

15T FPC Punch Machine

Report Version: 0



YUSH Electronic Technology
Co.,Ltd

Risk Assessment



Report Issued by
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PILZ
THE SPIRIT OF SAFETY

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1 Document Identification

DOCUMENT IDENTIFICATION	
Project Name:	15T FPC Punch Machine
Document Number:	4262148.01
Version:	0
Date:	Sep 21, 2023

	Name	Sign	Date
Lead Author:	Jason Deng		2023-09-21
Reviewed by:	Allen Xu		2023-09-21

Customer contact:	Eva Liu		
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Table 1 Document Identification

2 List of Revisions

Revision	Description	Changed by	Date
Rev A	Initial draft	Jason Deng	Sep 21, 2023
Rev B	Internal review	Allen Xu	2023-09-21
0	Sent to the customer	Jason Deng	2023-09-23

Table 2 List of Revisions

3 General Information

3.1 Project Information

MACHINE INFORMATION	
Machine Name:	15T FPC Punch Machine
Manufacturer:	YUSH Electronic Technology Co.,Ltd
Machine Type:	Punch machinery
Serial Number:	No Serial No. Available
Date of Manufacture:	2023-07
Machine Certification:	No Certification Available

Table 3 Machine information

PILZ PERSONNEL / ASSESSMENT DATE	
Initial Risk Assessment	
Lead Author:	Jason Deng
Date of assessment:	Sep 21, 2023

Table 4 Pilz Personnel / Assessment Date

YUSH ELECTRONIC TECHNOLOGY CO.,LTD PERSONNEL	
Name:	Function / Job Title:
Eva Liu	Sales Manager

Table 5 YUSH Electronic Technology Co.,Ltd Personnel

3.2 Motivation

YUSH Electronic Technology Co.,Ltd would like to make a risk assessment on the 15T FPC Punch Machine in YUSH Electronic Technology Co.,Ltd. As an approved vendor of YUSH Electronic Technology Co.,Ltd, Pilz is asked to undertake this risk assessment.

A Risk Assessment is necessary in order to determine the health and safety requirements which apply to machinery. The results of the Risk Assessment must be taken into account when designing, constructing or modifying a machine. The following details the method to undertake an iterative process of risk assessment for a machine:

- Determine the limits of the machinery, which include the intended use and any reasonably foreseeable misuse thereof
- Identify the hazards that can be generated by the machinery and the associated hazardous situations
- Estimate the risks, taking into account the severity of the possible injury or damage to health and the probability of its occurrence
- Evaluate the risks, with a view to determining whether risk reduction is required
- Eliminate the hazards or reduce the risks associated with these hazards by application of protective measures

To ensure the appropriate procedure for Risk Assessment, the International standard ISO 12100 “Safety of machinery - General principles for design - Risk assessment and risk reduction” has been followed. This standard gives guidance for decisions during the design of machinery and describes principles for a consistent and systematic approach to risk assessment.

A Risk Assessment has been carried out on the 15T FPC Punch Machine on the 2023-09-13.

3.3 Method of risk analysis

In accordance with ISO 12100, the risk assessment is implemented in a series of logical steps to enable a systematic examination of the hazards associated with machinery. Risk assessment is followed, whenever necessary by risk reduction as described in clause 6 of ISO 12100: 2010. When this process is repeated it gives an iterative process for eliminating hazards as far as possible and for implementing safety measures.

The risk assessment methodology approach includes:

- Risk analysis
 - Determination of limits
 - Hazard identification
 - Risk estimation
- Risk evaluation

The risk assessment provides the information required for the risk evaluation, which in turn allows judgements to be made on the safety of machinery.

The following diagram shows the step-by-step process of risk analysis:

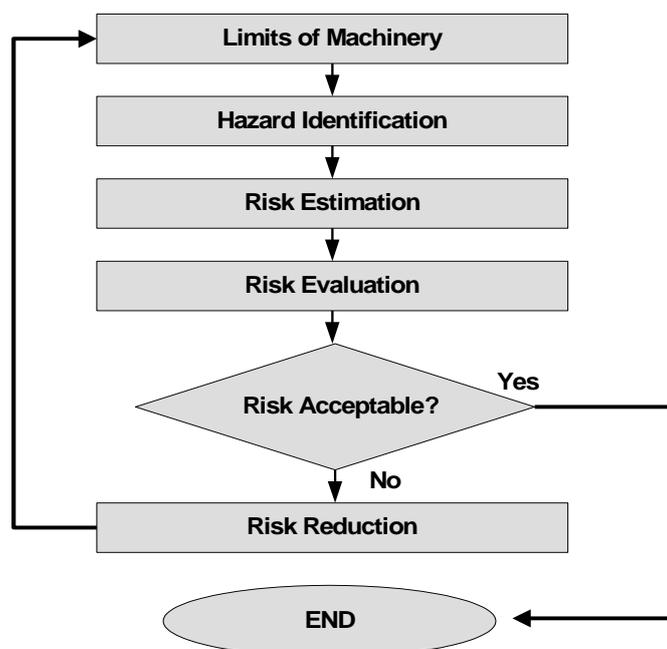


Figure 1 Method of Risk Analysis

3.4 Limits of Report

This risk assessment report is based on information that was accumulated during the on-site risk assessment of the 15T FPC Punch Machine in YUSH Electronic Technology Co.,Ltd on the Sep 21, 2023.

This risk assessment for work equipment examines significant hazards where risk reduction measures still need to be applied.

The information was accumulated in the following fashion:

1. Discussions with engineering personnel
2. Reviewing all available machine technical information
3. Conducting a physical examination of the machine
4. Conducting a design review of the machine

In order to ensure the accuracy of the risk assessment for the machine, it is imperative that the information provided on the date of the risk assessment be correct and reliable. Pilz cannot take any responsibility for judgements made on inaccurate or lack of information.

The following technical information was made available for the 15T FPC Punch Machine:

DOCUMENTATION EXAMINED			
N°	Document Name	Type	Issue Date
N/A	YSPE Electrical drawings	Electrical Drawings	2023-08-17
N/A	15T FPC Punch Machine Manual	Operating Manual	2023-09
N/A	15T FPC Punch Machine safety distance calculation	Safety Instructions	2023-09

Table 6 Documentation examined

Every effort is made to evaluate the risk associated with each hazard identified throughout the report, however it may not be possible to quantify the risk with all hazards. When this is not possible the hazards are assessed in relation to their conformance with all relevant Legislation. Each hazard is identified individually throughout the report; the outcome from the accumulation of hazards has not been evaluated.

Human error and misuse related to areas such as incorrect feeding of the machine, incorrect use of materials and operator ability to operate the machine are not considered to be under the scope of this report. Only clear foreseen misuse of the machine was considered.

Due to practical reasons not all the machine lifecycle was examined as part of this report, the following phases were excluded:

- Transport
- Assembly and Installation
- Dismantling, Disabling and Scrapping
- Commissioning

4 Machine Assessment

4.1 Basic Machine Description

The 15T FPC Punch Machine is used to cut electrical board and the operator is required to manually load and unload from the front opening of the machine.



Picture 1 15T FPC Punch Machine general view

4.2 Machine Control System Description

The machine control system is PLC based.

- Standard PLC (MITSUBISHI ELECTRIC FX3GA-40MT) carries out process control functions;
- Safety relays (Pilz, PNOZ X2.8P) are used to carry out safety functions (E-Stop and safety light curtain).



Picture 2 15T FPC Punch Machine main control panel

4.3 Machine Specifications

The following data contains the general specifications of the machine:

MACHINE LIMITS	
Intended Environment:	Industrial
Required Level of Training:	Introductory Training
Operated By:	Plant Operators, Maintenance and Technical Personnel
Intended Use:	The assembly machine is used to cut electrical board
Machine Lifetime:	20 Years
Machine Dimensions:	L*W*H Approx: 654mm *784mm*2140mm
Machine Environment:	The machine is still in the manufacturer's assembly plant. The machine has been designed for indoor use. The machine should be located in a clean room. The room should be clean and dry with an ambient temperature suitable for the machine.

