initiation, the AOPD and the associated part of the control system comply with a higher safety-related performance than under normal conditions.	**N/A**
5.2.6	Protective measures for stability	**-**
	If stability cannot be achieved by inherently safe design measures such as weight distribution (see 4.6), it will be necessary to maintain it by protective measures such as the use of:	**-**
	- anchorage bolts;	**P**
	- locking devices;	**P**
	- movement limiters or mechanical stops;	**N/A**
	- acceleration or deceleration limiters;	**N/A**
	- load limiters;	**N/A**
	- alarms warning of the approach to stability or tipping limits.	**N/A**
5.2.7	Other protective devices	**-**
	When a machine requires continuous control by operator (e.g. mobile machines, cranes, cranes) and an error of the operator can generate a hazardous situation, this machine shall be equipped with the necessary devices to enable the operation to remain within specified limits, in particular:	**N/A**
	- when the operator has insufficient visibility of the hazard zone;	**N/A**
	- when the operator lacks knowledge of the actual value of a safety-related parameter (e.g. a distance, a speed, the mass of a load, the angle of a slope);	**P**
	- when hazards may result from operations other than those controlled by the operator.	**P**
	The necessary devices include, e.g. :	

Clause	Requirement - test	Verdict
	-devices for limiting parameters of movement (distance, angle, velocity, acceleration);	P
	-overloading and moment limiting devices;	N/A
	- devices to prevent collisions or interference with other machines;	P
	- devices for preventing hazards to pedestrian operators of mobile machinery or other pedestrians;	N/A
	- torque limiting devices, breakage points to prevent excessive stress of components and assemblies;	N/A
	- devices for limiting pressure, temperature;	N/A
	- devices for monitoring emissions;	N/A
	- devices to prevent operation in the absence of the operator at the control position;	N/A
	- devices to prevent lifting operations unless stabilizers are in place;	N/A
	- devices to limit inclination of the machine on a slope;	N/A
	- devices to ensure that components are in a safe position before traveling.	N/A
	Automatic protective measures triggered by such devices which take operation of the machinery out of the control of the operator (e.g. automatic stop of hazardous movement) should be preceded or accompanied by a warning signal to enable operator to take appropriate action (see 6.3).	N/A
5.3.2.3	Requirements for movable guards	-
a)	Movable guards which provide protection against hazards generated by moving transmission parts shall:	N/A
	- as far as possible remain fixed to the machinery or other structure (generally by means of hinges or guides) when open;	N/A
	- be interlocking guards (with guard locking when necessary) (see ISO 14119). See figure 1.	N/A
b)	Movable guards against hazards generated by non-transmission moving parts shall be designed and associated with the machine control system so that:	-
	- moving parts cannot start up while they are within the operator's reach and the operator cannot reach moving parts once they have started up; this can be achieved by interlocking guards, with guard locking when necessary;	N/A
	- they can be adjusted only by an intention action, such as the use of a tool or key;	N/A
	- the absence or failure of one of their components prevents starting of the moving parts or stops them; this can be achieved by automatic monitoring (see 4.11.6). See figure 1 and ISO 14119.	N/A

Clause	Requirement - test	Verdict
5.3.2.4	Requirements for adjustable guards	-
	Adjustable guards may only be used where the hazard one cannot for operational reasons be completely enclosed.	N/A
	They shall: - be designed so that the adjustment remains fixed during a given operation; - be readily adjustable without the use of tools.	N/A
5.3.2.5	Requirements for interlocking guards with a start function (control guards)	-
	An interlocking guard with a start function may be used only when all the following requirements are met: - all requirements for interlocking guards are satisfied (see ISO 14119); - the cycle time of the machine is short; - the maximum opening time of the guard is present to low value(e.g. equal to the cycle time). When this time is exceeded, the hazardous function(s) cannot be initiated by the closing of the interlocking guard with a start function and resetting is necessary before restarting the machine; - the dimension 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); - all other guards whether fixed (removable type) or movable are interlocking guards; - the interlocking device associated with the interlocking guard with a start function is designed in such a way-e.g. by duplication of position detectors and use of automatic monitoring (see 4.11.6) – that its failure cannot lead to an unintended/unexpected start-up; - the guard is securely held open (e.g. by a spring or counterweight) such that it cannot initiate a start while falling by its own weight.	P
5.3.2.6	Hazards from guards	-
	Care shall be taken to prevent hazards which might be generated by:	-
	- the guard construction (e.g. sharp edges or comers, material);	P
	- the movements of the guards (shearing or crushing zones generated by power-operated guards and by heavy guards which are liable to fall).	P
5.3.3	Technical characteristics of protective devices	-
	Protective devices shall be selected or designed and connected to the control system so as to ensure correct implementation of their safety function(s).	P

Clause	Requirement - test	Verdict
	Protective devices shall be either selected as meeting the appropriate product standard (e.g. for active opto-electronic protective see IEC 61496-2) or designed according to one or several of the principles formulated in ISO 13849-1.	P
	Protective devices shall be installed and connected to the control system so that they cannot be easily defeated.	P
5.3.4	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 this fitting will be necessary because the work to be done on it willvary.	P
5.4	Safeguarding for reducing emissions	-
5.4.1	General	-
	If the measures for the reduction of emissions at source mentioned in 4.2.2 are not adequate, the machine shall be provided with additional protective measures.	P
5.4.2	Noise	-
	Additional protective measures include, for example: - enclosures (see ISO 15667); - screens fitted to the machine; - silencers (see ISO 14163).	N/A
5.4.3	Vibration	-
	Additional protective measures include, for example, damping devices for vibration isolation between the source and the exposed person such as resilient mounting or suspended seats.	N/A
	For measures for vibration isolation of stationary industrial machinery see EN 1299.	N/A
5.4.4	Hazardous substances	-
	Additional protective measures include, for example:	-
	- encapsulation of the machine (enclosure with negative pressure);	P
	- local exhaust ventilation with filtration;	P
	- wetting with liquids;	N/A
	- special ventilation in the area of the machine (air curtains, cabins for operators). See ISO 14123-1.	P
5.4.5	Radiation	-
	Additional protective measures include, for example:	-

Clause	Requirement - test	Verdict
	- use of filtering and absorption;	**N/A**
	- use of attenuating screens or guards.	**N/A**
5.5	Complementary protective measures	**-**
5.5.1	General	**-**
	Protective measures which are neither inherently safe design measures, nor safeguarding (implementation of guards and/or protective devices), nor information for use may have to be implemented as required by the intended use and the reasonably foreseeable misue of the machine. Such measures include, but are not limited to, the ones dealt with in 5.5.2 to 5.5.6.	**P**
5.5.2	Components and elements to achieve the emergency stop function	**P**
	If following a risk assessment, a machine needs to be fitted with components and elements to achieve an emergency stop function to enable actual or impending emergency situations to be averted, the following requirements apply:	**P**
	- the actuators shall be clearly identifiable, clearly visible and readily accessible;	**P**
	- the hazardous process shall be stopped as quickly as possible without creating additional hazards. If this is not possible or the risk cannot be reduced, it should be questioned whether implementation of an emergency stop function is the best solution;	**P**
	- the emergency stop control shall trigger or permit the triggering of certain safeguard movements where necessary.	**P**
	Once active operation of the emergency stop device has ceased following an emergency stop command, the effect of this command shall be sustained until it is reset. This reset shall be possible only at that location where the emergency stop command has been initiated. The reset of the device shall not restart the machinery, not but only permit restarting.	**P**
	More details for the design and selection of electrical components and elements to achieve the emergency stop function are provided in IEC 60204 series.	**P**
5.5.3	Measures for the escape and rescue of trapped persons	**N/A**
	Measures for the escape and rescue of trapped persons may consist, e.g. of:	**-**
	- escape routes and shelters in installations generating operator- trapping hazards;	**N/A**
	- arrangements for moving some elements by hand, after an emergency stop;	**N/A**
	- arrangements for reversing the movement of some elements;	**N/A**

Clause	Requirement - test	Verdict
	- anchorage points for descender devices;	**N/A**
	- means of communication to enable trapped operators to call for help.	**N/A**
5.5.4	Measures for isolation and energy dissipation	-
	Especially with regard to their maintenance and repair, machines shall be equipped with the technical means to achieve the isolation from power supply(ies) and dissipation of stored energy as a result of following actions:	**P**
a)	Isolating (disconnecting, separating) the machine (or defined parts of the machine) from all power supplies;	**P**
b)	Locking (or otherwise securing) all the isolating position;	**P**
c)	Dissipating or, if this is not possible or practicable, restraining (containing) any stored energy which may give rise to a hazard;	**P**
d)	Verifying, by means of a safe working procedure, that the actions taken according to a), b) and c) above have produced the desired effect.	**P**
	See ISO 14118:2000, clause 5 and IEC 60204-1:2005, 5.5 and 5.6.	-
5.5.5	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 capable of being provided with suitable attachment devices for transport by means of lifting gear.	**P**
	These attachments may be, e.g.:	-
	- standardized lifting appliances with slings, hooks, eyebolts, or tapped holes for appliance fixing;	**P**
	- appliances for automatic grabbing with a lifting hook when attachment is not possible from the ground;	**N/A**
	- guiding grooves for machines to be transported by a fork truck;	**P**
	- lifting gear and appliances integrated into the machine.	**N/A**
	Parts of machinery which can be removed manually in operation shall be provided with means for their safe removal and replacement.	**N/A**
	See also 6.4. c) (3rd dash).	-
5.5.6	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.	**P**

Clause	Requirement - test	Verdict
	Where this is not possible, machines shall have built-in platforms, stairs or other facilities to provide safe access for those tasks, but care should be taken to ensure that such platforms or stairs do not give access to danger zones of machinery.	P
	The walking areas shall be made from materials which remain as lip resistant as practicable under working conditions and, depending on the height from the ground, suitable guard-rails (see ISO 14122-3) shall be provided.	P
	In large automated installations, particular attention shall be given to safe means of access such as walkways, conveyor bridges or crossover points.	N/A
	Means of access to parts of machinery located at a height shall be provided with collective means of protection against falls (e.g. guard-rails for stairways, stepladders and platforms and/or safety cages for ladders). As necessary, anchorage points for personal protective equipment against falls from a height shall also be provided (e.g. in carriers of machinery for lifting persons or with elevating control stations).	P
	Openings shall whenever possible open towards a safe position .They shall be designed to prevent hazards due to unintended opening.	P
	The necessary aids for access shall be provided (e.g. steps, handholds). Control devices shall be designed and located to prevent their being used as aids for access.	N/A
	When machinery for lifting goods and/or persons includes landings at fixed levels, these shall be equipped with interlocking guards preventing falls when the platform is not present at the level. Movement of the lifting platform shall be prevented while the guards are open.	N/A
	For detailed provisions see ISO 14122-1, ISO 14122-2, ISO 14122-3 and ISO 14122-4.	N/A
6	Information for use	
6.1	General requirements	
	Drafting information for use is an integral part of the design of a machine (see ISO 12100-1:2003, figure 1). Information for use consists of communication links, such as texts, words, directed to professional and/or non-professional users.	P
6.1.1	Information shall be provided to the user about the intended use of the machine, taking into account, notably, all its operating modes.	P
	It shall contain all directions required to ensure safe and correct use of the machine.	P
	With this in view, it shall inform and warn the user about residual risk.	P

Clause	Requirement - test	Verdict
	The information shall indicate:	-
	- if training is needed;	N/A
	- if personal protective equipment is needed;	N/A
	- the possible need for additional guards or protective devices (see ISO 12100-1:2003, figure 1, note 4).	P
	It shall not exclude use of the machine that can reasonably be expected from its designation and description and shall warn about the risk which would result from using the machine in other ways than ones described in the information, especially considering its reasonably foreseeable misuse.	P
6.1.2	Information for use shall cover, separately or in combination, transport, assembly and installation, commissioning, use (setting, teaching/programming or process changeover, operation, cleaning, fault finding and maintenance) of the machine, and the machine, and, if necessary, de-commissioning, dismantling and disposal.	P
6.2	Location and nature of the 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:	N/A
	- in/on the machine itself (see 6.3 and 6.4);	P
	- in accompanying documents (in particular instruction handbook, see 6.5);	P
	- on the packaging;	P
	- by other means such as signals and warning outside the machine.	P
	Standardized phrases shall be considered where important messages such as warnings need to be given (see also IEC 62079).	P
6.3	Signals and warning devices	-
	Visual signals (e.g. flashing lights) and audible signals (e.g. sirens) may be used to warn of an impending hazardous event such as machine start-up or overspeed.	P
	Such signals may also be used to warn the operator before the triggering of automatic protective measures (see last paragraph of 5.2.7).	P
	It is essential that these signals:	-
	- are emitted before the occurrence of the hazardous event;	P
	- are unambiguous;	P

Clause	Requirement - test	Verdict
	-can be clearly perceived and differentiated from all other signals used;	P
	- can be clearly recognized by the operator and other persons.	P
	The warning devices shall be designed and located such that checking is easy. The information for use shall prescribe regular checking of warning devices.	P
	The attention of designers is drawn to the risks from "sensorial saturation" which results from too many visual and/or acoustic signals, which may also lead to defeating the warning devices.	P
6.4	Markings, signs(pictograms), written warnings	-
	Machinery shall bear all markings which are necessary:	-
a)	For its unambiguous identification, at least :	-
	- name and address of the manufacturer;	P
	- designation of series or type;	P
	- serial number, if any;	P
b)	In order to indicate its compliance with mandatory Requirements:	-
	- marking;	P
	- written indications (e.g. for machines intended for use in potentially explosive atmosphere);	P
c)	For it safe use, e.g.:	-
	- maximum speed of rotating parts;	P
	- maximum diameter of tools;	P
	- mass (expressed in kilograms) of the machine itself and/or of removable parts;	P
	- maximum working load;	P
	- necessary of wearing personal protective equipment;	N/A
	- guard adjustment data;	N/A
	- frequency of inspection.	P
	Information printed directly on the machine should be permanent and remain legible throughout the expected life of the machine.	P
	Signs or written warnings only saying "danger" shall not be used.	P

Clause	Requirement - test	Verdict
	Markings, signs and written warnings shall be readily understandable and unambiguous, especially as regards the part of the function(s) of the machine which they are related to. Readily understandable signs (pictograms) should be used in preference to written warnings.	P
	Signs and pictograms should only be used if they are understood in the culture in which the machinery is to be used.	P
	Written warnings shall be drawn up in the language(s) of the country in which the machine will be used for the first time and, on request, in the language(s) understood by operators.	P
	Markings shall comply with recognized standards (see ISO 2972, ISO 7000, particularly for pictograms, symbols, colours).	P
	See IEC 60204 series as regards marking of electrical equipment.	-
6.5	Accompanying documents (in particular, instruction handbook)	-
6.5.1	Content	-
	The instruction handbook or other written instructions(e.g. on the packaging) shall contain among others:	-
a)	Information relating to transport, handling and storage of the machine, e.g.:	-
	- storage conditions for the machine;	P
	- dimensions, mass value(s),position of the center(s) of gravity;	N/A
	- indications for handling(e.g. drawings indicating application points for lifting equipment);	P
b)	Information relating to installation and commissioning of the machine, e.g.:	-
	- fixing/anchoring and vibration conditions;	P
	- assembly and mounting conditions;	P
	- space need for use and maintenance;	P
	- permissible environmental conditions (e.g. temperature, moisture, vibration, electromagnetic radiation);	P
	- instructions for connecting the machine to power supply (particularly about protection against electrical overloading);	P
	- advice about waste removal/disposal;	P
	- if necessary, recommendations about protective measures which have to be taken by the user; e.g. additional safeguards (see ISO 12100-1:2003, figure 1, NOTE 4), safety distances, safety signs and signals;	P

Clause	Requirement - test	Verdict
c)	Information relating to the machine itself, e.g.:	
	- detailed description of the machine, its guards and/or protective devices;	P
	- 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;	P
	- diagrams (especially schematic representation of safety functions);	P
	- data about noise and vibration generated by the machine, about radiation, gases, vapours, dust emitted by it, with reference to the measuring methods used;	P
	- technical documentation about electrical equipment (see IEC 60204 series);	P
	- documents attesting that the machine complies with the mandatory regulations;	N/A
d)	Information relating to the use of the machine, e.g. about:	
	- intended use;	P
	- description of manual controls (actuators);	P
	- setting and adjustment;	P
	- modes and means for stopping (especially emergency stop);	P
	- risks which could not be eliminated by the protective measures taken by the designer;	P
	- particular risks which may be generated by certain applications, by the use of certain fittings, and about specific safeguards which are necessary for such applications;	P
	- reasonably foreseeable misuse and prohibited usages;	P
	- fault identification and location, repair, and restarting after an intervention;	P
	-personal protective equipment which need to be used and training required;	
e)	Information for maintenance, e.g.:	
	- nature and frequency of inspections for safety functions;	P
	- instructions relating to maintenance which require a definite technical knowledge or particular skills and hence should be carried out exclusively by skilled persons (e.g. maintenance staff, specialists);	P
	- instructions relating to maintenance actions (e.g. replacement of parts) which do not require specific skills and hence may be carried out by users(e.g. operators);	P

Clause	Requirement - test	Verdict
	- drawings and diagrams enabling maintenance personal to carry out their task rationally (especially fault-finding tasks);	**P**
f)	Information relating to de-commissioning, dismantling and disposal;	**P**
g)	Information for emergency situations, e.g.:	
	- type of fire-fighting equipment to be used;	**P**
	- warning about possible emission or leakage of harmful substance(s), and if possible, indication of means to fight their effects;	**N/A**
h)	Maintenance instructions provided for unskilled persons (third dash in e)), that should appear clearly separated from each other.	**P**
6.5.2	Production of the instruction handbook	
a)	Type 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.	**P**
b)	Information for use shall be given in the language(s) of the country in which the machine will be used for the first time and in the original version. If more than one language are to be used, each language should be readily distinguished from the other(s), and efforts should be made to keep the translated text and the relevant illustration together.	**P**
c)	Whenever helpful to the understanding, test should be supported by illustrations. Illustrations should be supplemented with written details enabling, for instance, manual controls (actuators) to be located and identified; they should not be separated from the accompanying text and should follow sequential operations.	**P**
d)	Consideration should be given to presenting information in tabular from where this will aid understanding. Tables should be adjacent to the relevant text.	**P**
e)	The use of clouds should be considered, particularly in relation to components requiring quick identification.	**P**
f)	When information for use is lengthy, a table of contents and/or an index should be given.	**P**
g)	Safety-relevant instructions which involve immediate action should be provided in a form readily available to the operator.	**P**
6.5.3	Advice for drafting and editing information for use	
a)	Relationship to model: the information shall clearly relate to the specific model of machine.	**P**

Clause	Requirement - test	Verdict
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 answers provided.	**P**
c)	Information for use shall be as simple and as brief as possible, and should be expressed in consistent terms and units with a clear explanation of unusual technical terms.	**P**
d)	When it is foreseen that a machine will be put to nonprofessional use, the instructions should be written in a form that is readily understood by the non-professional users. If personal protective equipment is required for the safe use of the machine, 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 may be useful to mark them "keep for future reference". Where information for use is kept in electronic form (e.g. CD, DVD, tape) information on safety-related issues that need immediate action shall always be backed up with a hard copy that is readily available.	**P**

TEST REPORT

MD DIRECTIVE 2006/42/EC &LVD DIRECTIVE 2014/35/EU
PROJECT NO.:96221559-2

EN 60204-1:2018/prA1:2020

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

ZHEJIANG SAYEAH MACHINERY CO.,LTD.

MULTI-POSITION THERMOFORMING MACHINE

3.3 EN 60204-1:2018/PRA1:2020 test report

Test item particulars - **MULTI-POSITION THERMOFORMING MACHINE**
Possible test case verdicts: - Test case does not apply to the test object : N(.A.) - Test object does meet the requirement : P(Pass) - Test object does not meet the requirement : F(Fail)
Testing EN60204-1:2006+A1:2009 Safety of Machinery-Electrical equipment of machines Part 1: General requirements
General remarks: The test results presented in this report relate only to the object tested. This report shall not be reproduced, except in full, without the written approval of the issuing testing laboratory.
Test product information: **Model : FSCT820/650-3** **Parameters : Voltage : 380VAC** **Power: 82kW** **Frequency: 50Hz** Same construction as basic model except enclosure.