OPERATIONAL AND MAINTENANCE INFORMATION	
Operational Information	
Raw Material:	automotive parts and screws
Emergency Stopping Time:	Immediately
Machine Cycle Time:	Decided by end user
Number of Operators (Normal Use):	1
Number of Control Positions:	1
Maintenance Information	
Maintained By:	Trained Permanent Staff
Maintenance Frequency:	Monthly
Cleaning:	Operators
Jamming Repair:	Operators
Housekeeping:	The machine is still in the manufacturer's assembly plant. The housekeeping in the area of machine should be adequate.

POWER SOURCES	
Control, Electrical Supply:	24V DC
Main feed, Electrical Supply:	220V AC - 50Hz
Pneumatic Supply:	6 bar
Hydraulic Supply:	Not Applicable

Table 7 Machine Specification and Limits

4.4 Risk Estimation & Evaluation Criteria

In order to identify, estimate and reduce the hazards present in the machine a Preliminary Hazard Analysis was performed using Pilz Hazard Rating (PHR) techniques.

A preliminary hazard analysis produces a line item tabular inventory of non-trivial system hazards, and an assessment of their remaining risk after countermeasures have been imposed. The Pilz Hazard Rating technique was used to analyse the risks associated with the machine. This technique offers an analytical approach to the Preliminary Hazard Analysis method.

The Evaluation methodology based on Pilz criteria and experience, an evaluation of the factors, Degree of Possible Harm (DPH), Probability of Occurrence of a Hazardous Event (PO), Possibility of Avoidance (PA) and Frequency and/or duration of Exposure (FE), and has been performed on the risk related with each hazard. A Pilz Hazard Rating has then been calculated from the following formula:

$$PHR = DPH \times PO \times PA \times FE$$

Where the above parameters can take the following values:

Degree of Possible Harm (DPH)

0.25	Scratch / Bruise
0.5	Laceration / cut / mild ill health effect/ minor burns
3	Fracture minor bone – fingers, toes
5	Fracture major bone – hand, arm, leg
8	Loss of 1 or 2 fingers/ toes or major burns
11	Leg / hand amputation, partial loss of hearing or eye
15	Amputation of 2 legs/hands, total loss of hearing/sight in both ears/eyes
25	Critical injuries or permanent illness/condition/injury
40	Single Fatality
65	Catastrophe

Possibility of Occurrence of Hazard Event (PO)

0.05	Almost impossible
1.25	Unlikely
2.5	Possible
4	Probable
6	Certain

Possibility of Avoidance (PA)

0.75	Possible
2.5	Possible under certain circumstances
5	Not Possible

Frequency of Exposure (FE)

0.5	Annually
1	Monthly
2	Weekly
3	Daily
4	Hourly
5	Constantly

The maximum and minimum numerical values that could be assigned to each factor for every hazard are shown in the following table.

	PHR	Risk	Comment
	1 - 10	Negligible Risk	Presents practically no risk to health and safety, no further risk reduction measures are required.
	11 - 20	Very Low Risk	Presents very little risk to health and safety, no significant risk reduction measures are required, may necessitate the use of personal protective equipment and/or training.
	21 - 45	Low Risk	Risk to health and safety is present, but low. Risk reduction measures must be considered.
	46 - 160	Significant Risk	The risk associated with the hazard is substantial enough to require risk reduction measures. These measures should be implemented at the next suitable opportunity.
	161 - 500	High Risk	Potentially dangerous hazard, which requires risk reduction measures to be implemented urgently.
	501+	Very High Risk	Risk reduction measures should be implemented immediately, corporate management should be notified.

Table 8 PHR Numerical Range

After a complete examination of the machine based on applicable standards, a numerical value was determined for each factor while conducting the Risk Assessment and the Pilz Hazard Rating was calculated. The calculated number was then used to evaluate the risk associated with the hazard by comparison with predetermined acceptable levels.

The calculated Pilz Hazard Rating ranges from 1 to 9750 where 1 is the lowest showing minimum and 9750 is the highest risk.

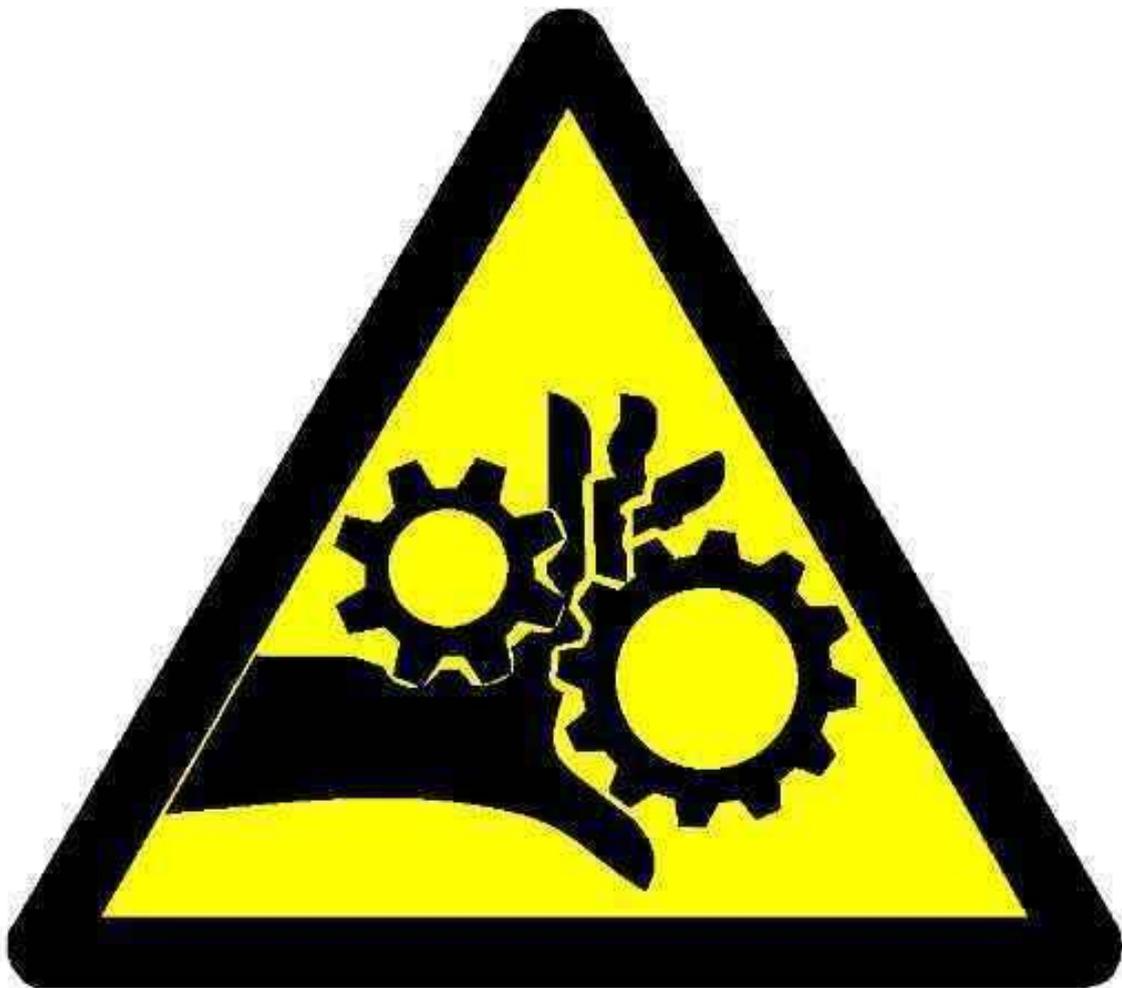
4.5 Findings

The following tables contain detailed descriptions of the hazards found during the risk assessment. Each hazard is described individually but considered as a part of the system.