AUDIT INFORMATION:		
Description of Test	Standard No.	EN 60204-1:2018/prA1:2020
Test Engineer by	MICHAEL	Signature: Michael
Reviewer by	Jack .H	Signature:
Test Result	**Pass**	**May 9, 2022**
SAPO CERTIFICATION & TESTING LABORATORY LIMITED		

Clause	Requirement - test	Verdict
1	Scope	-
	This part of EN 60204 applies to the application of electrical and electronic equipment and systems to machines not portable by hand while working, including a group of machines working together in a coordinated manner but excluding higher level system aspects	-
	This part is applicable to the electrical equipment or parts of the electrical equipment that operate with nominal supply voltages not exceeding 1000V for alternating current and not exceeding 1500V for direct current, and with nominal frequencies not exceeding 200Hz	-
2	Normative references	-
3	Definitions	-
4	General requirements	-
4.1	The risks associated with the hazards relevant to the electrical equipment shall be assessed as part of the overall requirements for risk assessment of the machine	p
4.2	Selection of equipment	-
	Electrical components and devices shall be suitable for their intended use and shall conform to relevant IEC standards where such exist	p
4.3	Electrical supply	-
	The electrical equipment shall be designed to operate correctly with the relevant conditions of supply	p
4.4	Physical environment and operating conditions	-
	Shall be suitable for use as specified : - Electromagnetic compatibility - Ambient air temperature - Humidity - Altitude - Contaminants - Ionizing and non-ionizing radiation - Vibration, shock and bump	p
4.5	Transportation and storage	-
	-25°C to +55 °C and short periods not exceeding 24 h at up to +70 °C	p
4.6	Provisions for handling	-
	Heavy and bulky equipment shall be moved by cranes or similar equipment	p
4.7	Installation and operation	-
	According to supplier's instructions	p

Clause	Requirement - test	Verdict
5	Incoming supply conductors terminations and devices for disconnecting and switching off	-
5.1	Incoming supply conductor terminations	-
	Single or multiple power supply	p
	The supply conductors are terminated at the supply disconnecting device If not, the separate terminals shall be provided	p
	If a neutral conductor is used, it shall be indicated clearly in the technical documentation	p
	Labelled N shall be provided for the neutral conductor	p
	No connection between the protective bonding circuit and the neutral conductor	p
	All terminals for the incoming supply connection shall be identified clearly	p
5.2	Terminal for connection to the external protective earthing system	-
	Shall be in the vicinity of the associated phase conductor terminals	p
	Cross-sectional area of the external protective copper conductor according to table 1	p
	Marking of the external protective conductor with the letters "PE"	p
	Other protective terminals shall be marked with the symbol	p
	All protective terminals shall be coloured by use of the bicolour combination Green-And-Yellow	p
5.3	Supply disconnecting (isolating) device	-
5.3.1	General	-
	Shall disconnect (isolate) the electrical equipment of the machine from supply when required	p
	If two or more supply disconnecting devices are provided, protective interlocks shall be used	p
5.3.2	Type	-
	a) Switch-disconnector according to EN 60947-3 b) A disconnector with auxiliary contact c) Circuit breaker according to EN 60947-2 d) Plug / socket combination for a machine with a rated current not exceeding 16 A and a total power rating not exceeding 3 kW	p
5.3.3	Requirements	-
5.3.3.1	General	-
	Have one OFF and one ON position only	p

Clause	Requirement - test	Verdict
	Marked clearly with "I" and "O"	p
	Circuit-breakers, have a reset(tripped) position between "O" and "I"	p
	When "off"then all conductors are open	p
	Have an external operating handle	N/A
	Does not serve as an emergency stop devices	p
	The handle should be Black or Grey	N/A
	Could be locked in the OFF position	p
	Disconnect all live conductors of its power supply circuit	p
	Sufficient breaking capacity	p
5.3.3.2	Power operated circuit-breakers	-
	Shall have: -Manual operation -And when locked in OFF position, manual as well as remote closing shall be prevented	p
5.3.4	Operating handle	-
	Shall be easily accessible and located : 0.6 m~1.9 m	p
5.3.5	Excepted circuits	-
	Have their own disconnecting device (Recommended)	p
	If no disconnecting device, the relevant safety requirements shall be complied with	N/A
5.4	Devices for switching off for prevention of unexpected startup	-
	Unexpected start-up shall be prevented (Devices described in 5.3.2 may fulfill this function)	p
5.5	Devices for disconnecting electrical equipment	-
	Devices shall be provided for disconnecting (isolating) electrical equipment to enable work to be carried out without a risk from electric shock or burn	N/A
5.6	Protection against unauthorized, inadvertent and/or mistaken connection	-
	The devices described in 5.4 and 5.5 shall be equipped with such function	p
6	Protection against electric shock	-
6.1	General	-

Clause	Requirement - test	Verdict
	The recommended measures are given in 6.2, 6.3 and 6.4	-
6.2	Protection against direct contact	-
6.2.1	General	-
	Either 6.2.2 or 6.2.3 and, where applicable , 6.2.4 shall be applied	p
	When the equipment is located in places open to all persons, measures of either 6.2.3 or 6.2.2 with a min. degree of protection against direct contact corresponding to IP4X or IPXXD shall be applied	N/A
6.2.2	Protection by enclosures	-
	Min. protection degree for live parts : IP2X or IPXXB	p
	Min. protection degree for top surface : IP4X or IPXXD	p
	Opening an enclosure shall only be possible under one of the following conditions :	-
a)	The use of a key or tool is necessary by skilled or instructed persons	p
	Min. protection degree for live parts on the inside of doors : IP1X or IPXXA	p
	Min. protection degree for live parts inside the enclosure : IP2X or IPXXB	N/A
b)	The disconnection of live parts inside the enclosure before the enclosure may be opened (Use of the supply disconnecting device)	p
	Min. protection degree for all parts are still have live after switching off the disconnecting device : IP2X or IPXXB	p
	Such parts shall be marked with a warning sign :marking	p
c)	Opening without the use of a key or a tool and without disconnection of live parts shall be possible only when the min. protection degree is IP2X or IPXXB	N/A
6.2.3	Protection by insulation of live parts	-
	Live parts shall be covered by insulation which can only be removed by destruction	P
	Such insulation shall withstand the mechanical, chemical, electrical and thermal stresses under normal service conditions	P
6.2.4	Protection against residual voltages	-
	After disconnecting, any exposed conductive part having a residual voltage that shall be discharged to 60V or less within 5 seconds	P
	If mentioned above is not possible, a warning notice drawing shall be provided	N/A

Clause	Requirement - test	Verdict
	If the withdrawal of plugs or similar devices would make the exposure of the conductors (e.g. pins),the discharge time shall not exceed 1 second ; Such conductor shall have the protection degree at least IP2X or IPXXB	**N/A**
6.2.5	Protection by barriers	**-**
	For protection by barriers, see 412.2 of IEC 60364-4-41	**N/A**
6.2.6	Protection by placing out of reach or protection by obstacles	-
	For protection by placing out of reach see 412.4 of IEC 60364- 4-41	**N/A**
	For protection by obstacles see 412.3 of IEC 60364-4-41	**N/A**
	For collector wire systems or collector bar systems with a degree of protection less than IP2X see 13.8.1	**N/A**
6.3	Protection against indirect contact	-
6.3.1	General	**-**
	For each circuit or part, at least one of the measures in accordance with 6.3.2 to 6.3.3 shall be applied	**p**
6.3.2	Measure to prevent the occurrence of a hazardous touch voltage	**-**
6.3.2.1	General	**-**
6.3.2.2	Protection by use of class II equipment or by equivalent insulation	**-**
	Application of class II equipment or equivalent insulation	**p**
6.3.2.3	Protection by electrical separation	**-**
	Application of electrical separation	**p**
6.3.2.4	Supply system design	**-**
	Application of a supply system designed with its neutral point either insulated from or having a high impedance to earth	**N/A**
6.3.3	Protection by automatic disconnection of supply	**-**
	Use of the automatic disconnection of supply	N/A
6.4	Protection by the use of PELV	-
6.4.1	General requirements	-
	PELV (protective extra-low voltage) circuits shall satisfy all of the conditions specified in this clause	**p**

Clause	Requirement - test	Verdict
6.4.2	Sources for PELV	-
	The sources for PELV shall be one of the conditions specified in this clause	**N/A**
7	**Protection of equipment**	**-**
7.1	General	**-**
7.2	Overcurrent protection	**-**
7.2.1	General	**-**
7.2.2	Supply conductors	**-**
	The supplier is not responsible for providing the overcurrent device for the supply conductors	**p**
	Installation diagram with data necessary for selection of the overcurrent protective device	**p**
7.2.3	Power circuits	**-**
	All conductors shall be protected against overcurrent (except earthed neutral conductor)	**p**
	Cross-section area of neutral conductor	**p**
	For neutral conductors smaller than phase conductors then IEC 364-4-473 shall apply	**p**
	In IT-systems, it is recommended that the neutral conductor is not used	**N/A**
7.2.4	Control circuits	**-**
	Conductors of control circuits connected to the supply voltage and of circuits feeding control circuit transformers shall be protected against overcurrent in accordance with 7.2.3	**p**
7.2.5	Socket outlets and their associated conductors	**-**
	Overcurrent protection devices shall be provided in the unearthed live conductors	**N/A**
7.2.6	Lighting circuits	**-**
	All unearthed conductors of circuits supplying lighting shall be protected against the effects of short circuits by the provision of overcurrent devices separate from those protecting other circuits	**N/A**
7.2.7	Transformers	**-**
	Transformers shall be protected against overcurrent in accordance with IEC 60076-5 and IEC 60742 as appropriate	**N/A**
	The type and setting of the overcurrent protective device should be in accordance with the recommendations of the transformer supplier	**N/A**
7.2.8	Location of overcurrent protective device	**-**

Clause	Requirement - test	Verdict
	Overcurrent protective device shall be located at the point where the conductors to be protected are connected to their supply	**p**
7.2.9	Overcurrent protective devices	**-**
	Sufficient breaking capacity	**p**
	Where fuses are used, a type readily available in the country of use shall be selected, or arrangement shall be made with the user for the supply of spare parts	**N/A**
7.2.10	Rating and setting of overcurrent protective devices	**-**
	The rated current of fuses or the setting current of other overcurrent protective devices shall be selected as low as possible but adequate for the anticipated overcurrents	**P**
	The rated current or setting of an overcurrent protective device is determined by the current carrying capacity of the conductors to be protected by that device in accordance with 13.4	**P**
7.3	Overload protection of motors	-
	Overload protection of motors shall be provided for each motor rated at more than 0.5 kW	**P**
	In applications where an automatic interruption of the motor operation is unacceptable, the overload detection shall give a warning signal to which the operator can respond	**N/A**
	Detection of overload shall be provided in each live conductor excepted for the neutral conductor	**P**
	For motors having single-phase or D.C. power supplies, detection in only one unearthed live conductor is permitted	**P**
	Automatic restarting of any motor after the operation of overload protection shall be prevented	**P**
7.4	Abnormal temperature protection	**-**
	Use of abnormal temperature protection	**P**
7.5	Protection against supply interruption or voltage reduction and subsequent restoration	**-**
	Where a voltage drop or a supply interruption can cause a hazardous condition, damage to the machine, or to the work in progress, undervoltage protection shall be provided	**N/A**
	The operation of the undervoltage device shall not impair the operation of any stopping control of the machine	**N/A**
	Upon restoration of the voltage or upon switching on the incoming supply, automatic or unexpected restarting of the machine shall be prevented	**P**

Clause	Requirement - test	Verdict
	Where only a part of the machine or of the group of machines working together in a coordinated manner is affected by the voltage reduction or supply interruption, the undervoltage protection shall initiate appropriate control responses to ensure co-ordination	**N/A**
7.6	Motor overspeed protection	**-**
	Use of the motor overspeed protection	**N/A**
7.7	Earth fault/residual current protection	-
	Use of earth fault/residual current protection for automatic disconnection	**N/A**
7.8	Phase sequence protection	-
	Where an incorrect sequence of the supply voltage can cause a hazardous condition or damage to the machine, protection shall be provided	**N/A**
7.9	Protection against overvoltage due to lighting and to switching surges	-
	Protective devices can be provided to protect against the effects of overvoltages due to lighting or to switching surges	**N/A**
8	**Equipotential bonding**	**-**
8.1	General	**-**
8.2	Protective bonding circuit	**-**
8.2.1	General	**-**
	On mobile machines with on-board power supplies, it shall be connected to a protective bonding terminal to provide protection against electric shock	**N/A**
	hen a mobile machine is also capable of being connected to an external incoming supply, the protective bonding terminal shall be the connection point for the external protective conductor	**N/A**
	All parts of the protective bonding circuit shall be so designed that they are capable of withstanding the highest thermal and mechanical stresses	**p**
	Any structural part of the electrical equipment or of the machine may be used as part of protective bonding circuit	**p**
	If an IT distribution system is used, the machine structure shall be used as part of the protective bonding circuit in conjunction with an earth fault supervision system	**N/A**
	The structural bonding is not required where all the equipment provided is in accordance with 6.3.2.2	**p**
8.2.2	Protective conductors	**-**

Clause	Requirement - test	Verdict
	Protective conductors shall be identified according to 14.2.2	p
	Copper conductors should be used	p
	Where a conductor material other than copper is used, its electrical resistance per unit length shall not exceed that of the allorwable copper conductor and such conductors shall not be less than 16 mm2 in cross-sectional aea	N/A
	The cross-sectional area of protective conductors shall be determined according to the requirements of : - 543 of IEC 60364-5-54; or - 7.4.3.1.7 of IEC 60439-1, as appropriate	p
8.2.3	Continuity of the protective bonding circuit	-
	All exposed conductive parts shall be connected to the protective bonding circuit	p
	Where a part is removed for any reason, the protective bonding circuit for the remaining parts shall not be interrupted	p
	Connection and bonding points shall be so designed that their current-carrying capacity is not impaired by mechanical, chemical, or electrochemical influence	p
	Metal ducts of flexible or rigid construction and metallic cable sheathes shall not be used as protective bonding conductors	p
	Nevertheless such metal ducts and the metal sheathing of all connecting cables shall be connected to the protective bonding circuit	p
	Where the electrical equipment is mounted on lids, doors, or cover plates, continuity of the protective bonding circuit shall be ensured and it is recommended that a protective conductor is used	p
	Otherwise fastenings, hinges or sliding contacts designed to have a low resistance shall be used	p
	The continuity of the protective conductor in cables that are exposed to damage shall be ensured by appropriate measures	p
	For requirements for the continuity of the protective conductor using collector wires, collector bars and slip-ring assemblies (see 13.8.2)	p
8.2.4	Exclusion of switching devices from the protective bonding circuit	-
	Shall not incorporate a switching device, an overcurrent protective device nor a means for current detection for such devices	p
	The only means permitted for interruption shall be carried out by instructed or skilled persons by using a tool	p
8.2.5	Parts that need not to be connected to the protective bonding circuit	-

Clause	Requirement - test	Verdict
	Screws, rivets, and nameplates and to parts inside an enclosure, are not necessary to connect to the protective bonding circuit	p
8.2.6	Interruption of the protective bonding circuits	-
	The protective bonding circuit shall be interrupted only after the live conductors have been interrupted, and shall be reestablished before any live conductor is reconnected	p
	Metallic housings of plug/socket combinations shall be connected to the protective bonding circuit except where used for PELV	p
8.2.7	Protective conductor connecting points	-
	All protective conductors shall be terminated in accordance with 14.1.1	p
	Shall have no other function and shall not be used to attach or connect appliances or parts	p
	Use of earthing symbol	p
	By the bicolour combination GREEN-AND-YELLOW	p
	8.3 Bonding for operational purposes	-
	Use of bonding for operational purpose	-
8.3.1	General	-
8.3.2	Bonding to the protective circuit	-
	One method for protection against unintended operation as a result of insulation failure is achieved by connecting one side of a control circuit fed by a transformer to the protective bonding circuit	p
8.3.3	Bonding to a common reference potential	-
	Use of bonding to a common reference potential	N/A
9	Control circuits and control functions	-
9.1	Control circuits	-
9.1.1	Control circuit supply	-
	Transformers shall be used for supplying the control circuits	p
	Transformers are not mandatory for machines with a single motor starter and a maximum of two control devices	p
9.1.2	Control circuit voltages	-
	The nominal voltage shall not exceed 277 V when supplied from a transformer	N/A

Clause	Requirement - test	Verdict
9.1.3	Protection	-
	Overcurrent protection shall be provided according to 7.2.4 and 7.2.10	N/A
9.1.4	Connection of control devices	-
	Appropriate connection for control devices	P
9.2	Control	-
9.2.1	Start functions	-
	Start functions shall operate by energizing the relevant circuit	P
9.2.2	Stop functions	-
	Each machine shall be equipped with appropriate stop functions	P
9.2.3	Operating modes	-
	When hazardous conditions can arise from mode selection, such selection shall be prevented by suitable means Mode selection by itself shall not initiate machine operation (A separate action by the operator shall be required) Safeguarding shall remain effective for all operating modes Indication of the selected operating mode shall be provided	P
9.2.4	Suspensions of safeguarding	-
	Where it is necessary to suspend safeguarding, a secure provision shall be provided to prevent automatic operation	P
9.2.5	Operation	-
9.2.5.1	General	-
	The necessary interlocks (see 9.3) shall be provided for safe operation	P
	Measures shall be taken to prevent movement of the machine in an unintended manner after any stopping of the machine	P
9.2.5.2	Start	-
	The start of an operation shall be possible only when all the safeguards are in place and functional (except described in 9.2.4)	P
	Hold-to-run control shall be used for the others machines, as appropriate	P

Clause	Requirement - test	Verdict
	Suitable interlocks shall be provided to secure correct sequential starting	P
	The use of more than one control station to initiate a start: - Each control station shall have a separate manually actuated start control device. - All required condition for machine operation shall met - All start control device shall be in the released (off) position before a start nay be permitted - All start control device shall be actuated concurrently	P
9.2.5.3	Stop	-
	Category 0, category 1 and/or category 2 stops shall be provided where indicated by the risk assessment and the functional requirements of the machines	P
	Category 0 and category 1 shall be operational regardless of operating modes and category 0 shall take priority	P
	Stop functions shall override related start functions	P
9.2.5.4	Emergency operations (emergency stop, emergency switching off)	-
9.2.5.4.1	General	-
9.2.5.4.2	Emergency	-
	Shall function either as a category o stop or as a category 1 stop	P
	The choice of the emergency stop shall be determined by the risk assessment of the machine	P
	Where a category 0 stop is used for emergency stop function, it shall have only hard-wired electromechanical components	P
	The operation of emergency stop shall not depend on electronic logic or on the transmission of commands over a communications network or link	P
	Where a category 1 stop is used for the emergency stop function, final removal of power to the machine actuators shall be ensured and carried out by means of electromechanical components	P
9.2.5.4.3	Emergency switching off	-
	Use of emergency switching off	P
9.2.5.5	Monitoring of command actions	-
	Movement or action of a machine or part of a machine that can result in a hazardous condition shall be monitored	N/A

Clause	Requirement - test	Verdict
9.2.5.6	Hold-to-run controls	-
	Hold-to-run controls shall require continuous actuation of the control devices to achieve operation	P
9.2.5.7	Two-hand control	-
	Three types of two-hand control are available, the selection of which is determined by the assessment	N/A
9.2.5.8	Enabling device	-
	It shall be designed to allow motion when actuated in one position only (In any other position motion shall be stopped)	P
9.2.6	Combined start and stop controls	-
	Push-buttons and similar devices that, when operated, alternately initiate and stop motion shall only be used for functions which cannot result in a hazardous condition	P
9.2.7	Cableless control	-
9.2.7.1	General	-
	Means shall be provided to readily remove or disconnect the power supply of the operator control station	N/A
	Means shall be provided, as necessary, to prevent unauthorized use of the operator control station	N/A
	Each operator control station shall carry an unambiguous indication of which machine is intended to be controlled by that operator control station	N/A
9.2.7.2	Control limitation	N/A
	Measures shall be taken to prevent the machine from responding to signals other than those from the intended operator control station	N/A
	Where necessary, means shall be provided so that the machine can only be controlled from operator control station in one or more predetermined zones or locations	N/A
9.2.7.3	Stop	-
	Operator control stations shall include a separate and clearly identifiable means to initiate the stop function of the machine or of all the motions that can cause a hazardous condition	N/A
	The actuating means to initiate this stop function shall not be marked or labelled as an emergency stop device	N/A
	A machine which is equipped with cableless control shall have a means of automatically initiating the stopping of the machine and of preventing a potentially hazardous operation	N/A

Clause	Requirement - test	Verdict
9.2.7.4	Series data communication	-
	In a machine where the control of safety-related functions relies on series data transfer, correct communications shall be ensured by using an error detection method that is able to cope with up to three error bits in any command sequence	N/A
9.2.7.5	Use of more than one operator control station	-
	Where a machine has more than one operator control station, measures shall be taken to ensure that only one control station can be enabled at a given time	N/A
	An indication of which operator control station is in control of the machine shall be provided at suitable locations as determined by the risk assessment of the machine	N/A
9.2.7.6	Battery-powered operator control stations	-
	A variation in the battery voltage shall not cause a hazardous condition	N/A
	If one or more potentially hazardous motions are controlled using a battery-powered operator control station, a clear warning shall be given to the operator when a variation in battery voltage exceeds specified limits	N/A
	Under those circumstances, the operator control station shall remain functional long enough to put the machine into a non- hazardous condition	N/A
9.3	Protective interlocks	-
9.3.1	Reclosing or resetting of an interlocking safeguard	-
	The reclosing or resetting of an interlocking safeguard shall not initiate machine motion or operation	P
9.3.2	Overtravel	-
	Use of a position sensor or limit switch	P
9.3.3	Operation of auxiliary functions	-
	The correct operation of auxiliary functions shall be checked by appropriate devices	P
	Use of appropriate interlocking	P
9.3.4	Interlocks between different operations and for contrary motions	-
	Interlocking shall be provided against incorrect operation	P
9.3.5	Reverse current braking	-

Clause	Requirement - test	Verdict
	Use of reverse current braking	**N/A**
9.4	Control functions in the event of failure	**-**
9.4.1	General requirements	**-**
	Provision of control functions in case of failure according to the level of risk assessment	**P**
9.4.2	Measures to minimize risk in the event of failure	
9.4.2.1	Use of proven circuit techniques and components	**P**
9.4.2.2	Provisions for redundancy	**N/A**
9.4.2.3	Use of diversity	**N/A**
9.4.2.4	Functional	**N/A**
	Carried out automatically by the control system or manually by inspection	**P**
9.4.3	Protection against maloperation due to earth faults, voltage interruptions and loss of circuit continuity	**P**
9.4.3.1	Earth faults	**-**
	Bonding to the protective bonding circuit may be provided according to 8.2 and the devices may be connected as described in 9.1.4	**P**
9.4.3.2	Voltage interruptions	**-**
	Where a memory device is used, proper functioning in the event of power failure shall be ensured to prevent any loss of memory that can result in a hazardous condition	**P**
9.4.3.3	Loss of circuit continuity	**-**
	Where the loss of continuity of safety-related control circuits depending upon sliding contacts can result in a hazardous condition, appropriate measures shall be taken	**N/A**
10	Operator interface and machine-mounted control devices	
10.1	General	
10.1.1	General device requirements	
	As far as is practicable, those devices shall be selected, mounted, and identified or coded according to IEC 60073 and IEC 60447	**P**
10.1.2	Location mounting	**-**
	Appropriate location mounting for machine-mounted and hand-operated control devices	**P**

Clause	Requirement - test	Verdict
10.1.3	Protection	-
	Operator and machine mounted control devices shall withstand the stress of expected use	P
	The operator interface control devices shall have a min. degree of protection : IPXXD	P
10.1.4	Position	-
	Position sensors shall not be damaged in the event of overtravel	P
	Position sensors used in circuits with safety-related functions either shall have positive opening operation or shall provide similar reliability	P
10.1.5	Portable and pendant control stations	-
	Portable and pendant control stations and their control devices shall be so selected and arranged as to minimize the possibility of inadvertent machine operations caused by shocks and vibrations	N/A
10.2	Push-buttons	-
10.2.1	Colours	-
	Push-button actuators shall be colour-coded according to table 2	P
10.2.2	Markings	-
	Use of adequate markings for push-buttons	P
10.3	Indicator lights and displays	-
10.3.1	Modes of use	-
	Indication and/or confirmation	P
10.3.2	Colours	
	Colour-coded according to table 3 (Unless otherwise agree between the supplier and the user)	N/A The supplier and the user have the agreement
10.3.3	Flashing lights	-
	Use of flashing lights	N/A
10.4	Illuminated push-buttons	-
	Colour-coded according to table 2 and 3	P

Clause	Requirement - test	Verdict
10.5	Rotary control devices	-
	Devices having a rotational member shall be mounted to prevent rotation of the stationary member (Friction alone shall not be sufficient)	N/A
10.6	Start devices	
	Shall be constructed and mounted to minimise inadvertent operation	P
10.7	Devices for emergency stop	-
10.7.1	Location	-
	Devices for emergency stop shall be readily accessible	
	Emergency stop devices shall be located at each operator control station and at other locations where the initiation of an emergency stop can be required	P
10.7.2	Types	-
	Use of type - a push-button operated switch - a pull-cord operated switch - a pedal-operated switch without a mechanical guard	P a push-button operated switch
	Shall be of the self-latching type and shall have positive opening operation	P
10.7.3	Restoration of normal function after emergency stop	-
	It shall not be possible to restore an emergency stop circuit until all emergency stop devices have been manually reset	P
10.7.4	Actuators	-
	Shall be coloured Red and background be coloured Yellow	P
	The actuator of a push-button operated switch shall be of the palm or mushroom head type	P
10.7.5	Local operation of the supply disconnecting device to effect emergency stop	-
	The supply disconnecting device may be locally operated to serve the function of emergency stop when : - readily accessible - of the type described in 5.3.2 a), b) or c)	P
	It shall meet the colour requirements of 10.7.4	P
10.8	Devices for emergency switching off	-

Clause	Requirement - test	Verdict
10.8.1	Location	-
	Emergency switching off devices shall be located as necessary for the given application	P
10.8.2	Types	-
	The type of device for emergency switching off include : - a push-button operated switch; - a pull-cord operated switch	P
	The devices shall be of the self-latching type and shall have positive (or direct) opening operation	P
	The push-button operated switch may be in a break-glassenclosure	N/A
10.8.3	Restoration of normal function after emergency switching off	-
	It shall not possible to restore an emergency switching off circuit until the emergency switching off device has been manually reset	N/A
10.8.4	Actuators	-
	Shall be coloured RED	N/A
	The background immediately around the device actuator should be coloured YELLOW	P
	The actuator of a push-button operated emergency switching off device shall be of the palm or mushroom head type	P
	Local operation of the supply disconnecting device to effect emergency switching off	-
	Where the supply disconnecting device is to be locally operated for emergency switching off, it shall be readily accessible and should meet the colour requirements of 10.8.4	P
10.9	Displays	-
	Displays shall be selected and installed in such a manner as to be visible from the normal position of the operator	P
11	Electronic	-
11.1	General	-
11.2	Basic requirements	-
11.2.1	Inputs and outputs	-
	Status indication of all digital inputs and outputs should be provided	P
11.2.2	Equipotential bonding	-

Clause	Requirement - test	Verdict
	Electrically bonded together according to the supplier's specifications	P
11.3	Programmable equipment	-
11.3.1	Programmable controllers	-
	Programmable controllers shall conform to relevant IEC standards	N/A
11.3.2	Memory retention and protection	-
	Means shall be provided to prevent memory alternation by unauthorized persons and the requirements detailed in 9.4.3.2 shall apply	N/A
11.3.3	Software verification	-
	Shall have means for verifying	N/A
11.3.4	Use in safety-related functions	-
	Programming electronic equipment shall not be used for category 0 emergency stop functions	N/A
12	Controlgear: location, mounting, and enclosures	-
12.1	General requirements	-
12.2	Location and mounting	-
12.2.1	Accessibility and maintenance	-
	All controlgears can be identified without moving or the wiring	N/A
	Replacement without dismantling other equipment or parts of the machine	P
	Terminals not associated with controlgear shall also comply with the requirements mentioned above	P
	Facilitate operation and maintenance from the front	P
	Use of special tools(if necessary)	N/A
	If access is required for regular maintenance or adjustment, the devices shall be located between 0.4 m and 2.0 m above the severing level	P
	It is recommended that terminals be at least 0.2 m above the servicing level and so placed that connectors and cables can be easily connected to them	N/A
	Except those for operating, indicating, measuring and cooling, no devices shall be mounted on doors, and normally removable access covers, of enclosures	P
	If control devices are connected through plug-in arrangements, their association shall be made clear by type(shape), marking or designation, singly or in combination	N/A

Clause	Requirement - test	Verdict
	Plug-in devices shall be provided with non-interchangeable features	**N/A**
	Use of plug/socket combinations shall be unobstructed access	**N/A**
12.2.2	Physical separation or grouping	**-**
	Non-electrical parts and devices not directly associated with the electrical equipment shall not be located within enclosures containing controlgear	**P**
	Devices such as solenoid valves should be separated from the other electrical equipment	**P**
	Control devices mounted in the same location and connected to the supply voltage, or to both supply and control voltages, shall be grouped separately from those connected only to the control voltages	**P**
	Terminals shall be separated into groups for : - power circuits; - associated control circuits - other control circuits, fed from external sources	**P**
	The clearances and creepage distances specified for the devices shall be maintained	**P**
12.2.3	Heating	**-**
	Heat generating components shall be located so that the temperature of each component in the vicinity remains within the permitted limit	**P**
12.3	Degrees of protection	**-**
	Enclosures of controlgear : at least IP 22	**P**
12.4	Enclosures, doors and openings	**-**
	Enclosure shall be constructed using materials capable of withstanding the mechanical, electrical and thermal stresses	**P**
	Fasteners used to secure doors and covers should be of the captive type	**P**
	Windows provided for viewing internally mounted indicating devices shall be of a material suitable to withstand mechanical stress and chemical attack	**P**
	It is recommended that enclosures doors shall have : - Not wider than 0.9 m - Vertical hinges - Lift-off type - Angle of opening at least 95。	**N/A**
	If enclosures which readily allow a person fully to enter, the relevant requirements specified in this clause shall be comply	**N/A**
	The joints or gaskets of doors, lids, covers and enclosures shall withstand the chemical effects of the aggressive liquids, vapours, or gases used on the machine	**N/A**

Clause	Requirement - test	Verdict
	The means used to maintain the degree of protection of an enclosure on doors, lids and covers that require opening or removal for operation or maintenance shall be secured	P
	The degree of protection for all openings in the enclosures shall be secured	P
	Openings for cable shall be easily re-opened on site	P
	There shall be no opening between enclosures containing electrical equipment and compartments containing coolant, lubricating or hydraulic fluids, or those into which oil, other liquids, or dust can penetrate	P
	The requirement mentioned above does not apply to electrical devices specially designed to operate in oil nor to electrical equipment in which coolants are used	N/A
	Where there are holes in an enclosure for mounting purpose, the degree of protection for the enclosure shall be secured	P
	Equipment that, can attain a surface temperature sufficient to cause a risk of fire or harmful effect to an enclosure material, the relevant requirements shall be complied	P
12.5	Access to controlgear	-
	The min. dimensions of gangways in front of and between controlgear shall be according to 481.2.4 of IEC 60364-4-481	N/A
	Doors in gangways and for access to electrical operating areas shall: - be at least 0.7 m wide and 2.0 m high; - open outward; - have a means to allow opening from the inside without the use of a key or tool	N/A
13	Conductors cables	-
13.1	General requirements	-
	Conductors and cables shall be selected so as to be suitable for the operating conditions and external influences	P
13.2	Conductors	-
	Conductors shall be of copper	P
	Conductors of any other material shall have a nominal crosssectional area such that, carrying the same current, the max. temperature shall not exceed the value given in table 4	N/A
	If aluminium is used, the cross-sectional area shall be at least 16 mm2	N/A

Clause	Requirement - test	Verdict
	All conductors that are subject to frequent movement shall have flexible stranding of class 5 or class 6 (see table C.4)	P
13.3	Insulation	-
	Dielectric strength test for insulation conductors and cables : - 2000 V a.c. for a duration of 5 min.(for operating voltage higher than 50 V a.c.or 120 V d.c.) - 500 V a.c. for a duration of 5 min.(for separate PELV circuit)	N/A
	The mechanical strength and thickness of the insulation shall not be damaged in operation or during laying, especially for cables pulled into ducts	P
13.4	Current-carrying capacity in normal service	-
	Max. allowable temperature for conductors shall not exceed the values given in table 4	P
13.5	Conductor and cable voltage drop	-
	The voltage drop for conductors and cables shall not exceed 5% of the nominal voltage	P
13.6	Minimum cross-section area	-
	To ensure adequate mechanical strength, the cross-sectional area of conductors should not be less than as shown in table 6	P
13.7	Flexible cables	-
13.7.1	General	-
	Flexible cables shall have class 5 or class 6 conductors	P
	Cables that are subjected to severe duties shall be of adequate construction	N/A
13.7.2	Mechanical rating	-
	The tensile stress for copper conductors shall not exceed 15 N/mm2 of the copper cross-sectional area	P
	If the demands of the application exceed the tensile stress limit of 15 N/mm2, cables with special construction features should be used and the allowed max. tensile stress strength should be agreed with the cable manufacturer	N/A
13.7.3	Current-carry capacity of cables wound on drums	-
	Cables to be wound on drums shall be selected with conductors having a cross-sectional area such that, when fully wound on the drum and carrying the normal service load, the max. allowable conductor temperature is not exceeded	N/A

Clause	Requirement - test	Verdict
	For cables of circular cross-sectional area installed on drums, the max. current-carrying capacity in free air should be derated according to table 7	**N/A**
13.8	Collector wires, collector bars and slip-ring assemblies	**-**
13.8.1	Protection against direct contact	**-**
	Collector wires, collector bars and slip-ring assemblies shall be installed or enclosed by the application of one of the following protective measures: - by partial insulation of live parts - by enclosures or barriers of at least IP2X	**P**
	Min. protection degree of horizontal top surface of barriers or enclosures that are readily accessible : IP4X	**P**
	If the required degree of protection is not achieved, protection by placing live parts out of reach in combination with emergency switching off according to 9.2.5.4.3 shall be applied	**N/A**
	Collector wires and collector bars shall be so placed and/or protected as to : - prevent contact - prevent damage from a swinging load	**P**
13.8.2	Protective conductor circuit	**-**
	Where collector wires, collector bars and slip-ring assemblies are installed as part of the protective bonding circuit, they shall not carry current in normal operation	**N/A**
	The continuity of the protective conductor circuit using sliding contacts shall be ensured by taking appropriate measures	**N/A**
13.8.3	Protective conductor current collectors	**-**
	Not interchangeable with the other current collectors	**N/A**
	such current collectors shall be of the sliding contact type	**N/A**
13.8.4	Removable current collectors with a disconnector function	**-**
	Shall be so designed that the protective conductor circuit is interrupted only after the live conductors have been disconnected, and the continuity of the protective conductor circuit is re-established before any live conductor is reconnected	**N/A**
13.8.5	Clearance in air	**-**
	Shall be suitable for operation in pollution degree 3 conditions	**N/A**
13.8.6	Creepage distances	**-**

Clause	Requirement - test	Verdict
	Shall be suitable for operation in pollution degree 3 conditions	**N/A**
13.8.7	Conductor system sectioning	**-**
	If collector wires or collector bars can be divided into isolated sections, suitable design measures shall be employed to prevent the energization of adjacent sections by the current collectors themselves	**N/A**
13.8.8	Construction and installation of collector wire, collector bar systems and slip-ring assemblies	**-**
	Used for power circuits shall be grouped separately from those used for control circuit	**N/A**
	Shall be capable of withstanding, without damage, the mechanical forces and thermal effects of short-circuit currents	**N/A**
	Removable covers shall not be opened by one person without	**N/A**
	If collector bars are installed in a common metal enclosure, the individual sections of the enclosure shall be bonded together and earthed at several points depending upon their length	**N/A**
	Metal covers of collector bar laid underground or underfloor shall also be bonded together and earthed	**N/A**
	Underground and underfloor collector bar ducts shall have drainage facilities	**N/A**
14	Wiring practices	**-**
14.1	Connections and routing	**-**
14.1.1	General requirements	**-**
	All connections shall be secured against accidental loosening	**P**
	The means of connection shall be suitable for the cross-sectional areas and neutral of the conductors being terminated	**P**
	The connection of two or more conductors to one terminal is permitted (only when the terminal is designed for that purpose)	**N/A**
	One protective bonding circuit conductor shall be connected to one terminal connecting point	**P**
	Soldered connections shall only be permitted if terminals are suitable for soldering	**N/A**
	Terminals on terminal blocks shall be plainly identified to correspond with markings on the diagrams	**P**
	The installation of flexible conduits and cables shall be such that liquids shall drain away from the fittings	**P**
	Means of retaining conductor strands shall be provided (Solder shall not be used for that purpose)	**P**

Clause	Requirement - test	Verdict
	Shielded conductors shall be so terminated as to prevent fraying of strands and to permit easy disconnection	P
	Identification tags shall be legible, permanent, and appropriate for the physical environment	P
	Terminal blocks shall be so mounted and wired, that the internal and external wiring does not cross over the terminals	P
14.1.2	Conductor and cable runs	-
	Shall be run from terminal to terminal without splices or joints	P
	If it is necessary to connect and disconnect cables assemblies, a sufficient extra length shall be provided	N/A
	The terminations of cables shall be adequately supported to prevent mechanical stresses at the terminations of the conductors	P
14.1.3	Conductors of different circuits	-
	Suitable arrangement for conductors of different circuits	P
14.2	Identification of conductors	-
14.2.1	General requirements	-
	Conductors shall be identifiable at each termination according to the technical documentation (see clause 18)	P
	Use of colour-coding for identification of conductors	P
	Colour GREEN or YELLOW should not be used	P No used green an yellow
14.2.2	Identification of the protective conductor	-
	Shall be readily distinguishable by shape, location, marking or colour	P
	When identification is by colour alone, the bicolour combination GREEN-AND-YELLOW shall be used	P
	For the bicolour combination GREEN-AND-YELLOW : one of the colour covers at least 30% and not more than 70 % of the surface of the conductor, the other colour covering the remainder of the surface	P
	Use of graphical symbol	P
14.2.3	Identification of the neutral conductor	-
	The colour shall be Light Blue	P
	Requirements for bare conductors used as neutral conductors	P

Clause	Requirement - test	Verdict
14.2.4	Identification of other conductors	-
	Identification of other conductors shall be by colour, number,	P
	alphanumeric, or a combination of colour and numbers or alphanumeric	P
14.3	Wiring inside enclosures	-
	Panel conductors shall be supported where necessary to keep them in place	P
	Non-metallic ducts shall be permitted only when they are made with a flame-retardant insulating material	P
	Connections to devices mounted on doors or to other movable parts shall be made using flexible conductors according to 13.2	P
	The conductors shall be anchored to the fixed part and to the movable part independently of the electrical connection	P
	Conductors and cables that do not run in ducts shall be adequately supported	P
	Terminal blocks or plug-socket combinations shall be used for control wiring that extends beyond the enclosure	P
14.4	Wiring outside enclosures	-
14.4.1	General requirements	-
	The protection degree shall be ensured when cables or ducts are introduced into the enclosure	P
14.4.2	External	-
	Shall be enclosed in suitable ducts as described in 14.5 except for suitably protected cables	P
	Fittings used with ducts or multiconductor cable shall be suitable for the physical environment	P
	Flexible conduit or flexible multiconductor cable shall be used where it is necessary to employ flexible connections to pendant push-button stations	N/A
	The weight of the pendant stations shall be supported by means other than the flexible conduit or the flexible multiconductor cable	N/A
	Flexible conduit or flexible multiconductor cable shall be used for connections involving small or infrequent movements	P
14.4.3	Connection to moving elements of the machine	-
	Connection frequently moving parts shall be made using conductors according to 13.2	P
	Flexible cable and flexible conduit shall be so installed as to avoid excess flexing and straining, particularity at the fittings	P

Clause	Requirement - test	Verdict
	Cables subject to movement shall be supported in such a way that there is no mechanical strain on the connection points nor any sharp flexing	P
	If the requirement mentioned above is achieved by using of a loop, it shall have sufficient length to provide for a bending radius of the cable of at least 10 times the diameter of the cable	P
	Flexible cables of machines shall be protected to minimize the possibility of external damage	P
	The cable sheath shall be resistant to the normal wear that can be expected from movement and to the effects of atmospheric contaminants	P
	If cables subject to movement are close to moving parts, it shall have a space of at least 25 mm between the moving parts and the cables	P
	Where the distance mentioned above is not practicable, fixed barriers shall be provided between the cables and the moving parts	N/A
	The cable handing system shall be so designed that the lateral cable angles do not exceed 5 , avoiding torsion in the cable	P
	Measures shall be taken to ensure that at least two turns of flexible cables always remain on a drum	P
	Min. permitted bending radii for the forced guiding of flexible cables shall not less than the values given in table 8	P
	The strength section between two bends in an S-shaped length or a bend into another plane shall be at least 20 times the diameter of the cable	P
	Where flexible conduit is adjacent to moving parts, the construction and supporting means shall prevent damage to the flexible conduit under all conditions of operation	P
	Flexible metallic conduit shall not be used for rapid or frequent movements	P
14.4.4	Interconnection of devices on the machine	-
	The connections shall be made through terminals forming intermediate test points	P
	Such terminals shall be conveniently placed, adequately protected, and shown on the relevant diagrams	P
14.4.5	Plug/socket combinations	-
	Shall be of adequate size and shall have sufficient contact pressure and a wiping action to ensure electrical continuity	P
	Clearances between contacts shall be adequate for the voltages used and shall be maintained during insertion and removal of the connectors	P
	Prevent unintentional contact with live parts at any time	P

Clause	Requirement - test	Verdict
	Protective bonding circuit connection shall be made before any live connections are made, and shall not disconnected until all live connections in the plug are disconnected	P
	Rated at more than 16 A or that remain connected during normal service shall be of a remaining type to prevent unintended disconnection	P
	Rated at 63 A or above shall be of an interlocked type with a switch, so that connection and disconnection is possible only when the switch is in the OFF position	N/A
	If more than one plug-socket combination is used in the same electrical equipment, they shall be clearly identifiable	P
	It is recommended that mechanical coding be used to prevent incorrect insertion	N/A
	According to IEC 60309-1 or of a type used for domestic application shall not be used for control circuits	N/A
14.4.6	Dismantling for shipment	-
	Terminals shall be suitably enclosed and plug/socket combinations shall be protected from the physical environment during transportation and storage	P
14.4.7	Additional conductors	-
	Spare conductors shall be connected to spare terminals or isolated to prevent contact with live parts	N/A
14.5	Ducts, connection boxes and other boxes	-
14.5.1	General requirements	-
	Min. protection degree for ducts : IP 33	P
	Appropriate protection for conductors insulation	P
	Drain holes of 6 mm diameter are permitted	P
	Ducts and cables trays shall be rigidly supported and positioned at a sufficient distance from moving parts	P
	In areas where human passage is required, the ducts and cable trays shall be mounted at least 2 m above the working surface	N/A
	Ducts shall be provided only for mechanical protection	N/A
	Cable trays that are partially covered should not be considered to be ducts or cable trunking system, and the cables used shall be suitable for installation on cable trays	N/A
14.5.2	Percentage fill of ducts	-
	The dimensions and arrangement of the ducts be such as to facilitate the insertion of the conductors and cables	P

Clause	Requirement - test	Verdict
14.5.3	Rigid metal conduit and fittings	-
	Shall be of galvanized steel or of a corrosion-resistant material	P
	Conduits shall be securely held in place and supported at each end	P
	Fittings shall be threaded	P
	Where threadless fittings are used, the conduit shall be securely fastened to the equipment	P
	The conduit shall not be damage and the internal diameter of the conduit shall not be effectively reduced when it is bent	P
14.5.4	Flexible metal conduit and fittings	-
	Flexible metal tubing and suitable for the expected physical environment	P
14.5.5	Flexible non-metal conduit and fittings	-
	Shall be resistant to kinking and suitable for the expected physical environment	N/A
14.5.6	Cable trunking systems	-
	Shall be rigidly supported and clear of all moving or contaminating portions of the machine	P
	Covers shall be shaped to overlap the sides; gasket shall be permitted	P
	Covers shall be attached to cable trunking systems by hinges or chain and held closed by means of captive screws or other suitable fasteners	P
	On horizontal cable trunking systems, the cover shall not be on the bottom	P
	Where the cable trunking system is furnished in sections, the joints between sections shall fit tightly but need not be gasketed	P
	The only openings permitted shall be those required for wiring or for drainage	P
	Cable trunking systems shall not have opened but unused knockouts	P
14.5.7	Machines compartments and cable trunking systems	-
	Are isolated from coolant or oil reservoirs and are entirely enclosed	P
	Conductors run in enclosed compartment and cable trunking systems shall be so secured and arranged that they are not subject to damage	P
14.5.8	Connection boxes and other boxes	-
	Shall be readily accessible for maintenance	P
	Shall provide protection against the ingress of solid bodies and liquids	P