4.5.1 Mechanical Hazards

This section describes the mechanical hazard which will be involved in the machine operation as required by Machinery Directive and other related Normative standards, including (if applicable):

- Insufficient Fixed Guard
- Insufficient Safety Distance
- Incorrect Fixing Means
- Guard Rail
- Working Platform
- Walk way
- Elastic elements
- Falling objects
- Gravity
- Height from the ground
- High pressure



Picture 3 Mechanical Hazards

Hazard Identification		Hazard No:	1.1
Title	Crushing hazard due to the movement of the upper mold		
Location	Machine Front		
Target	Upper Limbs		
Activity	Normal Operation		
Task	Operation		
Sub Task	Manual loading/unloading		
Hazard Type	Mechanical Hazard with the consequence of		
Sub Type	Crushing		
Description	<p>There is an opening on the front side of the machine for loading and unloading where there is a risk of crushing when the upper die moves downwards. Two sets of safety light curtains (PSEN op114F-s-14) have been installed in this opening to prevent upper limbs from accessing the moving upper mold through this opening. When the safety light curtain is triggered, the hazardous moving parts of the machine will be stopped.</p> <p>According to the report on the calculation of the safety distances provided by the manufacturer, the stopping time of the machine is 81ms, the required safety distance is 162mm, the distance from the top horizontal light curtain to the nearest hazardous point of the upper mold is 190mm, and the distance from the front vertical light curtain to the nearest hazardous point is 421mm, which is greater than 162mm, the safety distances from the safety light curtains are sufficient to prevent the risk of crushing of upper limbs from the loading and unloading opening as a result of the movement of the upper mold.</p>		
Risk Estimation and Evaluation			
Degree of Possible Harm:	11	Possibility of Avoidance:	2.5
Probability of Occurrence of a Hazardous Event:	0.05	Frequency And / Or Duration of Exposure:	5
Pilz Hazard Rating (PHR):	6	Summary Level:	Negligible Risk
Risk Reduction		Reference	
According to the report on the calculation of the safety distances provided by the manufacturer, this risk is acceptable.		EN ISO 13855	
Possible Residual Risk			
Degree of Possible Harm:	11	Possibility of Avoidance:	2.5

Probability of Occurrence of a Hazardous Event:	0.05	Frequency And / Or Duration of Exposure:	5
Pilz Hazard Rating (PHR):	6	Summary Possible Level:	Negligible Risk



Picture 4 Hazard 1.1, Image 1, Loading opening and warning signs



Picture 5 Hazard 1.1, Image 2, Loading opening

15吨冲床安全距离计算 型号: YSPE-15T
 品牌: 宇顺力

light curtain	PSM-eq/IT	ms
entry safety	PNK/20/SP	10
PLC + other		20
subtotal value	4VZ3DL 08	40

$S = (Kt) / C$

σ	16	C = 0
K	2	
L	K1	
S ₀	167	

Calculating the minimum safety distance S
 according to EN 955

Formula for ASPTs up to 40 mm resolution and perpendicular approach to the working field:

$$S = (K + T) \cdot v$$

S = Minimum safety distance in mm
 K = 2 mm for approaching speed
 T = 14 + 0.12 · v in mm
 v = response time of the ASPT
 C = stopping performance of the machine
 σ = resolution of the ASPT (range 14 to 40 mm)

$S [mm] = 12 \frac{[mm/min]}{s} \cdot (1 + 0.12 \cdot 12) \frac{[mm]}{s} = 210 + 1$ [mm]

If the result is less than 150 mm, a minimum distance of 150 mm must be maintained. If the result is less than 950 mm, it has to be offset to 950 mm. In this case 150 mm is 950 mm.

Picture 6 Hazard 1.1, Image 3, Safety distance calculation report

Hazard Identification		Hazard No:	1.2
Title	Impact hazard due to the movement of the lower mold		
Location	Machine Front		
Target	Upper Limbs		
Activity	Normal Operation		
Task	Operation		
Sub Task	Manual loading/unloading		
Hazard Type	Mechanical Hazard with the consequence of		
Sub Type	Crushing		
Description	<p>There is an opening on the front side of the machine for loading and unloading, and there is a risk of impact when the lower mold is moved horizontally (in and out). Two sets of safety light curtains (PSEN op114F-s-14) have been installed in this opening to prevent upper limbs from accessing the moving lower mold through this opening. When the safety light curtain is triggered, the hazardous moving parts of the machine will be stopped.</p> <p>According to the report on the calculation of the safety distances provided by the manufacturer, the stopping time of the machine is 81ms, the required safety distance is 162mm, the distance from the top horizontal light curtain to the nearest hazardous point of the lower mold is 190mm, the safety distances for the horizontal light curtain is sufficient.</p> <p>However, the safety distance from the vertical light curtain to the lower mold is less than 100mm, which is insufficient. The warning labels already provided on the front of the machine indicating the risk of impacts.</p>		
Risk Estimation and Evaluation			
Degree of Possible Harm:	3	Possibility of Avoidance:	0.75
Probability of Occurrence of a Hazardous Event:	1.25	Frequency And / Or Duration of Exposure:	5
Pilz Hazard Rating (PHR):	14	Summary Level:	Very Low Risk
Risk Reduction		Reference	
End-users need to train operators to caution about the risk of lower mold impacts.		EN ISO 13855 EN ISO 12100	
Possible Residual Risk			
Degree of Possible Harm:	3	Possibility of Avoidance:	0.75

Probability of Occurrence of a Hazardous Event:	0.05	Frequency And / Or Duration of Exposure:	5
Pilz Hazard Rating (PHR):	1	Summary Possible Level:	Negligible Risk



Picture 7 Hazard 1.2, Image 1, Loading opening and warning signs



Picture 8 Hazard 1.2, Image 2, Loading opening



Picture 9 Hazard 1.2, Image 3, Safety distance is about 50mm

Hazard Identification		Hazard No:	1.3
Title	Mechanical hazard - Access to the hazard moving parts from the side and rear of the machine		
Location	Machine Front		
Target	Upper Limbs		
Activity	Normal Operation		
Task	Operation		
Sub Task	Minor adjustments and setting of functional parameters of the machine		
Hazard Type	Mechanical Hazard with the consequence of		
Sub Type	Crushing		
Description	<p>Fixed guards have been installed on the both sides and rear side of the machine to prevent personnel accessing the hazardous moving parts, for example.</p> <ul style="list-style-type: none"> • Risk of crushing when the upper mold moves downwards • Risk of impact when the lower mold is moved horizontally <p>The fixed guard cannot be removed without the aid of the tools. The fixed guards can meet the requirements of EN ISO 14120 & EN ISO 13857. This risk is acceptable.</p>		
Risk Estimation and Evaluation			
Degree of Possible Harm:	11	Possibility of Avoidance:	2.5
Probability of Occurrence of a Hazardous Event:	0.05	Frequency And / Or Duration of Exposure:	5
Pilz Hazard Rating (PHR):	6	Summary Level:	Negligible Risk
Risk Reduction		Reference	
Following the measures implemented by YUSH Electronic the risk is acceptable.		EN ISO 14120 EN ISO 13857	
Possible Residual Risk			
Degree of Possible Harm:	11	Possibility of Avoidance:	2.5
Probability of Occurrence of a Hazardous Event:	0.05	Frequency And / Or Duration of Exposure:	5
Pilz Hazard Rating (PHR):	6	Summary Possible Level:	Negligible Risk