Clause	Requirement - test	Verdict
	Shall not have opened but unused knockouts nor any other opening and shall be so constructed as to exclude materials such as dust, flyings, oil, and coolant	P
14.5.9	Motor connection boxes	-
	Shall enclose only connections to the motor and motor-mounted devices	P
15	Electric motors and associated equipment	-
15.1	General requirements	-
	Electric motor should conform to the requirements of IEC 60034-1	P
	Motor control equipment shall be located and mounted according to clause 12	P
15.2	Motor enclosures	-
	Protection degree shall be at least IP 23	P
15.3	Motor dimensions	-
	As far as is practicable, the dimensions of the motors shall comply with IEC 60072-1 and IEC 60072-2	P
15.4	Motor mounting and compartments	
	Each motor and its associated couplings, belts and pulleys, or chains, shall be so mounted that they are adequately protected and are easily for inspection	P
	Shall be such that all motor hold-down means can be removed and all terminal boxes are accessible	P
	The proper cooling shall be ensured and the temperature rise remains within the limits of the insulation class	P
	Motor compartment should be clean and dry, and shall be ventilated directly to the exterior of the machine	P
	The vents shall be such that ingress of swarf, dust, or water spray is at an acceptable level	P
	There shall be no opening between the motor compartment and any other compartment that does not meet the motor compartment requirements	P
	If a conduit or pipe is run into the motor compartment from another compartment not meet the motor compartment requirements, any clearance around the conduit or pipe shall be sealed	P
15.5	Criteria for motor selection	-
	Shall be selected according to the anticipated service and physical environment conditions	N/A
15.6	Protective devices for mechanical brakes	-

Clause	Requirement - test	Verdict
	Operation of the overload and overcurrent protective devices for mechanical brake actuators shall initiate the simultaneous de-energization (release) of the associated machine actuators	P
16	Accessories and lightning	-
16.1	Accessories	-
	Socket-outlets for accessory equipment shall comply :	-
	Should conform to IEC 60309-1 (if this is not possible, they should be clearly marked with the voltage and current ratings)	P
	The continuity of the protective bonding circuit to the socket- outlet shall be ensured	P
	All unearthed conductors : Overcurrent or overload protection according to 7.2 and 7.3 separately from the protection of other circuits	N/A
	If the power supply to the socket outlet is not disconnected by the supply disconnecting device, the clause 5.3.5 shall apply	N/A
16.2	Local lighting of the machine and equipment	-
16.2.1	General	-
	Connections to the protective bonding circuit according to 8.2.2	N/A
	The ON-OFF switch shall not be incorporated in the lampholder or in the flexible connecting cords Stroboscopic effects from lights shall be avoided	N/A
16.2.2	Supply	-
	The nominal voltage of the local lighting circuit shall not exceed 250 V	N/A
	Lighting circuits shall be supplied from one of the sources specified in this clause	N/A
16.2.3	Protection	-
	Local lighting shall be protected according to 7.2.6	N/A
16.2.4	Fittings	-
	Adjustable lighting fittings shall be suitable for the physical environment	N/A
	The lampholders shall be : - according to the relevant IEC publication; - constructed with an insulating material protecting the lamp cap so as to prevent unintended contact	N/A
	Reflectors shall be supported by a bracket and not by the lampholder	N/A

Clause	Requirement - test	Verdict
17	Marking, warning signs and reference designations	-
17.1	General	-
	The electrical equipment shall be marked with the supplier's name, trade mark, or other identifying symbol and, when required, with a certification mark	P
	Shall be of sufficient durability to withstand the physical environment involved	P
17.2	Warning	-
	Enclosures shall be marked with the warning sign	P
	The warning sign shall be plainly visible on the enclosure door or cover	P
17.3	Functional identification	-
	Control devices, visual indicators and displays, used in man- machine interface shall be clearly and durably marked with regard to their functions either on or adjacent to the item	P
	Preference should be given to the use of standard symbols given in IEC 60417 and ISO 7000	P
17.4	Marking of control equipment	P
	Control equipment shall be legibly and durably marked in a way that is plainly visible after the equipment is installed	P
	A nameplate giving the relevant information specified in this clause shall be attached to the enclosure	P
	The full-load current shown on the nameplate shall be sufficient	P
17.5	Reference designations	-
	All enclosures, assemblies, control devices, and components shall be plainly identified with the same reference designations as shown in the technical documentation	P
	Where size or location preclude the use of an individual reference designation, group reference designation shall be used	N/A
18	Technical documentation	-
18.1	General	-
	The information necessary for installation, operation, and maintenance of the electrical equipment of a machine shall be supplied in the form of drawings, diagrams, charts, tables and instructions	P
	The information shall be in an agreed language	P

Clause	Requirement - test	Verdict
	The supplier shall ensure that the technical documentation in this clause is provided with each machine	P
18.2	Information to be provided	-
	The information provided with the electrical equipment shall include the requirements specified in this clause	P
18.3	Requirements applicable to all documentation	-
	Relevant requirements according to 18.4 to 18.10 shall be complied	P
18.4	Basic information	-
	Min. requirements for the technical documentation shall be contained	P
18.5	Installation diagram	-
	Use and requirements for installation diagram	P
18.6	Block (system) diagrams and function diagrams	-
	Use and requirements for system (block) diagram	N/A
18.7	Circuit diagrams	-
	Use and requirements for circuit diagrams	P
18.8	Operating manual	-
	Use and requirements for operating manual	P
18.9	Maintenance manual	-
	Use and requirements for maintenance manual	P
18.10	Parts list	-
	Use and requirements for parts list	P
19	Testing and verification	-
19.1	General	-
	When these tests are performed, it is recommended that they follow the sequence listed	p
	When the electrical equipment is modified, the requirements stated in 19.7 shall apply	p
19.2	Continuity of the protective bonding circuit	-

Clause	Requirement - test	Verdict
	Test conditions : a current of at least 10 A at 50 Hz or 60 Hz	**N/A**
	The measured voltage shall not exceed the values given in table 9	**N/A**
19.3	Insulation resistance tests	**-**
	Test conditions: 500 V d.c.	**-**
	The measured values shall not less than 1 MΩ	**-**
19.4	Voltage	**-**
	Test conditions : - at least 1 second - test voltage is twice the rated supply voltage of the equipment or 1000 V, whichever is greater - frequency of 50/60 Hz - supplied from a transformer with a min. rating of 500 VA	**P**
	Shall not breakdown	
19.5	Protection against residual voltages	
	Tests shall be performed to ensure compliance with 6.2.4	**P**
19.6	Functional tests	**-**
	The functions of electrical equipment shall be tested (particularly those related to safety and safeguarding)	**P**
19.7	Retesting	
	Where a portion of the machine and its associated equipment is changed or modified, that portion shall be reverified and retested, as is appropriate	**P**

TEST REPORT

MD DIRECTIVE 2006/42/EC &LVD DIRECTIVE 2014/35/EU
PROJECT NO. 96221559-4

EN 12409:2008+A1:2011

Plastics and rubber machines - Thermoforming machines - Safety requirements

ZHEJIANG SAYEAH MACHINERY CO.,LTD.

MULTI-POSITION THERMOFORMING MACHINE

3.4 EN 12409:2008+A1:2011 test report

Test item particulars - **MULTI-POSITION THERMOFORMING MACHINE**
Possible test case verdicts: - Test case does not apply to the test object : N(.A.) - Test object does meet the requirement : P(Pass) - Test object does not meet the requirement : F(Fall)
Testing EN 12409:2008+A1:2011 Plastics and rubber machines - Thermoforming machines -Safety requirements
General remarks: The test results presented in this report relate only to the object tested. This report shall not be reproduced, except in full, without the written approval of the issuing testing laboratory.
Test product information: **Model : FSCT820/650-3** **Parameters : Voltage : 380VAC** **Power: 82kW** **Frequency: 50Hz** Same construction as basic model except enclosure.

AUDIT INFORMATION:		
Description of Test	Standard No.	EN 12409:2008+A1:2011
Test Engineer by	Michael	Signature: Michael
Reviewer by	Jack .H	Signature:
Test Result	**Pass**	**May 9, 2022**
SAPO CERTIFICATION & TESTING LABORATORY LIMITED		

Clause	Requirement - test	Verdict
5	Safety requirements and/or protective measures	-
5.1	General	-
	Machinery shall comply with the safety requirements and/or protective measures of this clause. In addition, the machine shall be designed according to the principles of EN ISO 12100-2:2003 for relevant but not significant hazards which are not dealt with by this document	P
5.2	General safety requirements and/or protective measures relating to all units	-
5.2.1	Access to danger zones	-
5.2.1.1	General	-
	Machines shall be designed and constructed as far as possible such that there is no access to danger zones, e. g. by safe machine design, fixed guards.	P
5.2.1.2	Protective measures when access into a danger zone is required	P
5.2.1.3	Additional requirements where whole body access is possible	-
5.2.1.4	Drive and power transmission systems	-
	Access to dangerous movements of drive and power transmission systems including, for example, shafts, belts, chains, linkages, clutches and gears shall be prevented by design. If this cannot be achieved completely access shall be prevented by fixed guards in accordance with EN 953:1997, 3.2	P
5.2.2	Electrical equipment	-
5.2.2.1	General	-
	The electrical equipment shall be in accordance with EN 60204-1:2006.	P
5.2.2.2	Supply disconnecting (isolating) device	-
	The supply disconnecting (isolating) devices shall be in accordance with EN 60204-1:2006, 5.3.2 and 5.3.3	P
5.2.2.3	Unexpected start-up	-
	Hazards due to unexpected start-up have to be prevented in accordance with EN 1037:1995. See also EN 60204-1:2006, 5.4.	P
5.2.2.4	Protection against direct contact	-
	The protection against direct contact shall be in accordance with 6.2 of EN 60204-1:2006	P
5.2.2.5	Protection against indirect contact	-

Clause	Requirement - test	Verdict
	The protection against indirect contact shall be in accordance with 6.3 of EN 60204-1:2006	P
5.2.3	Unintended gravity fall of raised elements	-
5.2.3.1	General	-
	Machines shall be designed and constructed such that there is no danger resulting from raised elements falling due to gravity, e.g. in the event of failure of energy supply or fault.	P
5.2.3.2	Fluid drives	-
	For fluid drives the movement of the machine axes shall be stopped by a valve such that any movement can only be initiated or maintained as long as a command signal is maintained. Cancelling the command signal shall stop the movement or possibly reverse it if this does not create further hazards.	P
	a) a controllable non-return valve or a shut-off valve, which is fixed directly or if this is not possible by a minimum length of steel pipework to the drive element, e.g. cylinder;	P
	b) a friction-locked clamping device;	P
	c) gears that have sufficient inherent resistance to motion to prevent unintended unpowered movement under gravitational forces, e.g. self-locking gear;	P
	d) a positive-locking pawl that shall either be engageable at any height of the parts creating the gravity fall hazard or interlocked with an interlocking guard with guard locking so that access to the danger zone is prevented until the pawl is effective. When a pawl is applied to a rotating part, it shall act in both direction of rotation if rotation in either direction could cause a gravity fall.	P
5.2.3.3	Electrical drives	-
5.2.3.3.1	Raising of elements achieved by using a control system in accordance with PLr 'c'	P
5.2.3.3.2	Raising of elements achieved by using a control system in accordance with PLr 'd'	N
5.2.4	Pneumatic equipment	-
	Pneumatic equipment shall be in accordance with EN 983:1996. Flexible hoses shall be installed so that they do not have contact with moving and/or hot machine parts.	P
5.2.5	Hydraulic equipment	-
	Hydraulic equipment shall be in accordance with EN 982:1996. Flexible hoses shall be installed so that they do	P

Clause	Requirement - test	Verdict
	not have contact with moving and/or hot machine parts.	
5.2.6	Precautions for emergencies	-
	Measures to give protection in emergency situations shall be taken in accordance with EN ISO 12100-2:2003,5.5.2 and 5.5.3.	P
5.2.7	Noise	-
5.2.7.1	Main sources of noise	-
	-Drive motors; -power transmission systems; - pneumatic systems; - vacuum systems; -ventilators; -hydraulic systems; -control valves; - pipework; -perforation of sheet by spiked chain.	P
5.2.7.2	Noise reduction at source by design	P
5.2.7.3	Noise reduction by protective measures	P
5.2.7.4	Information connected with noise hazards	P
5.2.8	Inhalation of hazardous dusts, fumes and gases	P
	Machines shall be designed and constructed such that appropriate extraction systems may be connected; see also 7.2.5. The control system of the machine shall be designed such that the machine cannot be run without the extraction system in operation.	P
5.2.9	Hot surfaces	-
	Protection shall be given in accordance with EN ISO 13732-1:2006 against contact of parts of the body with hot surfaces in areas where people have to work or may pass by. Suitable measures are e. g. shielding, personal protective equipment or warning signs. Requirements for specific units are given in 5.3.	P
5.2.10	Ergonomics	-
	Machine operator working places shall be designed and constructed in accordance with ergonomic requirements, described in EN 614-1.2006.	P
5.2.11	Unexpected start up	-
	Equipment preventing unexpected start up or continuing operation shall be designed and constructed inaccordance with EN 1037:1995.	P
5.2.12	Setting mode	-

Clause	Requirement - test	Verdict
	Thermoforming machines shall be designed such that machine setting, teaching, process changeover, fault finding, cleaning and maintenance can be carried out with the production mode safety systems effective or the machine safely set to standstill	P
5.2.13	Access during production	-
	When it is necessary to check the correct operation (e. g. checking correct perforation by visual inspection) by opening an interlocking guard with the machine running at production speed, the following requirements shall apply:	P
	- the production safeguard shall be an interlocked guard with guard locking in accordance with EN 953, 3.6;	P
	- electro-sensitive protective equipment (light curtain) in accordance with EN 61496-1:2004, type 4 shall be positioned behind the interlocking guard	P
	- the interlocking guard shall remain locked until the electro-sensitive protective equipment is activated by means of a key operated switch. Subsequent interruption of the light curtain with the interlocking guard open shall at least stop the units or stations to which the interlocking guard gives access	N
5.2.14	Laser devices	-
	Where laser devices, for example laser sensors are used, warning signs shall be provided in close proximity to the device.	N
5.2.15	Permanent means of access	-
	Working platforms, steps and walkways shall be in accordance with EN ISO 14122-1:2001, EN ISO 14122-2:2001, EN ISO 14122-3:2001 and EN ISO 14122-4:2004 to prevent the risk of slipping, tripping or falling.	P
5.2.16	Common safeguarding system	-
	If a common safeguarding system, such as a perimeter fence, is used to control access to more than one unit and access to one unit permits access to other units	P
5.2.17	Fixing systems of fixed guards	
	Fixed guards shall be so designed, that their fixing systems remain attached to the guards or to the machinery when the guards are removed	P
5.3	Specific safety requirements and/or	P
5.3.1	protective measures relating to individual units	P
	Continuous sheet unwind unit	P

Clause	Requirement - test	Verdict
5.3.1.1	Safety distances	P
	Safety distances shall be in accordance with EN ISO 13857:2008, Tables 1, 3 and 4.	P
5.3.1.2	Mechanical hazards	P
5.3.1.2.1	Impact, crushing and shearing hazards due to movement of the roll lifting devices shall be prevented by:	P
	- fixed guards in accordance with EN 953:1997, 3.2; or	P
	- using a hold to run control device in accordance with EN ISO 12100-1:2003, 3.26.3 whereby the speed of the roll lifting device shall not exceed 25 mm/s; or	P
	- using a two hand control in accordance with EN 574:1996, type I.	N
5.3.1.2.2	Crushing and shearing hazards between sheet roll support shafts and their bearings during loading shall be prevented by:	P
	Crushing and shearing hazards between sheet roll support shafts and their bearings during loading shall be prevented by:	P
	using a two hand control in accordance EN 574:1996, type I.	N
5.3.1.2.3	Drawing-in or trapping hazards between rotating haul-off rolls and/or by moving parts of haul-off roll drives shall be prevented by fixed guards in accordance with EN 953:1997, 3.2.	P
5.3.1.2.4	Impact and crushing hazards due to sheet rolls and shafts falling from their bearing shall be prevented, for example by the use of a retaining device such as bearing shells, retention pins or locking bolts	P
5.3.1.2.5	Impact and crushing hazards due to sheet rolls falling from shafts, which are supported only at one end, shall be prevented, for example by the use of a retaining device such as bearing shells, retention pins or locking bolts.	P
5.3.1.2.6	Impact and crushing hazards due to instability of the unwind unit causing it to fall over shall be prevented by design, e. g. by using anchorages, being sufficiently stable to withstand unwinding forces.	P
5.3.1.2.7	Warning signs shall be used to warn about cutting hazard due to sharp edges. The manufacturer shall recommend the wearing of personal protective equipment, e. g. gloves, in the instruction manual; see 7.2.3.	P
5.3.1.3	Hazards due to electric shock caused by electrostatic phenomena	P
5.3.2	Single sheet feed unit	-

Clause	Requirement - test	Verdict
5.3.2.1	Safety distances	-
	Safety distances shall be in accordance with EN ISO 13857:2008, Tables 1, 3 and 4.	P
5.3.2.2	Mechanical hazards	-
5.3.2.2.1	Crushing, shearing and impact hazards caused by movement of handling devices, sheet or parts of a single sheet magazine shall be prevented by:	P
	- fixed guards in accordance with EN 953:1997, 3.2; or	P
	- protective devices in accordance with 5.2.1.2 and 5.2.1.3.	P
5.3.2.2.2	Drawing-in and trapping hazard caused when sheet is fed to a material intake or conveying system shall be prevented by:	P
	- fixed guards in accordance with EN 953:1997, 3.2; or	P
	- protective devices in accordance with 5.2.1.2 and 5.2.1.3	P
5.3.2.3	Hazards due to a sticking together of sheets	P
	According to the type of material, sometimes in the sheet magazine sheets may stick together which leads to machine trouble. In such cases, the sheet magazine shall have equipment for separation of the sheets in order to prevent manual intervention; see 7.2.13.	P
5.3.2.4	Hazards due to electric shock caused by electrostatic phenomena	P
5.3.3	Material intake	-
5.3.3.1	Safety distances	-
	Safety distances shall be in accordance with EN ISO 13857:2008, Tables 2, 3 and 4.	P
5.3.3.2	Mechanical hazards	P
5.3.3.2.1	Drawing-in or trapping hazards during feeding of sheet into a holding down device shall be prevented by:	P
	- fixed guards in accordance with EN 953:1997, 3.2; or	P
	- protective devices in accordance with 5.2.1.2 and 5.2.1.3.	P
5.3.3.2.2	Crushing or cutting hazards during release of sheet in the area of a conveying system, shall be prevented by:	P
	- fixed guards in accordance with EN 953:1997, 3.2; or	P
	- protective devices in accordance with 5.2.1.2 and 5.2.1.3.	P

Clause	Requirement - test	Verdict
5.3.3.2.3	Cutting hazards during movement of a sharp-edged sheet shall be prevented by:	P
	- fixed guards in accordance with EN 953:1997, 3.2; or	P
	- protective devices in accordance with 5.2.1.2 and 5.2.1.3.	P
5.3.3.2.4	Hazards due to moving parts of adjacent sheet cutting unit	P
	- fixed guards in accordance with EN 953:1997, 3.2; or	P
	- protective devices in accordance with 5.2.1.2 and 5.2.1.3.	P
5.3.3.3	Hazards due to electric shock caused by electrostatic phenomena	P
	If the machine is to be used with materials which accumulates electrostatic charges during sheet feeding, then measures shall be taken to prevent hazards due to electric shock, for example by earthing or the use of ionisation devices; see 7.2.6	N
5.3.4	Conveying equipment	-
5.3.4.1	Safety distances	-
	Safety distances shall be in accordance with EN ISO 13857:2008, Tables 1, 3 and 4.	P
5.3.4.2	Mechanical hazards	-
	Cutting hazards during movement of a sharp-edged sheet shall be prevented by	P
	- fixed guards in accordance with EN 953:1997, 3.2; or	P
	- protective devices in accordance with 5.2.1.2 and 5.2.1.3.	P
5.3.4.2.2	Puncture, penetration and cutting hazards during movement of chain conveyors equipped with spikes or clamps shall be prevented by:	P
	- fixed guards in accordance with EN 953:1997, 3.2; or	P
	- protective devices in accordance with 5.2.1.2 and 5.2.1.3.	P
5.3.4.2.3	Impact and drawing-in or trapping hazards during movement of the sheet or parts of a conveying system shall be prevented by:	P
	- fixed guards in accordance with EN 953:1997, 3.2; or	P
5.3.4.3	- protective devices in accordance with 5.2.1.2 and 5.2.1.3.	P
	Hazards due to electric shock caused by electrostatic phenomena	P
	If the machine is to be used with materials which accumulates electrostatic charges during sheet	P

Clause	Requirement - test	Verdict
	feeding, then measures shall be taken to prevent hazards due to electric shock, for example by earthing or the use of ionisation devices; see 7.2.6.	
5.3.5	Heating, pre-heating and edge heating	-
5.3.5.1	Safety distances	-
	Safety distances shall be in accordance with EN ISO 13857:2008, Tables 1, 3 and 4.	P
5.3.5.2	Mechanical hazards	-
5.3.5.2.1	Crushing, shearing or impact hazards during movement of a heating or pre-heating device shall be prevented by:	-
	- fixed guards in accordance with EN 953:1997, 3.2; or	P
	- protective devices in accordance with 5.2.1.2 and 5.2.1.3.	P
5.3.5.2.2	Drawing-in or trapping hazards caused by rotating rolls (for example heating rolls, diverting rolls or driving rolls) or between sheet and rolls or between fixed machine parts and rotating rolls or moving sheet shall be prevented by:	-
	- fixed guards in accordance with EN 953:1997, 3.2; or	P
	- protective devices in accordance with 5.2.1.2 and 5.2.1.3.	P
5.3.5.3	Hazards due to electrical energy	-
	Access to live parts of the heating elements shall be prevented by enclosures having a minimum degree of protection of IP 20 in accordance with EN 60529:1991. This deviates from EN 60204-1:2006	P
5.3.5.4	Burning hazards	-
	If hot surfaces cannot be guarded in accordance with 5.2.9, e. g. because heating elements could be hot after opening of guards, warning signs shall be provided at appropriate positions on the machine to warn of the danger; see also 7.1.2	P
5.3.5.5	Fire hazards and hazards due to Inhalation of dusts, fumes and gases	-
	Fire hazards and hazardous dusts, fumes and gases, due to overheating of materials, shall be limited by heating system temperature monitoring and control and in addition by one of the following measures	P
	a) the prevention of contact between the material being processed and heating radiators; b) gas or flame detection; c) cutting off the heating system; d) for heating: moving the device out of position; e) inserting protective screens;	P

Clause	Requirement - test	Verdict
	f) installing a prearranged device in order to connect a fire extinguisher; this device shall be (minimum): 1) nozzle(s); 2) suitable pipe connection between the nozzle(s) and the fire extinguisher (located outside the guards).	
5.3.6	Forming station	-
5.3.6.1	Safety distances	-
	Safety distances shall be in accordance with EN ISO 13857:2008, Tables 2, 3 and	P
5.3.6.2	Mechanical hazards	
5.3.6.2.1	Continuous sheet machines	-
	Crushing, shearing or impact hazards during movement of machine parts such as linkages, clamping frames, platens, stretching punches or component feeding/inserting units shall be prevented by one or a combination of the following measures	P
	a) fixed guards in accordance with EN 953:1997, 3.2; b) interlocking guards in accordance with 5.2.1.2 and 5.2.1.3, whereby for the safety related parts of the control system:	P
5.3.6.2.2	Single sheet machines	-
	Crushing, shearing or impact hazards during movement of machine parts such as linkages, clamping frames, platens, stretching punches or component feeding/inserting units shall be prevented by one or a combination of the following measures	N
	a) fixed guards in accordance with EN 953:1997, 3.2; b) interlocking guards in accordance with 5.2.1.2 and 5.2.1.3, whereby for the safety related parts of the control system:	N
	1) PLr 'd' of EN ISO 13849-1:2008 applies in case of non-cyclic manual intervention; or 2) PLr 'd', category 3 of EN ISO 13849-1:2008 applies in case of cyclic manual intervention	N
	c) electro-sensitive protective equipment in accordance with EN 61496-1:2004, type 4, e.g. active optoelectronic protective devices like light beam devices or light curtains;	N
	d) for single sheet machines with manual sheet feed and take-off, where the protective devices in accordance with 5.2.1.3 are not used by: 1) two-hand control devices in accordance with EN 574:1996 type III C; and 2) fixed guards in accordance with EN 953:1997, 3.2 at the sides, the rear and, to the extent that this	N

Clause	Requirement - test	Verdict
	is necessary to prevent access by a second operator, at the front, whereby for the safety distances of EN ISO 13857:2008, Tables 2, 3 and 4 apply	
5.3.6.3	Burning hazards	-
	When hot surfaces, which are necessary for process reasons, cannot be guarded in accordance with 5.2.9, e.g. because dies could be hot after opening of guards, warning signs shall be provided at appropriate positions on the machine to warn of the danger; see also 7.1.2.	P
5.3.7	Finishing station	-
5.3.7.1	Safety distances	-
	Safety distances shall be in accordance with EN ISO 13857:2008, Tables 2, 3 and 4.	P
5.3.7.2	Integrated or downstream finishing stations	-
5.3.7.2.1	Mechanical hazards	-
5.3.7.2.1.1	Continuous sheet machines	-
	Crushing, shearing, impact or cutting hazards during movement of machine parts such as platens, ejectors, rim roll devices or discharge devices shall be prevented by one or a combination of the following measures	P
	a) fixed guards in accordance with EN 953:1997, 3.2;	P
	b) interlocking guards in accordance with 5.2.1.2 and 5.2.1.3, whereby for the safety related parts of the control system:	P
	c) electro-sensitive protective equipment in accordance with EN 61496-1:2004, type 4, e.g. active optoelectronic protective devices like light beam devices or light curtains	P
5.3.7.2.1.2	Single sheet machines	N
5.3.7.2.2	Burning hazards	-
	When hot surfaces, which are necessary for process reasons, cannot be guarded, in accordance with 5.2.9, warning signs shall be provided at appropriate positions on the machine to warn of the danger. See also 7.1.2.	P
5.3.8	Stacking zone	-
5.3.8.1	Adjustment of stacking height	-
	The stacking height shall be adjustable from outside closed guards with the machine process not interrupted	N

Clause	Requirement - test	Verdict
5.3.8.2	Safety distances	-
	Safety distances shall be in accordance with EN ISO 13857:2008, Tables 2, 3 and 4.	P
5.3.8.3	Mechanical hazards	-
5.3.8.3.1	Crushing, shearing or impact hazards caused by the movement of machine parts, for example stacking cages, stacking discs, staking pallets or slides or discharge devices or during movement of residual sheet shall be prevented by:	P
	- fixed guards in accordance with EN 953:1997, 3.2; or - protective devices in accordance with 5.2.1.2 and 5.2.1.3.	P
5.3.8.3.2	Drawing in or trapping hazards caused by the moving conveyor parts shall be prevented by:	-
	- fixed guards in accordance with EN 953:1997, 3.2; or - protective devices in accordance with 5.2.1.2 and 5.2.1.3.	P
5.3.8.4	Intervention during operation or as a result of a malfunction	P
5.3.8.5	Hazards due to electric shock caused by electrostatic phenomena	P
5.3.9	Discharge station	-
5.3.9.1	Safety distances	-
	Safety distances shall be in accordance with EN ISO 13857:2008, Tables 1, 3 and 4	P
5.3.9.2	Mechanical hazards	-
5.3.9.2.1	Discharge stations shall be designed such that access to danger zones in adjacent units is prevented. If this is not possible, the safety requirements and/or protective measures for those units shall apply.	P
5.3.9.2.2	Hazards due to the movement of product or machine parts shall be prevented by limiting to a maximum force of 75 N or kinetic energy of 4 J or contact pressure of 50 N/cm² if access is possible.	P
5.3.9.2.3	Information shall be given in the instruction manual to wear personal protection equipment, e. g. gloves against cutting hazards due to sharp edges; see also 7.2.3.	P
5.3.9.3	Burning hazards	N
	Information shall be given in the instruction manual to wear personal protection equipment, e. g. gloves against hot products; see also 7.2.2.	N

Clause	Requirement - test	Verdict
5.3.10	Residual sheet winding unit	-
5.3.10.1	Safety distances	P
	Safety distances shall be in accordance with EN ISO 13857:2008, Tables 1, 3 and 4	P
5.3.10.2	Mechanical hazards	P
5.3.11	Sheet cutting unit	-
5.3.11.1	Safety distances	-
	Safety distances shall be in accordance with EN ISO 13857:2008, Tables 2, 3 and 4.	P
5.3.11.2	Mechanical hazards	P
5.3.11.2.1	Crushing, shearing or impact hazards during movement of parts of the sheet cutting unit shall be prevented by:	-
	- fixed guards in accordance with EN 953:1997, 3.2; or - protective devices in accordance with 5.2.1.2 and 5.2.1.3	P
5.3.11.2.2	Cutting hazards caused by moving or stationary parts of the sheet cutting unit shall be prevented by:	-
	- design; or - fixed guards in accordance with EN 953:1997, 3.2; or - protective devices in accordance with 5.2.1.2 and 5.2.1.3	P
6	Verification of safety requirements and/or protective measures	P
	Type tests shall be used to verify the safety requirements and/or protective measures in accordance with Table 1.	P
7	Information for use	P

3.5 Earthing continuity test report

Manufacturer: ZHEJIANG SAYEAH MACHINERY CO.,LTD.

- EUT: MULTI-POSITION THERMOFORMING MACHINE
- Test model: FSCT820/650-3
- Ratings: ~; 380v 50Hz
- Test Equipment: Extech Electronics
  Withstanding Voltage/Arc/Insulation/Grounding Tester
  Model: 7740
- Test conditions: 5A/50Hz
- Date: May 9, 2022

Test Point	Diameter of Conductor (mm2)	Test Result-Voltage Drop (V)
Power Supply	2.5	0.08
Control panel	2.5	0.14
Motor 1	3.0	0.51
Motor 2	3.0	0.66
Motor 3	2.5	0.42
Motor 4	3.0	0.48
Motor 5	2.5	0.44
Motor 6	2.5	0.53
Motor 7	3.0	0.35
Motor 8	3.0	0.25
Motor 9	3.0	0.52
Motor 10	3.0	0.42
Motor 11	3.0	0.24
Motor 12	3.0	0.75
Motor 13	2.5	0.47
Motor 14	3.0	0.43
Motor 15	2.5	0.34
Motor 16	3.0	0.25
Motor 17	2.5	0.42
Motor 18	2.5	0.62

3.5 Insulation resistance test report

Manufacturer: ZHEJIANG SAYEAH MACHINERY CO.,LTD.

EUT: MULTI-POSITION THERMOFORMING MACHINE

Test model:

FSCT600/400-2,FSCT600/400-3,FSCT600/400-4,FSDT68/45-3,FSDT68/45-4,FSCT680/450-2,FSCT680/450-3,FSCT680/450-4,FSCT820/650-2,FSCT820/650-3,FSCT820/650-4

Ratings: 1~; 380V; 50Hz

Test Equipment: Extech Electronics

Withstanding Voltage/Arc/Insulation/Grounding Tester

Model: 7740

Test conditions: 10A/50Hz

Date: May 9, 2022

Test Point	Test Result (MΩ)
Power Supply	509
Control panel	549
Motor 1	520
Motor 2	587
Motor 3	591
Motor 4	521
Motor 5	512
Motor 6	525
Motor 7	515
Motor 8	545
Motor 9	542
Motor 10	540
Motor 11	513
Motor 12	517
Motor 13	523
Motor 14	545
Motor 15	540
Motor 16	517
Motor 17	518
Motor 18	523

3.6 Withstand voltage test report

Manufacturer: ZHEJIANG SAYEAH MACHINERY CO.,LTD.

EUT: MULTI-POSITION THERMOFORMING MACHINE

Test model:FSCT600/400-2,FSCT600/400-3,FSCT600/400-4,FSDT68/45-3,FSDT68/45-4,FSCT680/450-2,FSCT680/450-3,FSCT680/450-4,FSCT820/650-2,FSCT820/650-3,FSCT820/650-4

Ratings: 1~; 380V; 50Hz

Test Equipment: Extech Electronics

Withstanding Voltage/Arc/Insulation/Grounding Tester

Model: 7740

Test conditions: 10A/50Hz

Date: May 9, 2022

Test Point	Test Result (MΩ)
Power Supply	Pass
Control panel	Pass
Motor 1	Pass
Motor 2	Pass
Motor 3	Pass
Motor 4	Pass
Motor 5	Pass
Motor 6	Pass
Motor 7	Pass
Motor 8	Pass
Motor 9	Pass
Motor 10	Pass
Motor 11	Pass
Motor 12	Pass
Motor 13	Pass
Motor 14	Pass
Motor 15	Pass
Motor 16	Pass
Motor 17	Pass
Motor 18	Pass

3.7 Airborne noise test report

I. Applicable standards

1. EN ISO 3746: Acoustics-Determination of sound power levels of noise sources using sound pressure—Survey method using an enveloping measurement surface over a reflecting plane.
2. EN ISO 11202: Acoustics—Noise emitted by machinery and equipment—Measurement of emission sound pressure levels at the work station and at other specified positions—Survey method in situ.
3. ISO/TR 11688-1: Acoustics—Recommended practice for the design of low-noise machinery and equipment—Part 1 : Planning.

II. Test instrument

The sound level meter used in the noise measurement is TES1350A manufactured by TES Electrical Electronic Corp. with the following features:

- Portable with light weight & easy operation.
- Measurement range from 35 to 130 dB (A) .
- Type 1 precision.
- With "F" & "S" detect mode in accordance with IEC 651 type 1.
- Built in A-weighting network.
- Equipped with a high prepolarized condenser microphone.
- With automatic & manual display.
- DC output for level recorder.

III. Measurement method

The measurements of this test have been carried out by a hand-held sound level meter, and readings are taken by A-frequency weighting at each measuring position.

For operator positions in process of measurement, the measuring instrument is to be set at a distance of

1 m from the machine and 1.5 m above the floor.

IV. Test environment

The test was carried out in the location of machine inside the factory, and the background noise has been ensure that its measuring value is lower than that of machine.

V. Test result

1. Background

Reading value : 33dB(A)

2. Sound pressure level (machine on "Stand by" and normal load condition)

Position	1	2	3	4	5
Reading (dB (A))	75	76	75	75	76

3. Sound pressure level (machine on full load condition)

Position	1	2	3	4	5
Reading (dB (A))	75	79	75	70	77

4. Sound power level (where the measuring value of sound pressure level exceeds 85 dB(A))

Position	1	2	3	4	5
Readings (dB (A))	-	-	-	-	-
Position	6	7	8	9	Lw
Readings (dB (A))	-	-	-	-	-

The following is the calculation formula of Lw (Sound power level):

Lw = Lpf + 10 x log (S/So)

- Lpf is the A-weighted or frequency bank surface sound pressure level
- S is the area of the measurement surface in square meters: 20 m2
- S0 is 1 m2

Annex: Technical Information

A.1 Declaration of conformity with signature

A.2 Safety pictures

A.3 Mechanical drawing

A.4 Instruction manual

DECLARATION OF CONFORMITY

According to the following Directives

• MD DIRECTIVE **2006/42/EC** &LVD DIRECTIVE **2014/35/EU**

We **ZHEJIANG SAYEAH MACHINERY CO.,LTD.**

WANQUAN DISTRICT INDUSTRAL ZONE, WEST OF CHINA NATIONAL HIGHWAY 104, SUNLOU VILLAGE, WANQUAN TOWN PINGYANG COUNTY, ZHEJIANG PROVINCE

Declare that the machines mentioned hereafter:

Product: MULTI-POSITION THERMOFORMING MACHINE

Test product information:

Model/Parameters:
FSCT600/400-2,FSCT600/400-3,FSCT600/400-4,FSDT68/45-3,FSDT68/45-4,FSCT680/450-2,FSCT680/450-3,FSCT680/450-4,FSCT820/650-2,FSCT820/650-3,FSCT820/650-4

Same construction as basic model except enclosure.
Provided that it is used and maintained in accordance with the generally accepted codes of good practice and the recommendations of the instruction manual, meets the essential safety and health requirements of the Machinery Directive, Low Voltage and Electromagnetic Compatibility Directive. For the most specific risks of this machine, safety and compliance with the essential requirements of the Directive has been based on elements of:

EN ISO 12100: 2010/ Safety of machinery — General principles for design — Risk assessment and risk reduction
EN 60204-1:2018/ Safety of machinery-Electrical equipment of machines-Part 1: General requirements
EN 12409:2008+A1:2011 Plastics and rubber machines - Thermoforming machines -Safety requirements