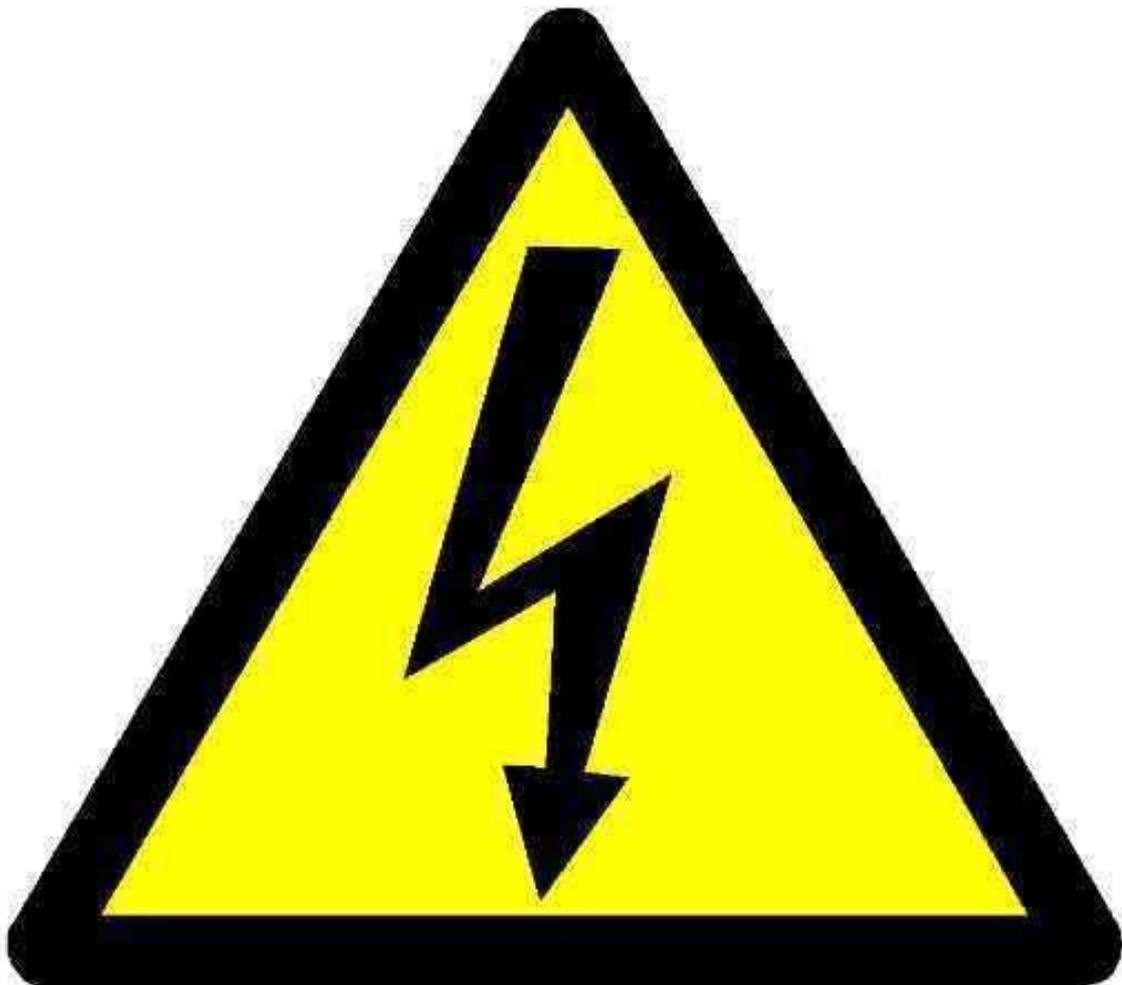


Picture 10 Hazard 1.3, Image 1, Allen type screws

4.5.2 Electrical Hazards

This section describes the Hazards related to the Electrical Panel which will be involved in the machine operation and maintenance as required by Low Voltage Directive and other related Normatives, including (if applicable):

- Arc
- Electromagnetic phenomena
- Electrostatic phenomena
- Live parts;
- Not enough distance to live
- Parts under high voltage;
- Overload
- Parts which have become live under fault conditions
- Short-circuit



Picture 11 Electrical Hazards

Hazard Identification		Hazard No:	2.1
Title	Unexpected start-up - electrical power isolation		
Location	Electrical Panel		
Target	People / Machine		
Activity	Maintenance		
Task	Cleaning Maintenance		
Sub Task	Isolation and energy dissipation		
Hazard Type	Other Hazards		
Sub Type	Unintended/unexpected start-up		
Description	<p>The release of stored energy which can be stored in the electrical storage devices can result in, for example, electric shock, unexpected machine behaviour or movement that can cause injury. The machine is fitted with a red/yellow lockable electrical isolator. This isolator, once turned to the off position and locked, removes electrical power from the machine. This prevents the risk of unexpected start-up during maintenance.</p>		
Risk Estimation and Evaluation			
Degree of Possible Harm:	40	Possibility of Avoidance:	5
Probability of Occurrence of a Hazardous Event:	0.05	Frequency And / Or Duration of Exposure:	1
Pilz Hazard Rating (PHR):	10	Summary Level:	Negligible Risk
Risk Reduction		Reference	
Proper LoTo procedure should be established by end user and operators should be trained to follow it.		EN 60204-1	
Possible Residual Risk			
Degree of Possible Harm:	40	Possibility of Avoidance:	5
Probability of Occurrence of a Hazardous Event:	0.05	Frequency And / Or Duration of Exposure:	1
Pilz Hazard Rating (PHR):	10	Summary Possible Level:	Negligible Risk

Hazard Identification		Hazard No:	2.2
Title	Electrical hazard due to insufficient protection of high voltage		
Location	Electrical Panel		
Target	People / Machine		
Activity	Maintenance		
Task	Fault-finding/Troubleshooting		
Sub Task	Fault-findings		
Hazard Type	Electrical Hazards		
Sub Type	Contact of persons with Live Parts (Direct Contact)		
Description	Touching any live parts (for example, exposed terminal, broken wire) installed inside the electrical cabinet can lead to electric shock. The electrical control cabinet is locked by keys and the electrical components in place can achieve IP2X to prevent direct contact with live parts. The electric cabinet on machine is marked with a warning signs to indicate a risk of electric shock. This risk is acceptable.		
Risk Estimation and Evaluation			
Degree of Possible Harm:	40	Possibility of Avoidance:	5
Probability of Occurrence of a Hazardous Event:	0.05	Frequency And / Or Duration of Exposure:	1
Pilz Hazard Rating (PHR):	10	Summary Level:	Negligible Risk
Risk Reduction		Reference	
Following the measures implemented by YUSH Electronic the risk is acceptable.		EN 60204-1	
Possible Residual Risk			
Degree of Possible Harm:	40	Possibility of Avoidance:	5
Probability of Occurrence of a Hazardous Event:	0.05	Frequency And / Or Duration of Exposure:	1
Pilz Hazard Rating (PHR):	10	Summary Possible Level:	Negligible Risk

	
<p>Picture 12 Hazard 2.2, Image 1, Insulation barrier</p>	<p>Picture 13 Hazard 2.2, Image 2, Warning signs</p>
	
<p>Picture 14 Hazard 2.2, Image 3, Warning signs</p>	

Hazard Identification		Hazard No:	2.3
Title	Indirect contact with live part under fault conditions		
Location	Electrical Panel		
Target	People / Machine		
Activity	Maintenance		
Task	Fault-finding/Troubleshooting		
Sub Task	Fault-findings		
Hazard Type	Electrical Hazards		
Sub Type	Parts which have become live under fault conditions (Indirect Contact)		
Description	<p>If a fault within an electrical device connects a live (unearthed) supply conductor to an exposed conductive surface, anyone touching it while electrically connected to the earth (e.g., by standing on it, or touching an earthed sink) will complete a circuit back to the earthed supply conductor and receive an electric shock. Protective earth bonding has been conducted, all electrical cabinet doors are connected with PE wires, PE terminals are applied inside the electrical cabinet for components earthing bonding, and there is no multi-bonding has been found.</p>		
Risk Estimation and Evaluation			
Degree of Possible Harm:	40	Possibility of Avoidance:	5
Probability of Occurrence of a Hazardous Event:	0.05	Frequency And / Or Duration of Exposure:	1
Pilz Hazard Rating (PHR):	10	Summary Level:	Negligible Risk
Risk Reduction		Reference	
Following the measures implemented by YUSH the risk is acceptable.		EN 60204-1	
Possible Residual Risk			
Degree of Possible Harm:	40	Possibility of Avoidance:	5
Probability of Occurrence of a Hazardous Event:	0.05	Frequency And / Or Duration of Exposure:	1
Pilz Hazard Rating (PHR):	10	Summary Possible Level:	Negligible Risk



Picture 15 Hazard 2.3, Image 1, PE cables



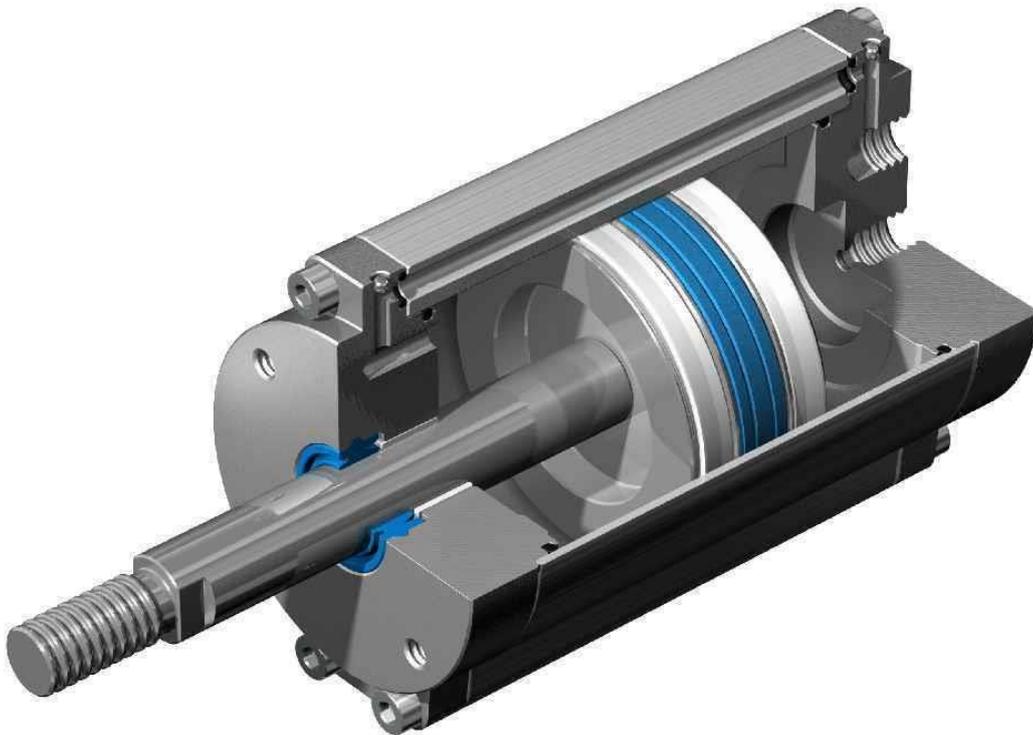
Picture 16 Hazard 2.3, Image 2, PE cables

Hazard Identification		Hazard No:	2.4
Title	Errors in wiring connections during maintenance		
Location	Electrical Panel		
Target	People / Machine		
Activity	Maintenance		
Task	Cleaning Maintenance		
Sub Task	Dismantling/removal of parts, components, devices of the machine		
Hazard Type	Other Hazards		
Sub Type	Errors of fitting		
Description	<p>Wrong colour of the cables and wires will make the operator misunderstanding if wrong colour of wire used. If the components, cables and terminals in the electrical cabinet is not labelled as per electrical drawings, it cannot be distinguished in case of repair and maintenance activities. Incorrect wiring could result in failure of the machines safety circuit or in general malfunctions and makes it very difficult for the maintenance team to undertake fault-finding. According to the site inspection, all electrical components and cables in the electrical drawing have their own labels, mis-wiring/wrong connection could be avoided.</p>		
Risk Estimation and Evaluation			
Degree of Possible Harm:	40	Possibility of Avoidance:	0.75
Probability of Occurrence of a Hazardous Event:	0.05	Frequency And / Or Duration of Exposure:	0.5
Pilz Hazard Rating (PHR):	1	Summary Level:	Negligible Risk
Risk Reduction		Reference	
Following the measures implemented by YUSH Electronic the risk is acceptable.		EN 60204-1	
Possible Residual Risk			
Degree of Possible Harm:	40	Possibility of Avoidance:	0.75
Probability of Occurrence of a Hazardous Event:	0.05	Frequency And / Or Duration of Exposure:	0.5
Pilz Hazard Rating (PHR):	1	Summary Possible Level:	Negligible Risk

4.5.3 Pneumatic Hazards

This section describes the pneumatic hazard which will be involved in the machine operation as required by Machinery Directive and other related Normative standard, including (if applicable):

- Insufficient Pneumatic and Hydraulic Power Supply
- Insufficient Cylinder Type
- Insufficient Solenoid Valve and Manual Valve Type
- Poor wiring of the pneumatic tube
- Other hazards related in the pneumatic and hydraulic part



Picture 17 Pneumatic Hazards

Hazard Identification		Hazard No:	3.1
Title	Unexpected start-up during maintenance - Pneumatic Isolation design		
Location	Pneumatic System		
Target	People / Machine		
Activity	Maintenance		
Task	Cleaning Maintenance		
Sub Task	Isolation and energy dissipation		
Hazard Type	Other Hazards		
Sub Type	Unintended/unexpected start-up		
Description	There is a manual valve with pressure release function at the inlet of the air source. This type valve can be locked during the maintenance to prevent unexpected start-up hazard. This risk is acceptable.		
Risk Estimation and Evaluation			
Degree of Possible Harm:	5	Possibility of Avoidance:	2.5
Probability of Occurrence of a Hazardous Event:	0.05	Frequency And / Or Duration of Exposure:	1
Pilz Hazard Rating (PHR):	1	Summary Level:	Negligible Risk
Risk Reduction		Reference	
Proper LoTo procedure should be established by end user and operators should be trained to follow it.		EN ISO 14118 EN ISO 4414	
Possible Residual Risk			
Degree of Possible Harm:	5	Possibility of Avoidance:	2.5
Probability of Occurrence of a Hazardous Event:	0.05	Frequency And / Or Duration of Exposure:	1
Pilz Hazard Rating (PHR):	1	Summary Possible Level:	Negligible Risk

Hazard Identification		Hazard No:	3.2
Title	Gravity fall of the vertical cylinder		
Location	Pneumatic System		
Target	People / Machine		
Activity	Normal Operation		
Task	Cleaning Maintenance		
Sub Task	Isolation and energy dissipation		
Hazard Type	Mechanical Hazard as a result of		
Sub Type	Gravity		
Description	A 5/3-way with mid-position exhausted valve and piloted check valve are used to prevent the risk of fall down due to gravity fall of the main vertical cylinder when loss of pressure. This risk is acceptable.		
Risk Estimation and Evaluation			
Degree of Possible Harm:	8	Possibility of Avoidance:	2.5
Probability of Occurrence of a Hazardous Event:	0.05	Frequency And / Or Duration of Exposure:	1
Pilz Hazard Rating (PHR):	1	Summary Level:	Negligible Risk
Risk Reduction		Reference	
The hazard of the residual air because of the use of piloted check valve shall be indicated in the operating manual.		EN ISO 4414	
Possible Residual Risk			
Degree of Possible Harm:	8	Possibility of Avoidance:	2.5
Probability of Occurrence of a Hazardous Event:	0.05	Frequency And / Or Duration of Exposure:	1
Pilz Hazard Rating (PHR):	1	Summary Possible Level:	Negligible Risk