CE

Signature _____

Name: _____

Qualification: _____

Date of issue: May 9, 2022

A.2 Safety pictures

MULTI-POSITION THERMOFORMING MACHINE

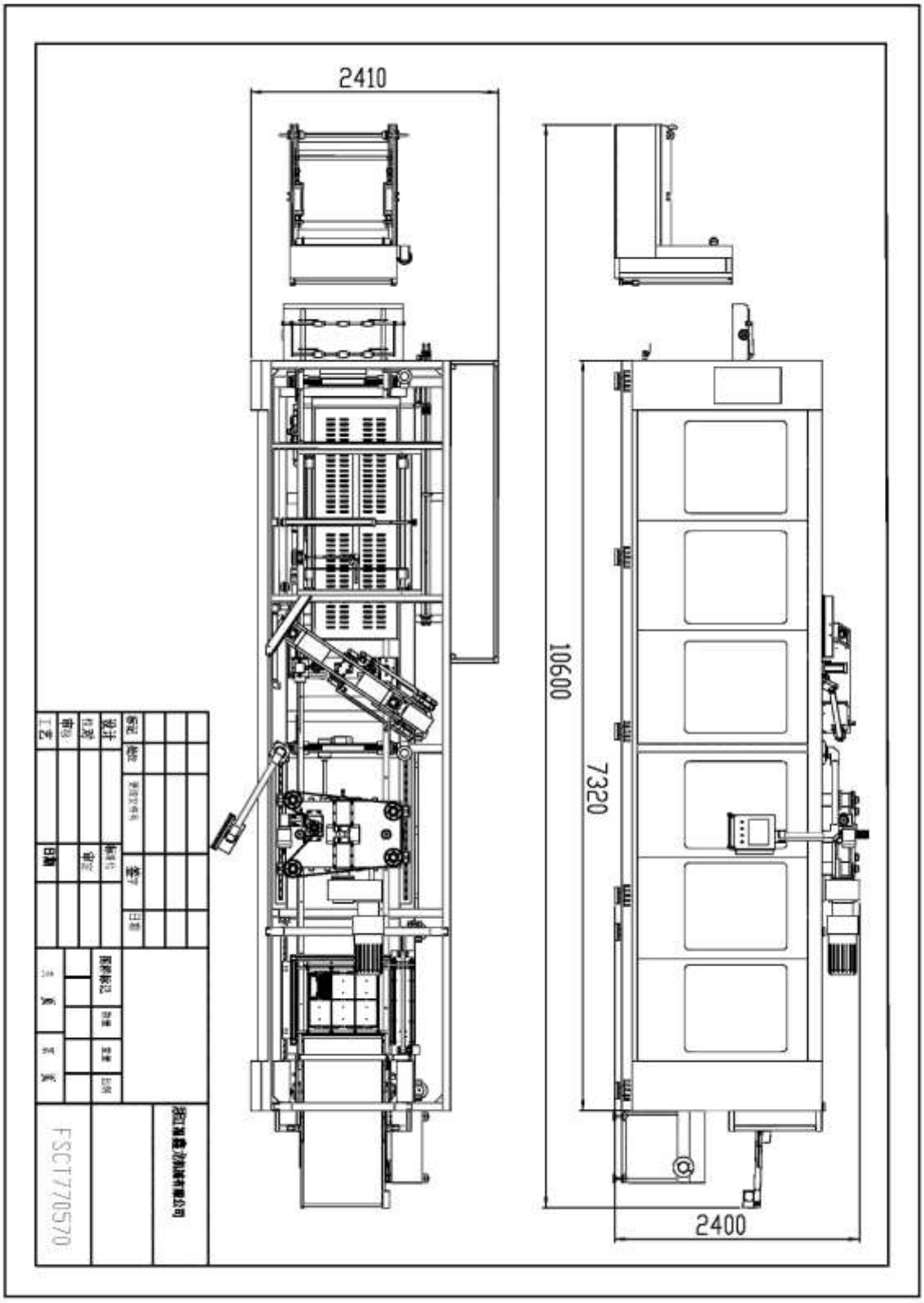

注 意 CAUTION

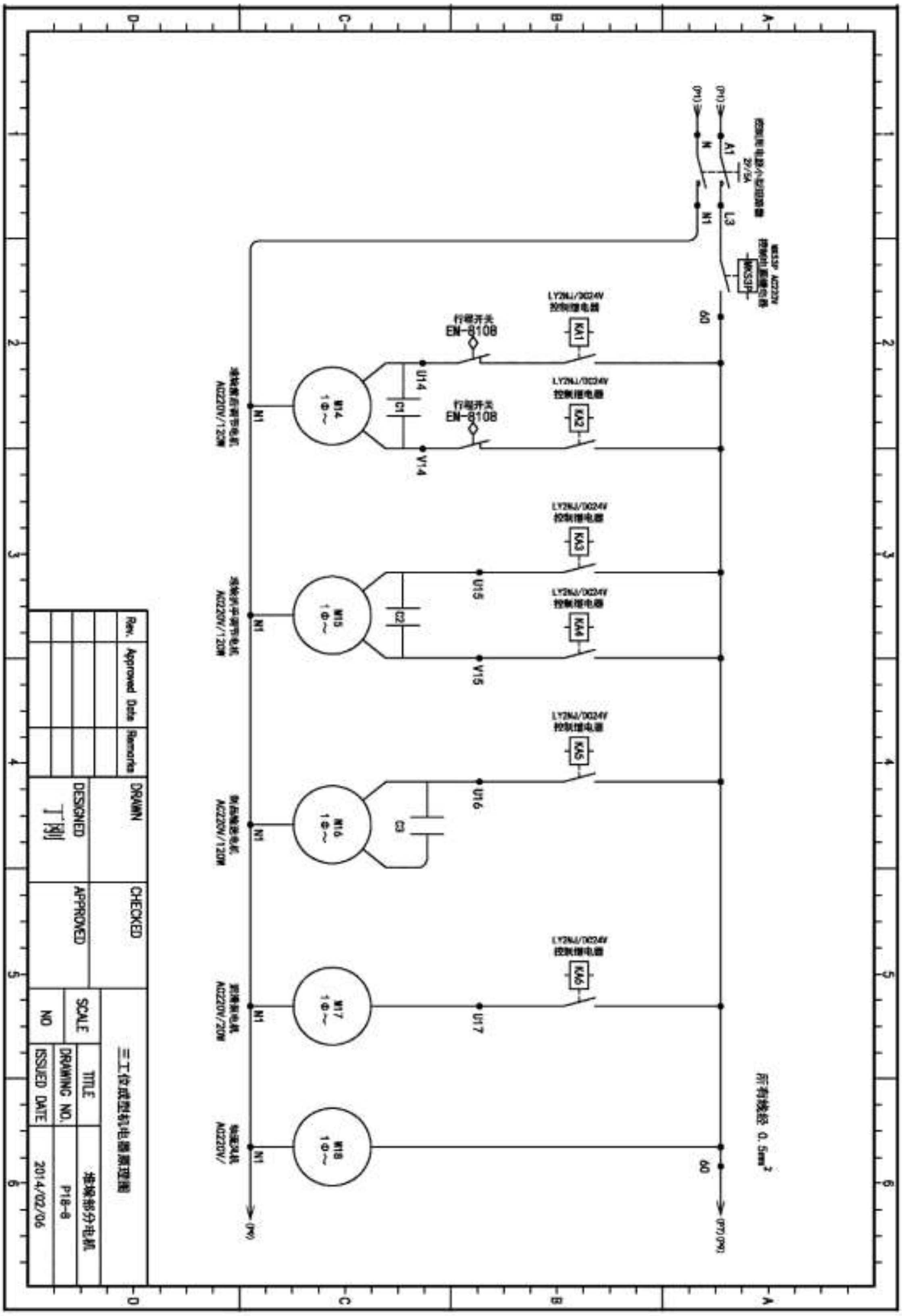

CAUTION

3. the warning marks

7. the ground terminal of the machine

A.3 Mechanical drawing

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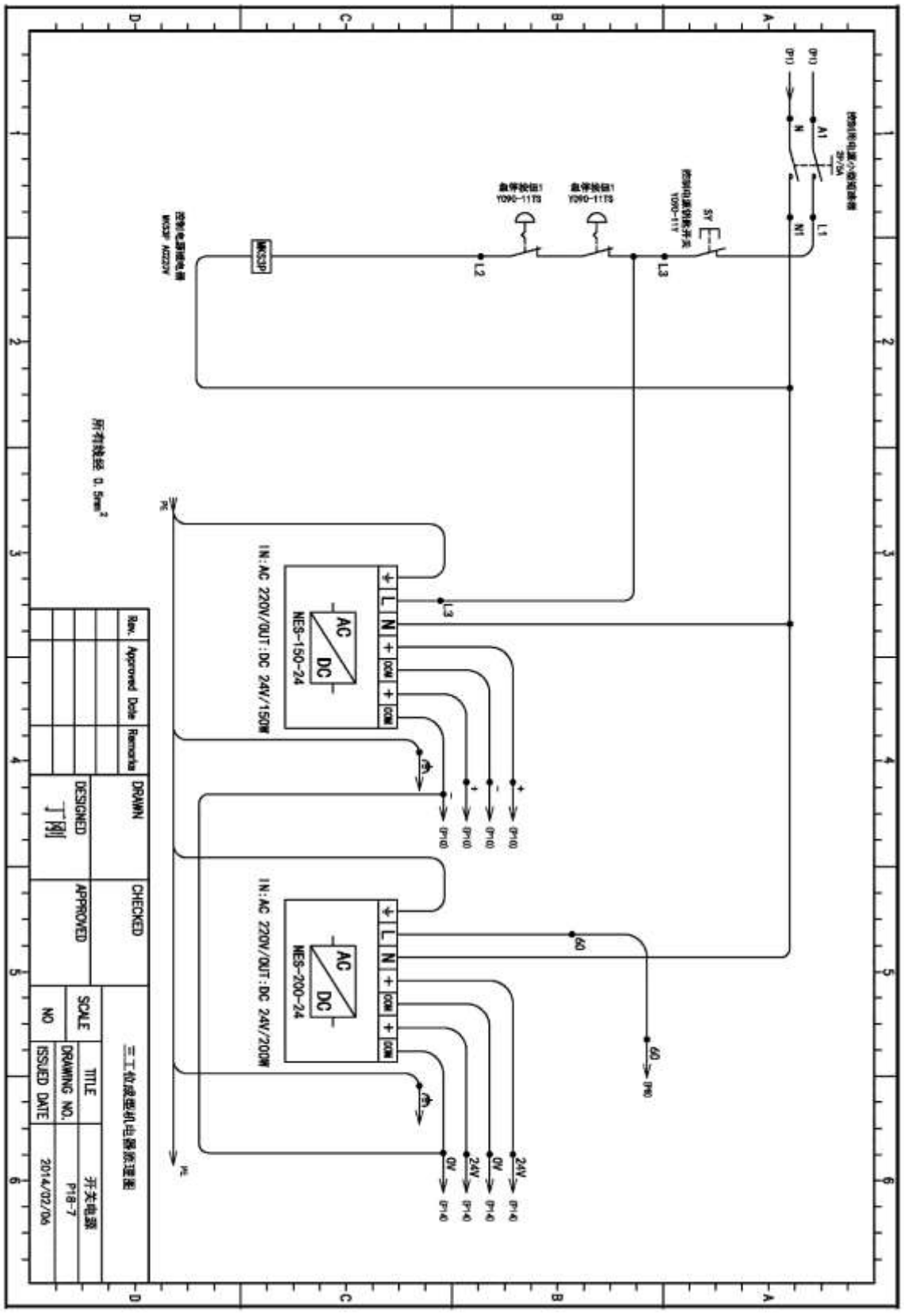
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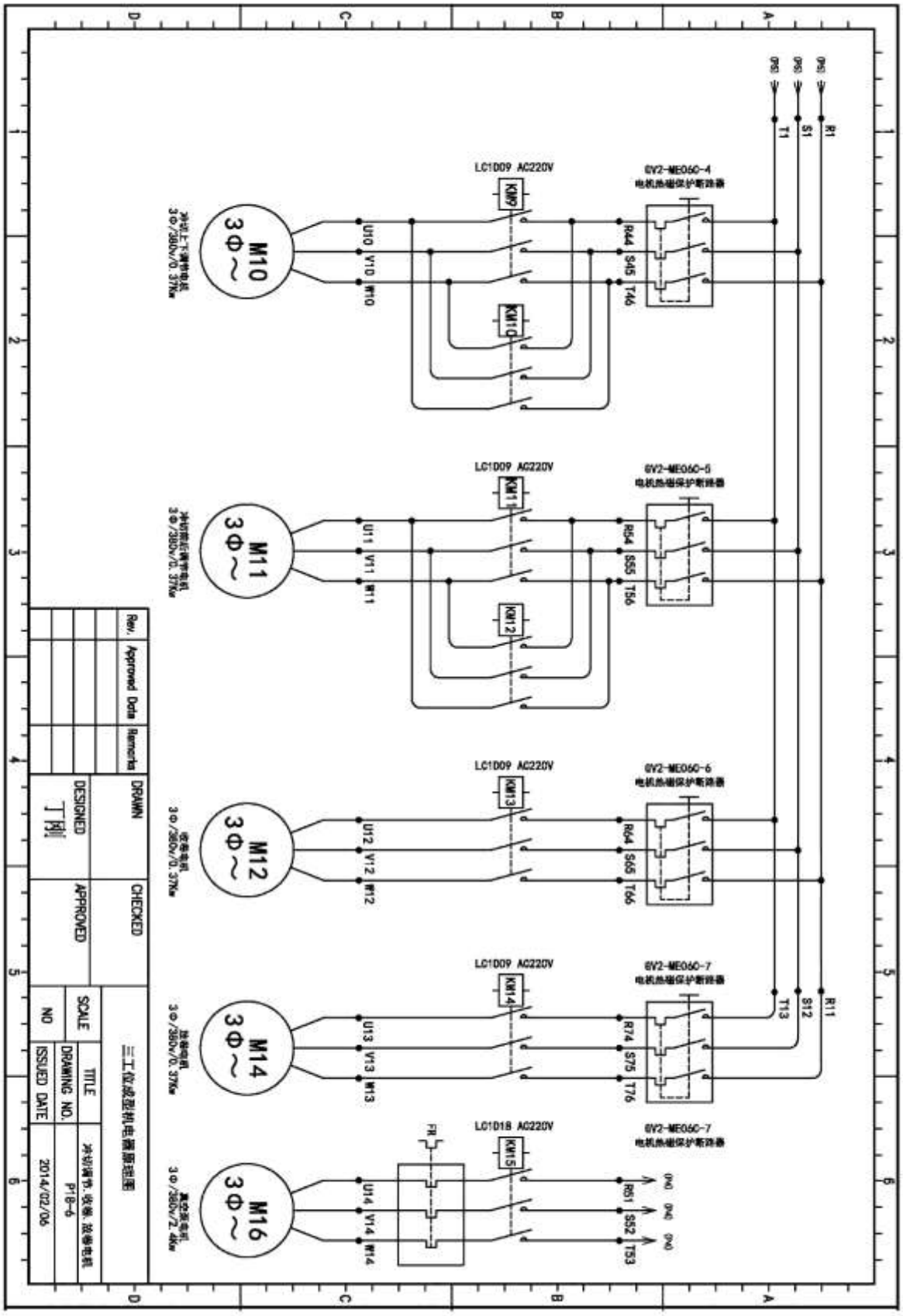
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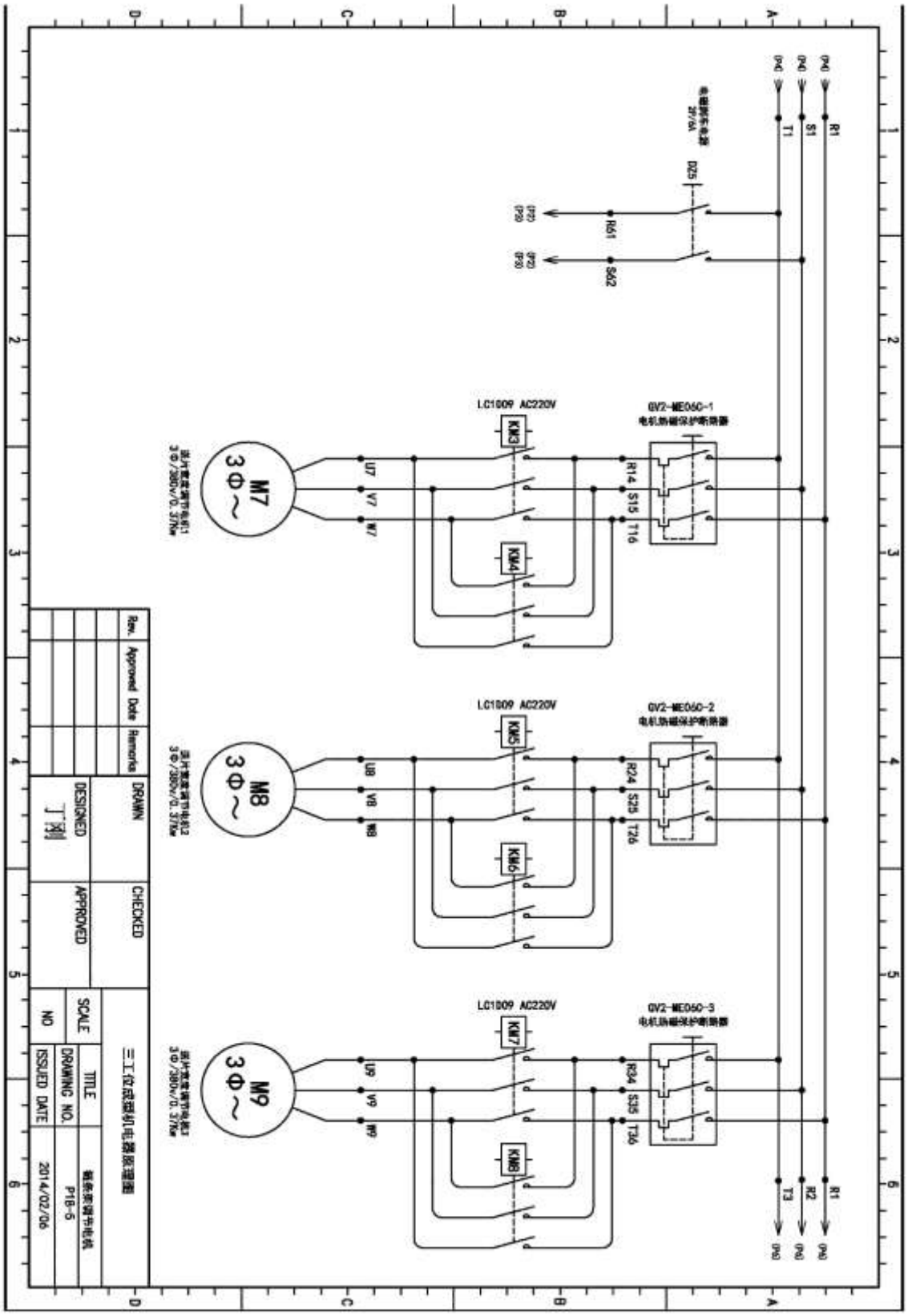
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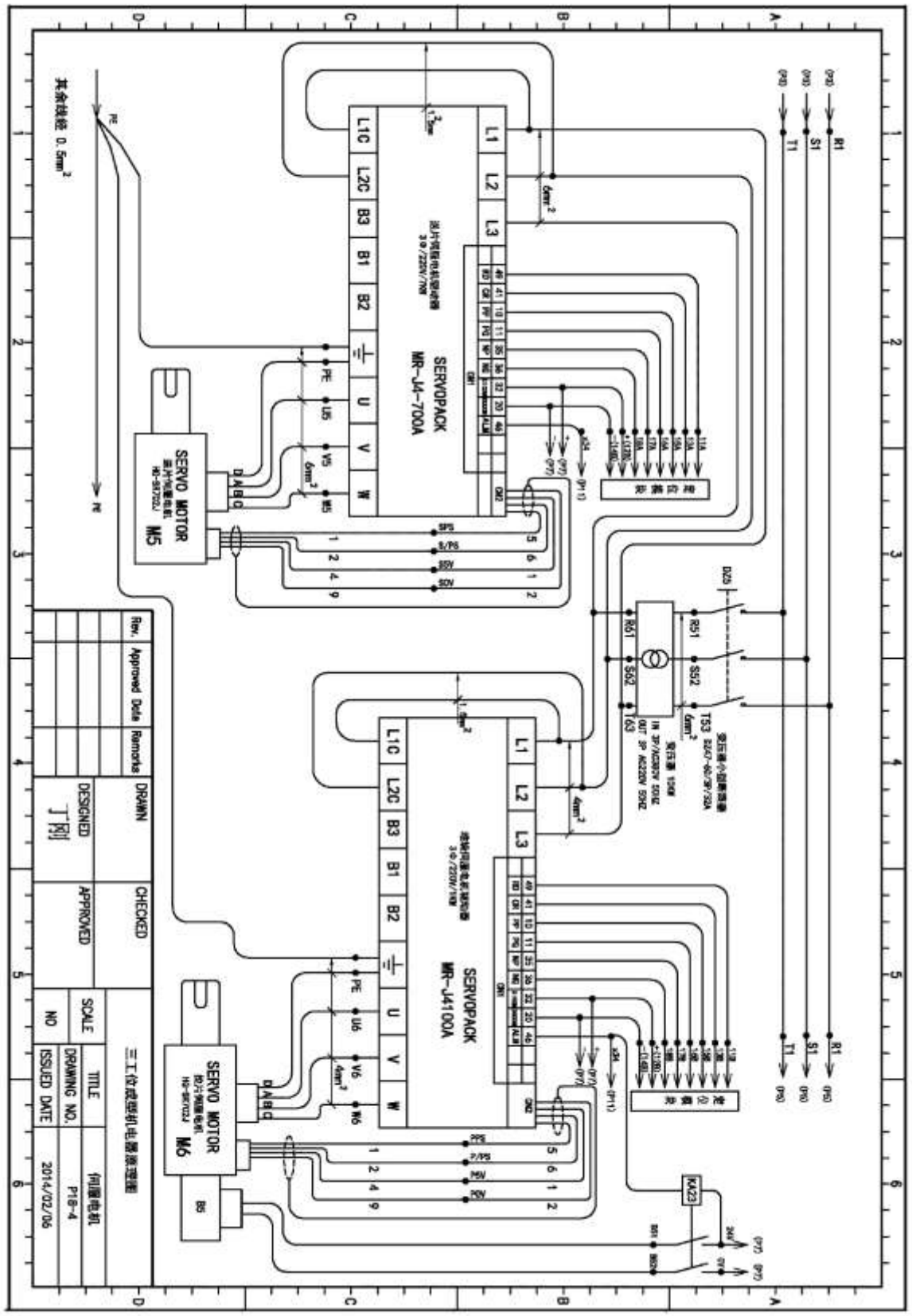
SERVOPACK
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SERVOPACK
MR-J4100A
SERVO MOTOR
M5
SERVO MOTOR
M6
L1C
L2C
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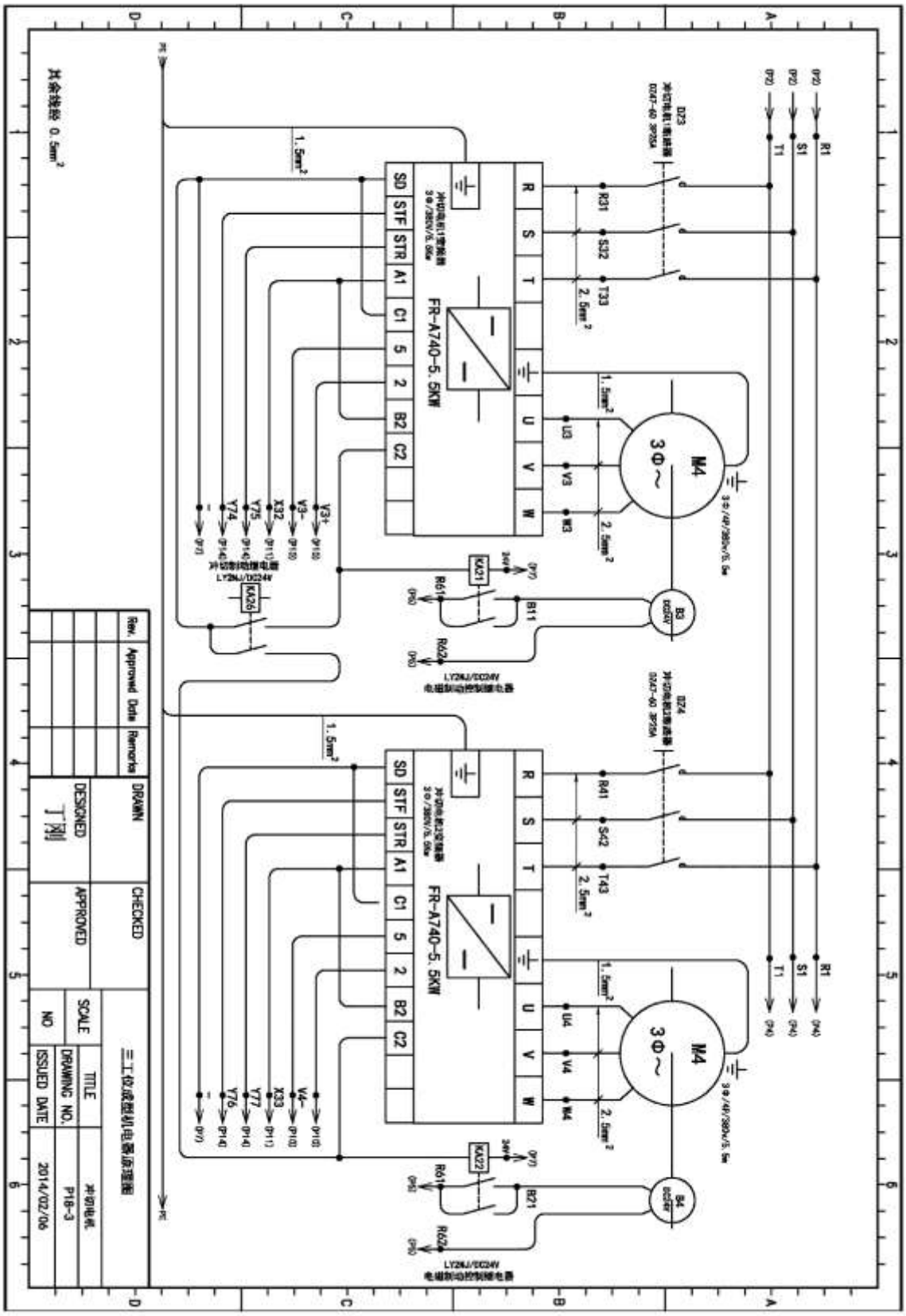
ISSUED DATE
2014/02/06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三工位成型机电器原理图
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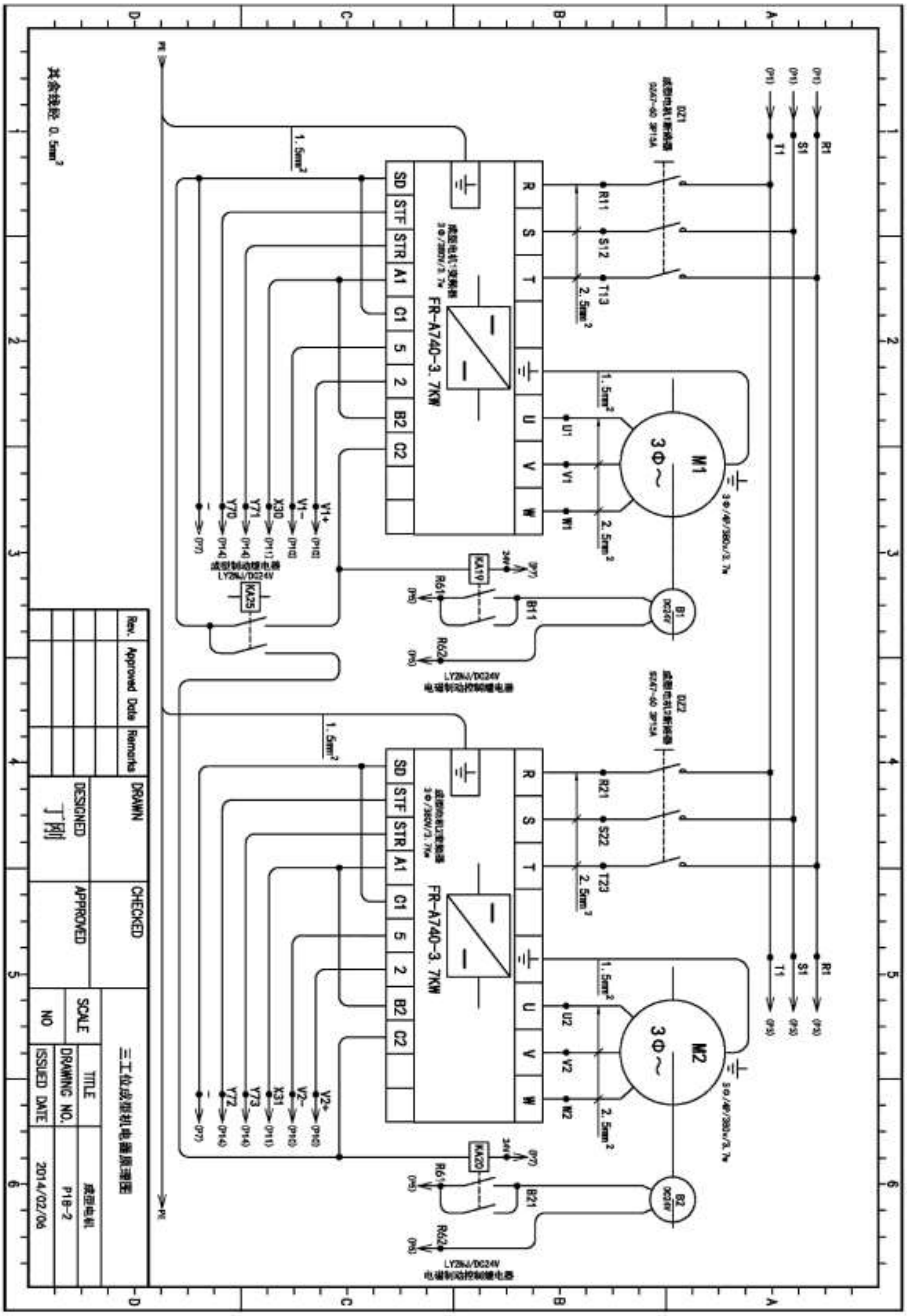
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FR-A740-3.7KW
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Rev.
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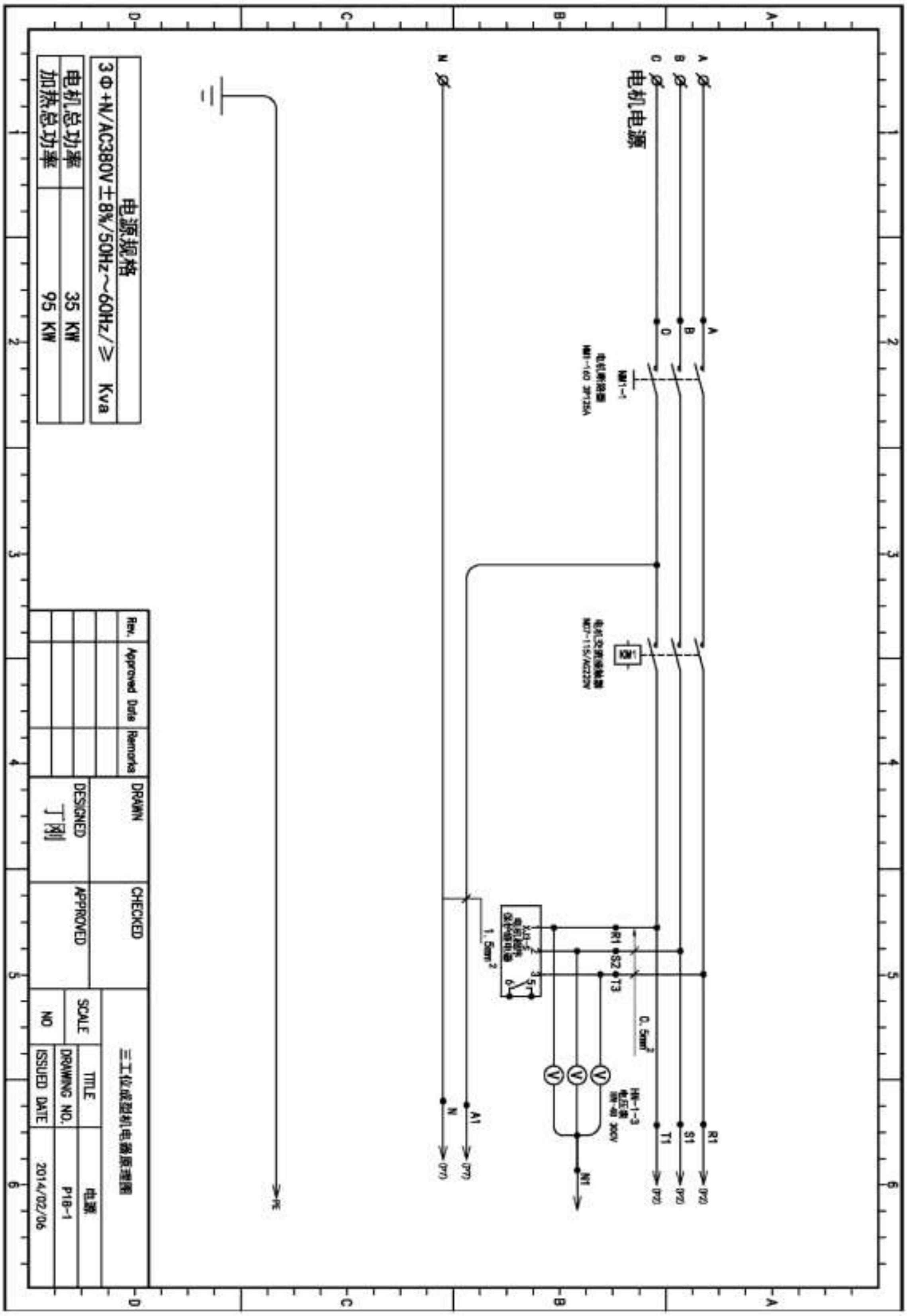
电机电源
电源规格
3Φ+N/AC380V±8%/50Hz~60Hz/≥ Kva
电机总功率 35 KW
加热总功率 95 KW
Rev. Approved Date Remarks
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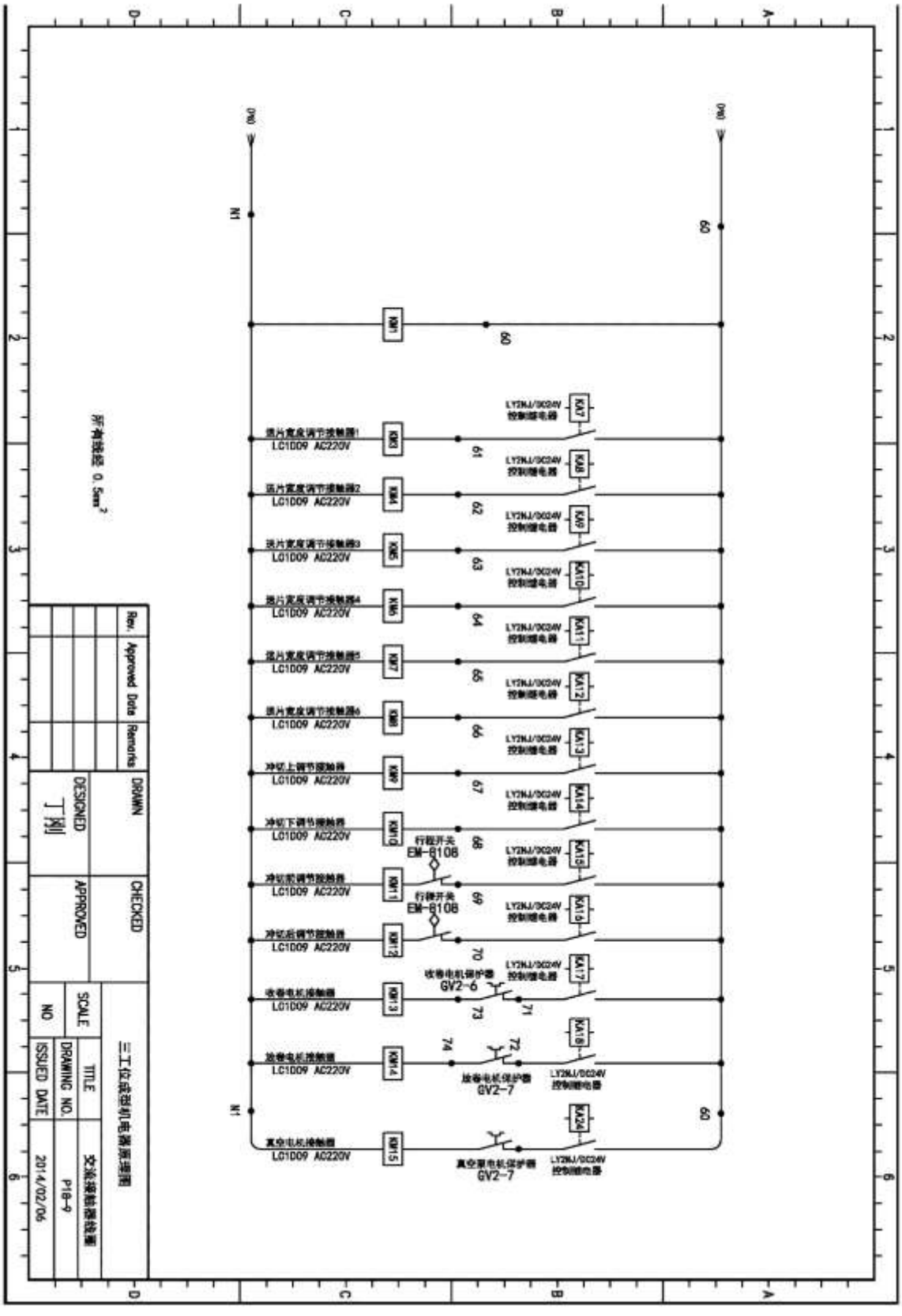
TITLE 电源
DRAWING NO. P18-1
ISSUED DATE 2014/02/06