Picture 18 Hazard 3.2, Image 1, 5/3-way with mid-position exhausted

Hazard Identification		Hazard No:	3.3
Title	Residual power in pneumatic circuit		
Location	Pneumatic System		
Target	People / Machine		
Activity	Normal Operation		
Task	Cleaning Maintenance		
Sub Task	Dismantling/removal of parts, components, devices of the machine		
Hazard Type	Other Hazards		
Sub Type	Unintended/unexpected start-up		
Description	Residual pneumatic power which is foreseeable to be remained in the circuit and/or cylinders after main pneumatic source has been cut off or related safety function has been violated could cause unexpected movement of moving elements, and this can cause injury to operator nearby. For example, piloted check valve and main cylinder still has residual power after the pneumatic isolator switch is cut off. This information has been indicated in the pneumatic drawing and manual.		
Risk Estimation and Evaluation			
Degree of Possible Harm:	5	Possibility of Avoidance:	0.75
Probability of Occurrence of a Hazardous Event:	2.5	Frequency And / Or Duration of Exposure:	1
Pilz Hazard Rating (PHR):	9	Summary Level:	Negligible Risk
Risk Reduction		Reference	
The end user needs to release the residual air pressure in the cylinder during maintenance to prevent accidental cylinder operation. This information shall be included in the user manual.		EN ISO 4414	
Possible Residual Risk			
Degree of Possible Harm:	5	Possibility of Avoidance:	0.75
Probability of Occurrence of a Hazardous Event:	0.05	Frequency And / Or Duration of Exposure:	1
Pilz Hazard Rating (PHR):	1	Summary Possible Level:	Negligible Risk

Hazard Identification		Hazard No:	3.4
Title	Wiring/wrong connection during maintenance		
Location	Pneumatic System		
Target	People / Machine		
Activity	Maintenance		
Task	Cleaning Maintenance		
Sub Task	Verification of parts, components, devices of the machine		
Hazard Type	Other Hazards		
Sub Type	Errors of fitting		
Description	<p>In a few but foreseeable situations that requires to disconnect pneumatic devices, for example replace broken device, therefore mis-wiring/wrong connection can occur when connecting and re-wiring which could result in fault condition in pneumatic circuit and cause wrong movements. All pneumatic components and pipes are identified by tags according to the pneumatic drawings, this risk is acceptable.</p>		
Risk Estimation and Evaluation			
Degree of Possible Harm:	11	Possibility of Avoidance:	2.5
Probability of Occurrence of a Hazardous Event:	0.05	Frequency And / Or Duration of Exposure:	0.5
Pilz Hazard Rating (PHR):	1	Summary Level:	Negligible Risk
Risk Reduction		Reference	
Following the measures implemented by YUSH Electronic the risk is acceptable.		EN ISO 4414 EN 60204-1	
Possible Residual Risk			
Degree of Possible Harm:	11	Possibility of Avoidance:	2.5
Probability of Occurrence of a Hazardous Event:	0.05	Frequency And / Or Duration of Exposure:	0.5
Pilz Hazard Rating (PHR):	1	Summary Possible Level:	Negligible Risk



Picture 19 Hazard 3.4, Image 1, Labels

4.5.4 Noise/Vibration Hazard

This section describes the noise and vibration hazard which will be generated from the process as shown blow:

- Cavitation phenomena;
- Exhausting system;
- Gas leaking at high speed;
- Manufacturing process(stamping, cutting, etc.);
- Moving parts;
- Scraping surfaces;
- Unbalanced rotating parts;
- Whistling pneumatics;
- Worn parts;
- Misalignment of moving parts;
- Mobile equipment;



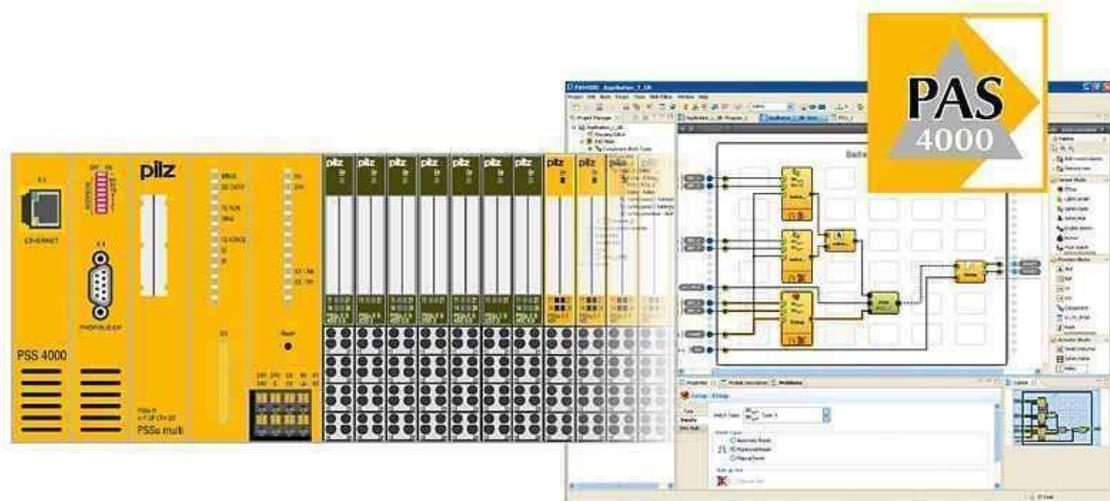
Picture 20 Noise/Vibration Hazard

Hazard Identification		Hazard No:	4.1
Title	Noise Generated From Machine		
Location	Machine Perimeter	<p>8.1 Noise test value 60-81dB. It is recommended that the operator wears headphones.</p>	
Target	People / Machine		
Activity	Normal Operation		
Task	Operation		
Sub Task	Driving the machine		
Hazard Type	Noise Hazards		
Sub Type	Gas leaking at high speed		
Description	The pneumatic leaking, noise of moving tool, deliver system shall be further measured to decide the required hearing protection measures. According to the manufacturer's manual, the noise level of the machine is 61-81dB, the operator needs to wear ear protection. Mandatory action signs to wear ear protection has been posted on the machine.		
Risk Estimation and Evaluation			
Degree of Possible Harm:		Possibility of Avoidance:	
Probability of Occurrence of a Hazardous Event:		Frequency And / Or Duration of Exposure:	
Pilz Hazard Rating (PHR):	N/A	Summary Level:	Acceptable
Risk Reduction		Reference	
The end-user should provide ear protection for the operator and train the relevant personnel.		EN ISO 12100	
Possible Residual Risk			
Degree of Possible Harm:		Possibility of Avoidance:	
Probability of Occurrence of a Hazardous Event:		Frequency And / Or Duration of Exposure:	
Pilz Hazard Rating (PHR):	N/A	Summary Possible Level:	Acceptable

4.5.5 Hazards related to the protective measures

This section describes the Hazards related to the Safety Related Control System which will be involved in the machine operation as required by Machinery Directive and other related Normatives, including (if applicable):

- Emergency Stops
- Interlock Switches
- Light Curtains
- Two Hand Control System
- Other Safety Related Control Devices
- Safety Related Part Control System
- Other hazards related in the Safety Related Control System



Picture 21 Hazards related to the protective measures

Hazard Identification		Hazard No:	5.1
Title	Operator error - Type of the E-stop button		
Location	Electrical Panel		
Target	People / Machine		
Activity	Normal Operation		
Task	Operation		
Sub Task	Control/inspection		
Hazard Type	Ergonomic Hazard		
Sub Type	Inadequate design, location or identification of control devices		
Description	There is an emergency stop button on the front of the machine, the emergency stop has a red activator and yellow background, the type of emergency stop can meet the requirements of EN ISO 13850.		
Risk Estimation and Evaluation			
Degree of Possible Harm:	11	Possibility of Avoidance:	2.5
Probability of Occurrence of a Hazardous Event:	0.05	Frequency And / Or Duration of Exposure:	2
Pilz Hazard Rating (PHR):	2	Summary Level:	Negligible Risk
Risk Reduction		Reference	
Following the measures implemented by YUSH Electronic the risk is acceptable.		EN ISO 13850	
Possible Residual Risk			
Degree of Possible Harm:	11	Possibility of Avoidance:	2.5
Probability of Occurrence of a Hazardous Event:	0.05	Frequency And / Or Duration of Exposure:	2
Pilz Hazard Rating (PHR):	2	Summary Possible Level:	Negligible Risk

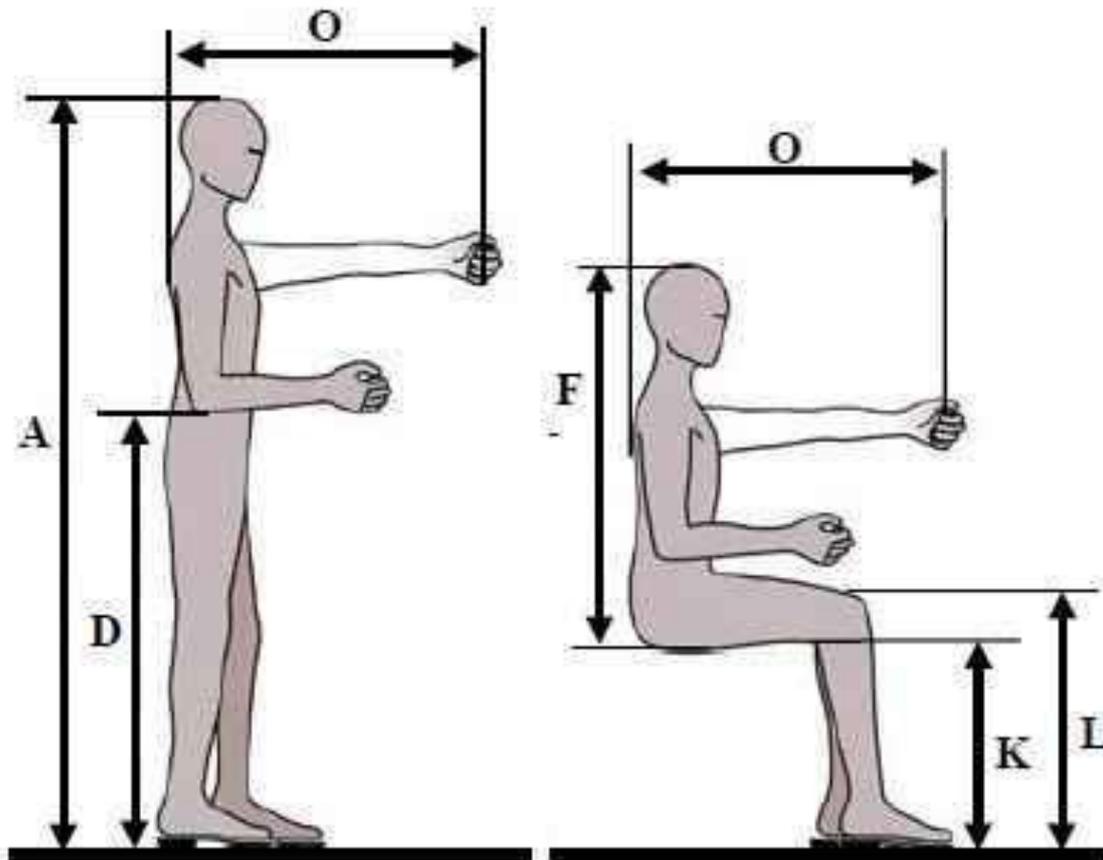
Hazard Identification		Hazard No:	5.2
Title	Failure of E-stop function - Insufficient Performance Level		
Location	Electrical Panel		
Target	People / Machine		
Activity	Normal Operation		
Task	Operation		
Sub Task	Control/inspection		
Hazard Type	Other Hazards		
Sub Type	Failure of the Control System		
Description	Dual-channel emergency stop (SB1) are connected in series to the safety relay (PILZ PNOZ X2.8P), the safety output will cut off the coils of KA1&KA2 to cut off the power supply of dual residual pressure release valve V1 (VP544R-5DZ1-03-X538), the feedback signal from the V1 is connected to the safety relay, and the emergency stop safety control circuit can meet the requirements of EN ISO 13849-1 PLr=d.		
Risk Estimation and Evaluation			
Degree of Possible Harm:	5	Possibility of Avoidance:	2.5
Probability of Occurrence of a Hazardous Event:	0.05	Frequency And / Or Duration of Exposure:	2
Pilz Hazard Rating (PHR):	1	Summary Level:	Negligible Risk
Risk Reduction		Reference	
Following the measures implemented by YUSH Electronic the risk is acceptable.		EN ISO 13850 EN ISO 13849-1	
Possible Residual Risk			
Degree of Possible Harm:	5	Possibility of Avoidance:	2.5
Probability of Occurrence of a Hazardous Event:	0.05	Frequency And / Or Duration of Exposure:	2
Pilz Hazard Rating (PHR):	1	Summary Possible Level:	Negligible Risk

Hazard Identification		Hazard No:	5.3
Title	Failure of safety light curtain function - Insufficient Performance Level		
Location	Electrical Panel		
Target	People / Machine		
Activity	Normal Operation		
Task	Operation		
Sub Task	Control/inspection		
Hazard Type	Other Hazards		
Sub Type	Failure of the Control System		
Description	<p>OSSD1 & OSSD2 of the safety light curtain are connected to the safety relay, the safety output will cut off the coils of KA1&KA2 to cut off the power supply of dual residual pressure release valve V1 (VP544R-5DZ1-03-X538), the feedback signal from the V1 is connected to the safety relay, and the light curtain safety control circuit can meet the requirements of EN ISO 13849-1 PLr=d.</p>		
Risk Estimation and Evaluation			
Degree of Possible Harm:	5	Possibility of Avoidance:	2.5
Probability of Occurrence of a Hazardous Event:	0.05	Frequency And / Or Duration of Exposure:	5
Pilz Hazard Rating (PHR):	3	Summary Level:	Negligible Risk
Risk Reduction		Reference	
Following the measures implemented by YUSH Electronic the risk is acceptable.		EN ISO 13849-1	
Possible Residual Risk			
Degree of Possible Harm:	5	Possibility of Avoidance:	2.5
Probability of Occurrence of a Hazardous Event:	0.05	Frequency And / Or Duration of Exposure:	5
Pilz Hazard Rating (PHR):	3	Summary Possible Level:	Negligible Risk

4.5.6 Ergonomic Hazard

This section describes the ergonomic factors have to be taken into account when designing machinery. Operator variability, space of movement, work rate, Concentration, Man/Machine Interface, including (if applicable):

- Excessive effort, Repetitive activity, Mental overload/boredom, and Unhealthy posture;
- Flicker, dazzling, shadow, stroboscopic effect
- Inadequate design, location or identification of control devices;
- Inadequate design or location of indicators and visual display units
- Insufficient visibility and Inadequate local lighting.