0V0
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KA24
LY2NJ/DC24V 控制继电器
LC1D09 AC220V
行程开关 EM-6108
收卷电机保护器 GV2-6
放卷电机保护器 GV2-7
真空泵电机保护器 GV2-7
所有接线 0.5mm²
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Approved Date
Remarks
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交流接触器线圈
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2014/02/04
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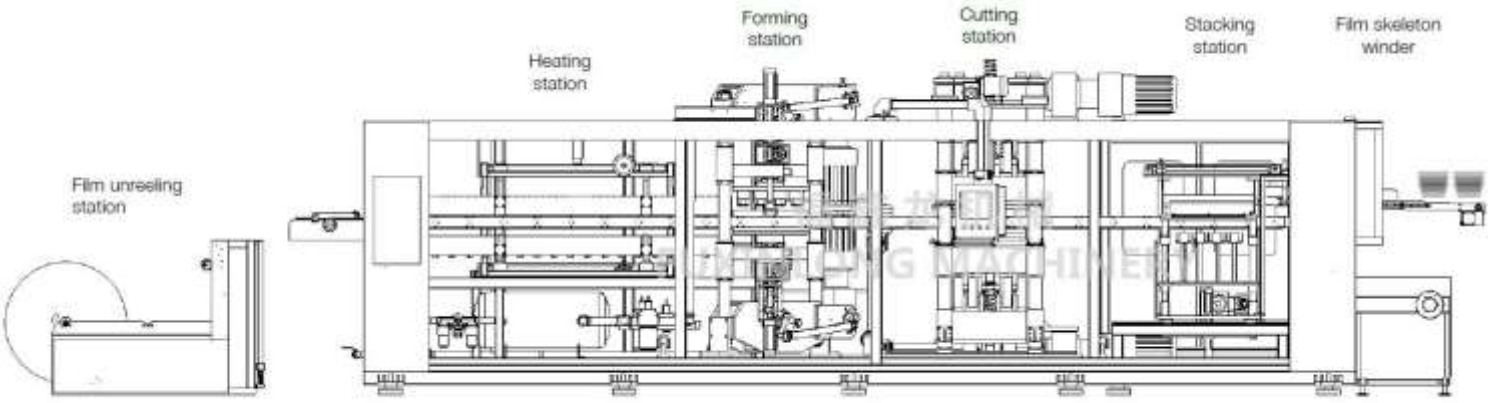
A.4 Instruction manual**l**

FSCT820/650-3 Pressure and vacuum thermoforming machine with multi-stations

Usage



This machine is suitable for OPS、HIPS、PS、PVC、PP、PET、ABS sheet to produce boxes、trays、bowls、fast-food boxes、dishes、lids etc.

Features:

This machine ,which is a combination of mechanical,electrical and pneumatic components,adopts the most advanced thermoforming technology.The whole system is controlled by micro PLC and operated by the man-machine interface.It combines the feeding、heating、forming、cutting and stacking into one process.

Main parameters

Power supply	380v/50Hz Three phase four wires
Raw material	PP/PVC/PS/PET/HIPS etc
Product types	All kinds of containers,plates,trays,bowls,lids etc
Size of machine	L11500*W2400*H2400

Max sheet width	≤790mm
Thickness of plastic sheet	0.1-2mm
Thickness of plastic sheet	18-35times/m
Air pressure	0.6-0.8mpa
Air consumption	3m³/min
Heating oven power consumption	About 55 KW/Hr
Max power consumption	≤82KW/Hr
Weight	9500kgs
Max forming area	Max forming area
Max forming depth	≤100mm
Max plastic width	≤790mm (Adjustable)
Max plastic sheet roll dia.	1000mm

FSCT820/650-3 Pressure and vacuum thermoforming machine manual

一. Automatic feeding equipment

Feeding hand controls the feeding cylinder and swing arm through motor and reduction gear connected with the roller,rubber roller ---- photoelectric controls the roller length

Technical parameters:

Max roller diameter	1000mm

Max roller width	800 mm
Diameter of roller putting plastic sheet roll	3 Inch（76.2 mm)
Feeding motor power	0.37KW
Feeding motor gear ratio	1：10
Feeding type	Automatical

二. Plastic sheet conveying system

1.In order to keep the conveying sheet precision,plastic sheet conveying system is driven by servo-motor and reduction box and drawn by the teeth chain.

2.For conveying sheet,we have both manual press sending and automatic sending

Manual press sending sheet:both positive press sending and reverse press sending available.

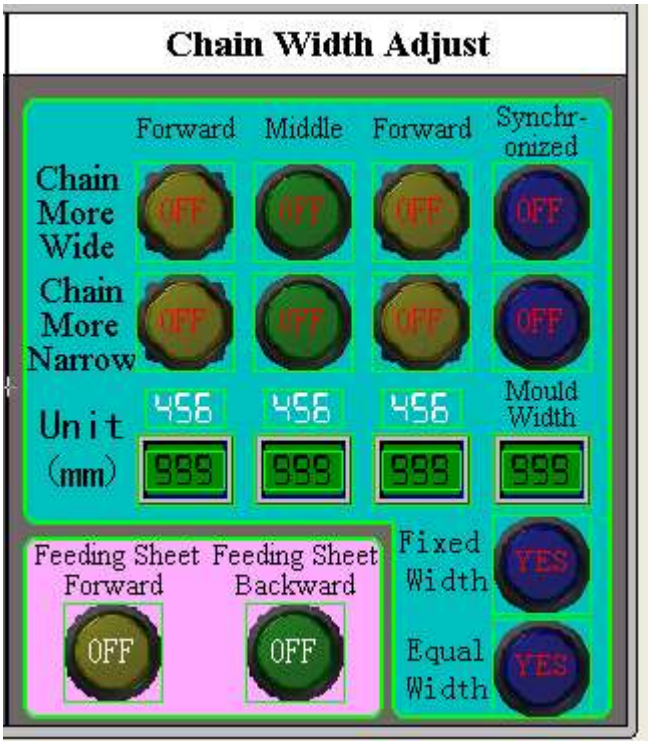
Automatic sending sheet:sheet length parameters can be adjusted according to requirements

3.The chain guard width can be adjusted by the front,middle and behind motors and reduction boxes,of which can be adjusted together and separately.

4.Mold width set:machine can be operated correctly if the width of chain guard is bigger than the mold width.Or else,it will give an alarm

5.There is water cooling system at the section of chain guard oven,used to cool the chain guard of oven heating section.

The manual conveying pictures shown as follows:

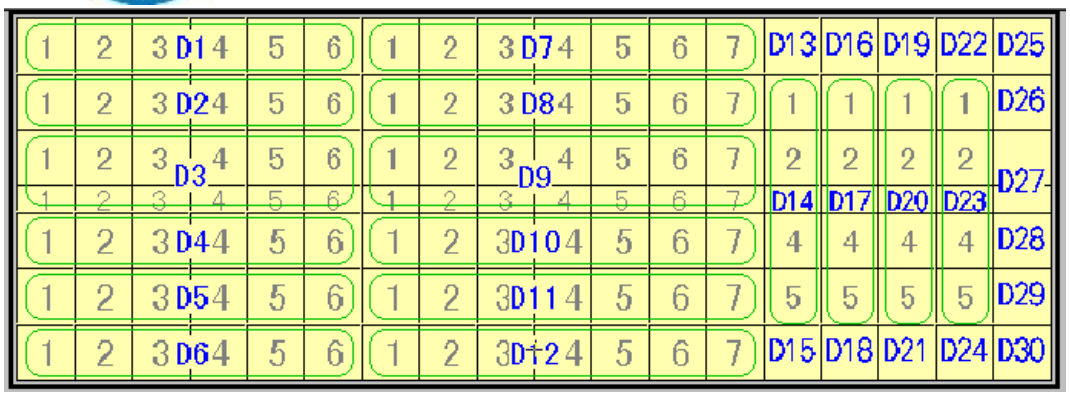


Feeding sheet technical parameters

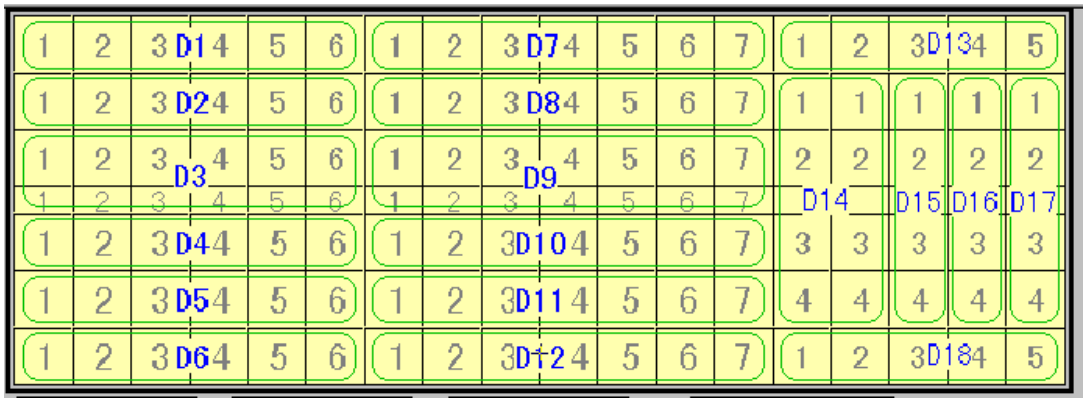
Max sheet width	800 mm
Min sheet width	400 mm
Feeding driven servomotor	7KW
Driven servomotor and reduction gear ratio	1：5
Width adjustable motor	0.37KW
Ratio of width adjustable motor	1：50

三. Oven heating system

1.The oven heating system is made up by both upper and down ovens,adopting Far-infrared ceramic heating.There is thirty lines for the upper oven,19lines for the down oven.(just as shown on the following picture)



Upper oven



Down oven

Every temperature of heating zone can be shown and adjusted on the PLC.

2.Every temperature of heating zone can be shown and adjusted on the PLC.

3.Upper and down oven can be adjusted according to the mold width.

4.Oven heating parameters:

Upper ceramic heater quantity	0.4KW 108pcs 0.2KW 18pcs
Upper oven heating power in all	46.8KW
Upper oven heating control lines	30 lines
Down oven ceramic heater	0.4KW 108pcs

quantity	0.2KW 18pcs
Down oven heating power in all	46.8KW
Down oven heating lines	19 lines

四. Forming station

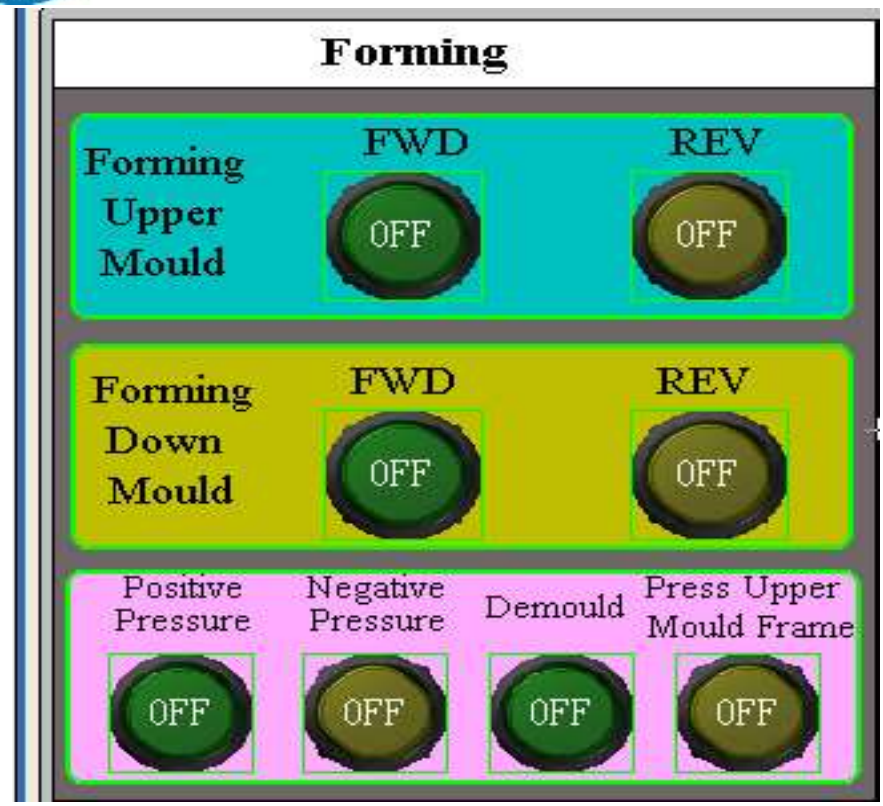
Thermoforming method is driven by the frequency motor and reduction gear.

Mold is controlled by positive and negative pressure .

For the forming process,first the plastic sheet is pressed and driven and then stretched,formed in the last.

Forming station is controlled by the sensor,and time controls the pressure and vacuum valve,then it is connected with PLC to control the action order.

Manual pictures of forming station shown on PLC(as follows)



Forming station parameters

Die spotting driven frequency motor	4KW-6 Grade
Frequency motor reduction box ratio	1：17.36
Pressing frame cylinder	Diameter 100*150mm
Max forming area	770mmX570mm
Max forming depth	100mm

六．Punching station

Upper and down mold close action is controlled by the frequency motor and reduction gear.The punching blade material is laster.

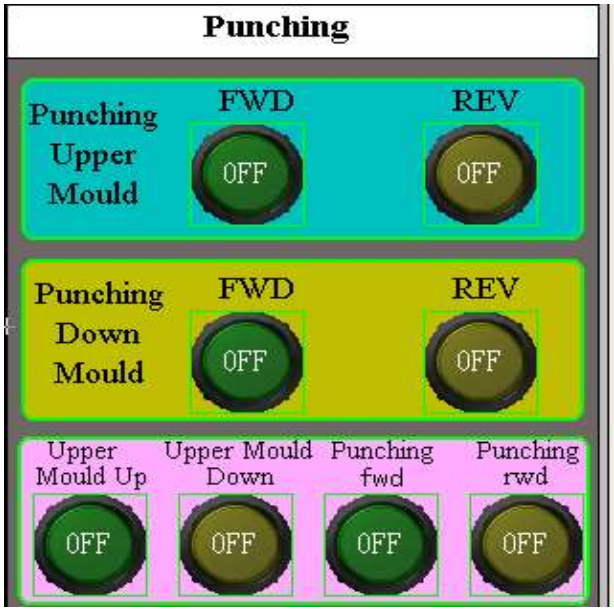
The adjustment of upper punching mold is controlled by the chain driven by the motor and reduction gear,adjusted by hand jogging-----punching mold can reach to its position by adjustment.

Forward and backward adjustment of punching station is controlled by

the screw driven by motor and reduction box,adjusted by hand jogging------punching station moves forward and backward.

The open and close od the punching mold is controlled by the travel switch.Punching station can act once the driven motor gets signal.

Manual pictures of punching station shown on PLC（as follows)



Punching station parameters

Punching frequency motor power	5.5KW
Punching reduction box ratio	1：35.11
Motor power of upper punching mold adjustable	0.37KW
Reduction box 1 ratio of upper punching mold motor	1：100
Reduction box 2 ratio of upper adjustable motor	1：10
Front and back adjustable motor of punching station	0.37KW
Reduction box of upper punching mold motor	1: 50

七. Stacking station

Down stacking mold is driven by the servo-motor and reduction box,upper mold is driven by the cylinder.After the finished products

quantity reaches its fixed parameters,the motor manipulator moves,and then send the products to the belt.

Stacking down mold manual operation-----upper and down adjustment

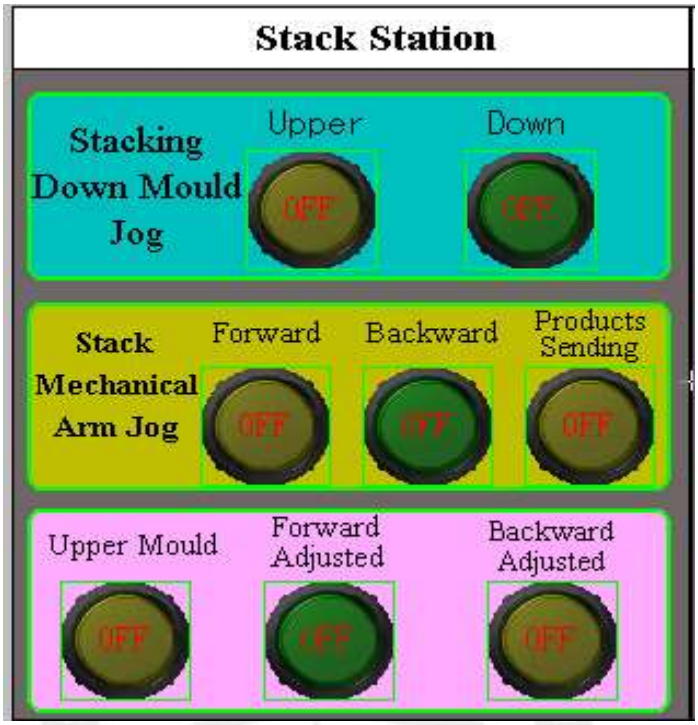
Manipulator manual operation--------forward and backward adjustment

Sending out motor manual open and close

Stacking upper mold manual open and close

Stacking counterpoint-----forward and backward adjustment

Manual pictures of stacking station shown on PLC(as follows)



Stacking station parameters

Stacking servomotor power	1KW
Stacking servomotor reduction gear ratio	1:10
Products manipulator pickpocket micro motor	0.12KW

Stacking forward and backward adjustable motor	0.12KW
Stacking upper mold cylinder	50X100 cylinder

八：Rewinding part

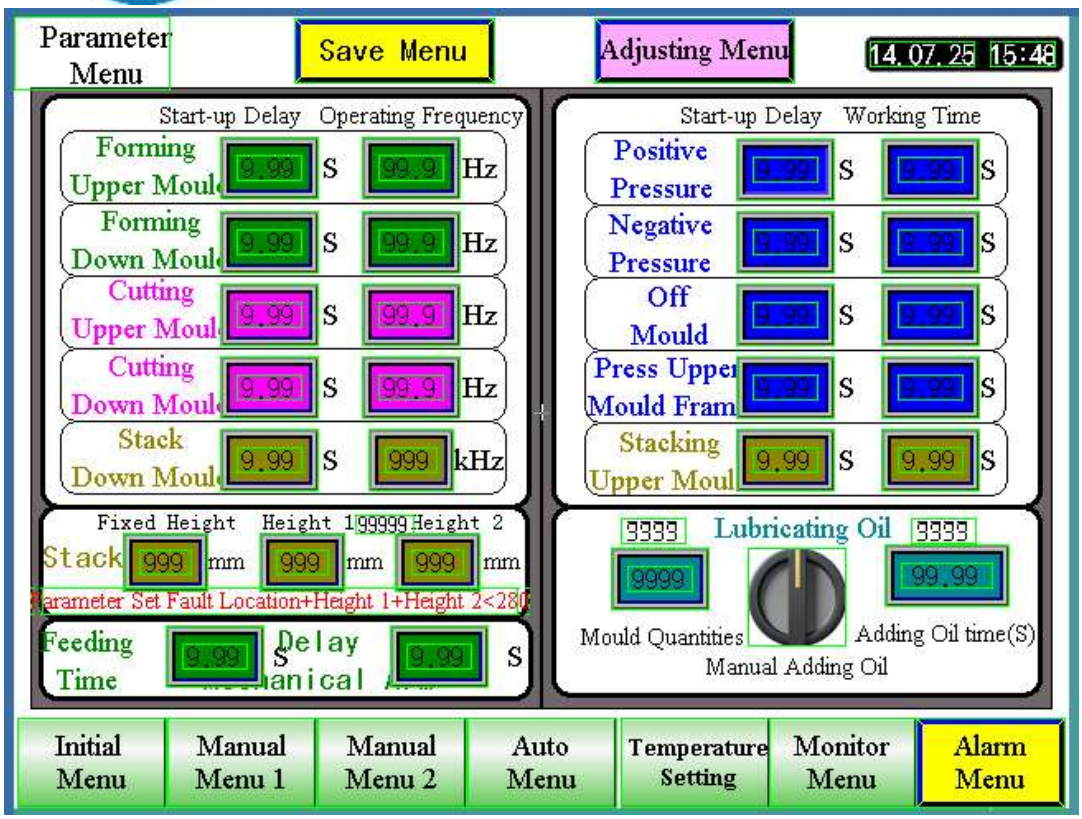
For the rewinding part,the friction disk can be driven by the motor and reduction box.The frictional force can be adjusted on the rewinding motor roller.

Rewinding parameters

Rewinding motor	0.37KW
Rewinding reduction gear	1:10
Max. Rewinding diameter	650mm

九．Parameters set

Parameters menu shown as follows:



Parameters menu explanation:

Running frequency----Controlling moving speed of each motor

Forming upper mold:start-up delay-----the delayed time of waiting for the heating plastic sheet moved to its position.Then the back motor runs,upper mold starting die assembly

Down forming mold:start-up delay-----the delayed time of waiting for the heating plastic sheet moved to its position.Then the back motor runs,upper mold starts die assembly.In operation,down mold moving is earlier than upper mold.

Punching upper mold:Start-up delay-----time of waiting for the finished products sending to its position.Then motor runs,and upper mold starts assembling.

Punching down mold:Start-up delay------time of waiting for the finished products sending to its position,then down mold starts assembling.

Delayed time of punching upper mold is the same as the down mold,so that both molds can move to their position meanwhile.

Stacking position:Start-up delay----time of waiting for finished product sending to its position then the motor starts running.The finished products will be sent to the stacking plate.

Positive pressure:Start-up delay------time of waiting for upper and down mold closing together,then the solenoid valve of positive air moves,products will be finished through the positive pressure.

Negative pressure:Start-up delay------time of waiting for the upper and down mold closing together,then solenoid valve of negative pressure moves,products will be finished by negative pressure.Negative and positive pressure works at the same time.

Demold:Start-up delay---time of waiting for upper and down forming die-open time,then the solenoid valve moves,the products start demolding

Press frame:Start-up delay-----delayed time of waiting for the upper mold assembling.In order to press first and then stretch,this action of solenoid valve should be earlier than the upper mold assembling action.

Manipulator Delay:time of waiting for upper mold moving to its positon while stacking quantity reaches its setting quantity.

Stacking fixed height:set the height of stacking down mold according to products.

Stacking fixed height 1:Set the first layer height of stacking down mold moving to the stacking upper mold according to the products.

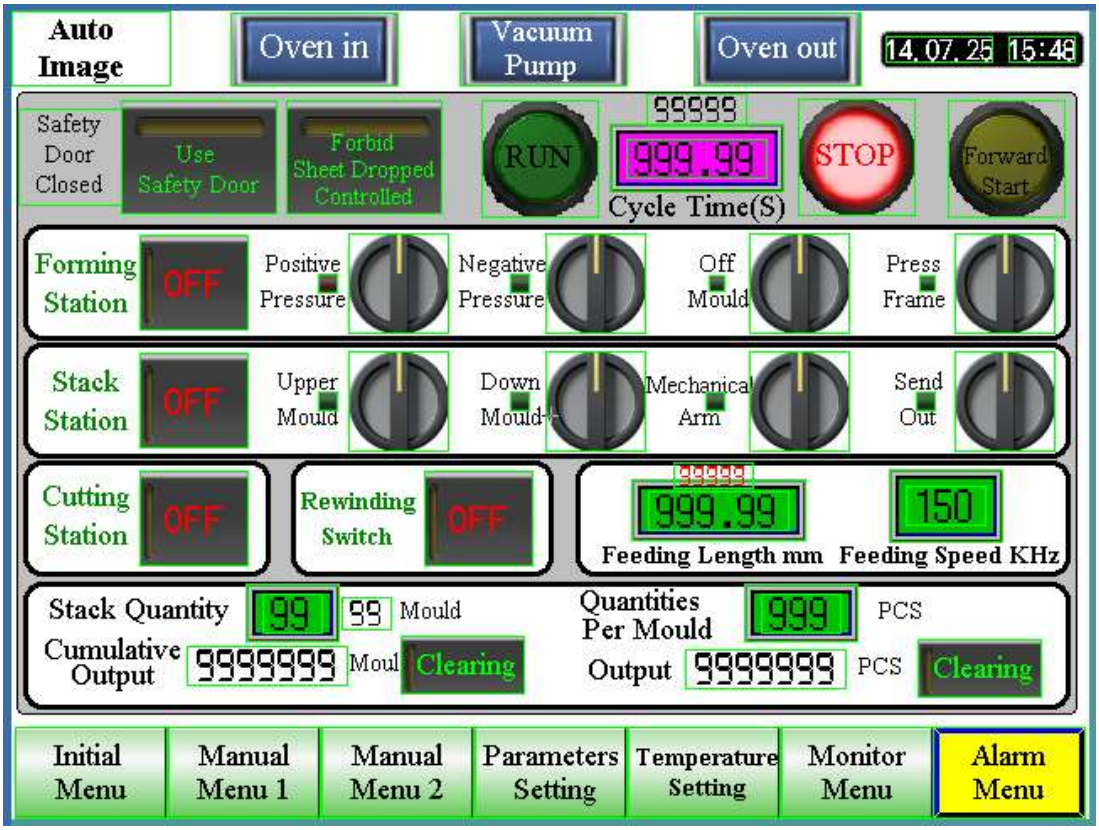
Stacking fixed height 2:Set the second layer height of stacking down mold moving to the stacking upper mold according to the products.

Lubricating pump control:set the interval mold quantity of automatic

oil,time of adding oil and manual adding oil.

十：Automatic control set

Automatic menu shown as follows



Automatic menu illustration

First press the automatic menu,then the machine can be adjusted automatically.

Oven in:Oven is moved to the heating zone.

Oven out:Oven is moved out of the heating zone.

Vacuum pump:Vacuum pump turn on and off.

Operation:Machine is running.

Cycle period:It is the time of one mold products finished.

Stop:The machine stops running.

Forming station: In automatic condition,the forming station turns on and

off.

Stacking station:In automatic condition,staking station turns on and off.

Punching station:In automatic condition,punching station turns

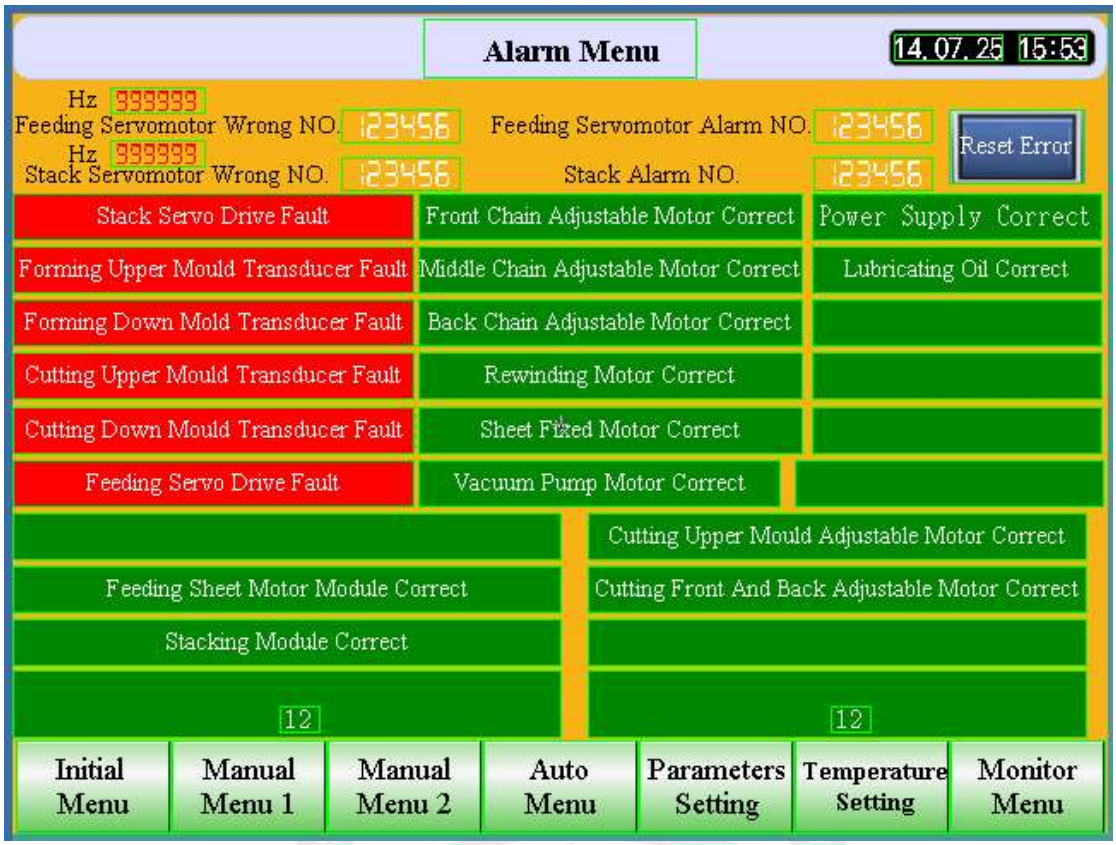
Rewinding switch:Rewinding part turns on and off.

Feeding sheet length:Set the feeding sheet length according to the mold.

Feeding sheet speed:Set the feeding sheet speed.

十一：Alarm menu

Alarm menu shown as follows:

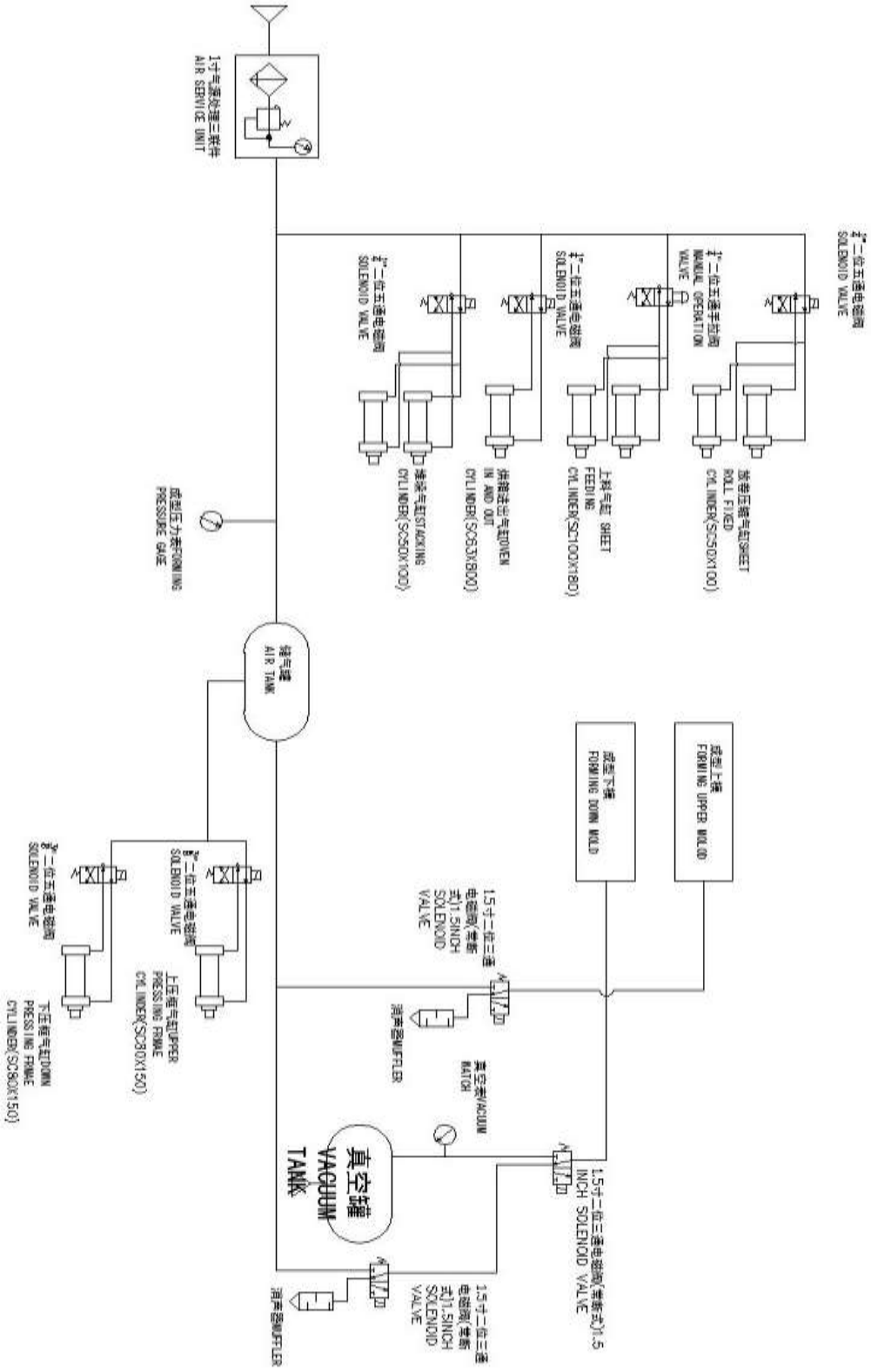


Alarm menu explanation

The green appearance shows the machine work normal.

The red appearance shows the machine work abnormal.

十一：Air circuit


AIR SERVICE UNIT
SOLENOID VALVE
MANUAL OPERATION VALVE
SOLENOID VALVE
SOLENOID VALVE
PRESSURE GAGE
AIR TANK
FORMING DOWN MOULD
FORMING UPPER MOULD
SOLENOID VALVE
SOLENOID VALVE
SOLENOID VALVE
MUFFLER
VACUUM METER
VACUUM TANK
INCH SOLENOID VALVE
SOLENOID VALVE
MUFFLER

FSCT820/650-3 Air illustration

Air circuit parameters

Using position	Specification
Air service unit	1 inch
Vacuum pump	3KW
Fixing sheet cylinder	1/4''Inch solenoid valve
Feeding sheet cylinder	Hand operated valve
Oven in and out cylinder	1/4'' Inch Solenoid valve
Stacking cylinder	1/4'' Inch Solenoid valve
Pressing upper frame cylinder	3/8'' Inch Solenoid valve
Pressing down frame cylinder	3/8'' Inch solenoid valve
Forming positive pressure	1.5Inch---solenoid valve
Forming negative pressure	1.5Inch----solenoid valve
Demould	1.5Inch----solenoid valve