Picture 22 Ergonomic Hazard

Hazard Identification		Hazard No:	6.1
Title	Possible misuse - Colour code and label of push-buttons or indicator		
Location	Electrical Panel		
Target	People / Machine		
Activity	Normal Operation		
Task	Operation		
Sub Task	Control/inspection		
Hazard Type	Ergonomic Hazard		
Sub Type	Inadequate design, location or identification of control devices		
Description	<p>Wrong colour code of the push button or lack of description label may cause the misuse of the machine. There are several push buttons on the front of the machine:</p> <ul style="list-style-type: none"> • Start button is green • Stop button is red • Reset button is blue <p>The color coding of the push buttons can meet the requirements of EN 60204-1. All pushbuttons are labelled with a description of their function.</p>		
Risk Estimation and Evaluation			
Degree of Possible Harm:	11	Possibility of Avoidance:	0.75
Probability of Occurrence of a Hazardous Event:	0.05	Frequency And / Or Duration of Exposure:	3
Pilz Hazard Rating (PHR):	1	Summary Level:	Negligible Risk
Risk Reduction		Reference	
Following the measures implemented by YUSH Electronic the risk is acceptable.		EN 60204-1 EN ISO 12100	
Possible Residual Risk			
Degree of Possible Harm:	11	Possibility of Avoidance:	0.75
Probability of Occurrence of a Hazardous Event:	0.05	Frequency And / Or Duration of Exposure:	3
Pilz Hazard Rating (PHR):	1	Summary Possible Level:	Negligible Risk

4.5.7 Documentation

This section describes the Non-compliance of documentation which will be involved in the machine operation as required by Machinery Directive and other related Normative standards, including (if applicable):

- Lack of electrical drawings
- Lack of pneumatic/hydraulic drawings
- Lack of necessary manuals
- Difference between documentation and actual situation
- Other non-compliance related in the documentation part



Picture 23 Documentation

Hazard Identification		Hazard No:	7.1
Title	Inadequate documentation		
Location	Documentation		
Target	People / Machine		
Activity	Various		
Task	Various		
Sub Task	Various		
Hazard Type	Other Hazards		
Sub Type	Inadequate Documentation		
Description	The electrical diagram, mechanical diagram, pneumatic diagram, safety distance calculation report and operator manual have been provided. The language of this documentation is English, which is acceptable to the end-user.		
Risk Estimation and Evaluation			
Degree of Possible Harm:		Possibility of Avoidance:	
Probability of Occurrence of a Hazardous Event:		Frequency And / Or Duration of Exposure:	
Pilz Hazard Rating (PHR):	N/A	Summary Level:	Acceptable
Risk Reduction		Reference	
Following the measures implemented by YUSH Electronic the risk is acceptable.		EN ISO 12100 EN ISO 4414 EN ISO 13855 EN ISO 20607	
Possible Residual Risk			
Degree of Possible Harm:		Possibility of Avoidance:	
Probability of Occurrence of a Hazardous Event:		Frequency And / Or Duration of Exposure:	
Pilz Hazard Rating (PHR):	N/A	Summary Possible Level:	Acceptable

4.6 Priority Listing

Priority	Hazard No	Hazard Name	PHR	Risk Level
1	1.2	Impact hazard due to the movement of the lower mold	14	Very Low Risk
2	2.1	Unexpected start-up - electrical power isolation	10	Negligible Risk
3	2.2	Electrical hazard due to insufficient protection of high voltage	10	Negligible Risk
4	2.3	Indirect contact with live part under fault conditions	10	Negligible Risk
5	3.3	Residual power in pneumatic circuit	9	Negligible Risk
6	1.1	Crushing hazard due to the movement of the upper mold	6	Negligible Risk
7	1.3	Mechanical hazard - Access to the hazard moving parts from the side and rear of the machine	6	Negligible Risk
8	5.3	Failure of safety light curtain function - Insufficient Performance Level	3	Negligible Risk
9	5.1	Operator error - Type of the E-stop button	2	Negligible Risk
10	2.4	Errors in wiring connections during maintenance	1	Negligible Risk
11	3.1	Unexpected start-up during maintenance - Pneumatic Isolation design	1	Negligible Risk
12	3.2	Gravity fall of the vertical cylinder	1	Negligible Risk
13	3.4	Wiring/wrong connection during maintenance	1	Negligible Risk
14	5.2	Failure of E-stop function - Insufficient Performance Level	1	Negligible Risk
15	6.1	Possible misuse - Colour code and label of push-buttons or indicator	1	Negligible Risk
16	4.1	Noise Generated From Machine	N/A	Acceptable
17	7.1	Inadequate documentation	N/A	Acceptable

4.7 Risk Reduction

Due to the hazards detailed in the earlier section 4.6 Findings, it is necessary to carry out a risk reduction for each hazard where the estimated risk is determined to be unacceptable as detailed in the findings.

After the required safety measures are implemented it will be necessary to ensure that the risk posed by each hazard has been reduced to the level specified in this document by performing a final risk evaluation.

On completion of the risk reduction measures and the final risk evaluation, the residual risk associated with all hazards will have to be assessed and documented as part of the risk assessment report. This is

the possible risk that a hazard may possess even after risk reduction measures have been implemented due to the fact that it was not possible to design a complete safety solution to eradicate the risk.

In order to inform the user of these residual risks related with the machine that have not been reduced by the design of contra measures, special indications should be included in the operator procedure documentation and warnings should be placed on the machine.

5 Conclusion

The risk assessment of the 15T FPC Punch Machine conducted at YUSH Electronic Technology Co.,Ltd site has found a few of non-conformances to the Machinery Directive 2006/42/EC and relevant European Normatives.

The main concern on the machine includes:

- The safety distance from the vertical light curtain to the lower mold is less than 100mm, which is insufficient. The warning labels already provided on the front of the machine indicating the risk of impacts. End-users need to train operators to caution about the risk of lower mold impacts.
- Proper LoTo procedure should be established by end user and operators should be trained to follow it.
- The end-user should provide ear protection for the operator and train the relevant personnel.
- The end user needs to release the residual air pressure in the cylinder during maintenance to prevent accidental cylinder operation.

For more detailed information about the deviations, please refer to the individual findings.

2023-09-21
Pilz China

APPENDIX 1 Terminology

Machinery / Machine:

Assembly, fitted with or intended to be fitted with a drive system consisting of linked parts or components, at least one of which moves, and which are joined together for a specific application.

Reliability:

The ability of a machine or components, or equipment to perform a required function under specified conditions and for a given period of time without failing.

Safety of machine:

The ability of a machine to perform its function, to be transported, installed, adjusted, maintained, dismantled and disposed of under conditions of intended use specified in the instruction handbook without causing injury or damage to health.

Hazard:

A potential source of harm.

Hazardous situation:

Any situation in which a person is exposed to a hazard or to hazards.

Risk:

A combination of the probability of occurrence of harm and the severity of that harm.

Risk Assessment:

Overall process comprising a risk analysis and a risk evaluation.

Harm:

Physical injury or damage to health.

Danger zone (or Hazard zone):

Any space within and/or around machinery in which a person can be exposed to a hazard.

Exposed person:

Any person wholly or partially in a danger zone.

Operator:

The person or persons given the task of mainly operating machinery. Minor adjusting, maintaining, and cleaning tasks might also be executed.

Preliminary Hazard Analysis:

PHA is an inductive method, whose objective is to identify, for all phases of life of a specified system / subsystem / component the hazards, hazardous situations and hazardous events which could lead to an accident.

Performance Level:

Discrete Level used to specify the ability of the safety-related parts of a control system to perform a safety function under unforeseeable conditions

Safety Component:

A component placed on the market separately to fulfil a safety function when in use and the failure or malfunctioning of which endangers the safety or health of exposed persons

Warning devices:

Visible/audible alarms to trigger avoidance or corrective responses (e.g., signals, lights, signs, horns). Training and discipline in recognizing and responding is necessary. Their value to personnel with vision or hearing impairments is questionable.

Procedures and training:

Formal or informal training, checklists, certification or experience requirements, personal protective equipment use.

Residual risk:

Risk remaining after protective measures have been implemented.

Safeguarding:

Protective measure using safeguards to protect persons from the hazards which cannot reasonably be eliminated or from the risks which cannot be sufficiently reduced by inherently safe design measures

Safety function:

Function of a machine whose failure can result in an immediate increase of the risk(s)

Failure:

The termination of the ability of an item to perform a required function.

Emergency situation:

Hazardous situation needing to be urgently ended or averted.

Machine control system:

System which responds to an input from, for example, the process, other machine elements, an operator, external control equipment, and generates an output(s) causing the machine to behave in the intended manner.

Safety-related electrical control system (SRECS):

Electrical, electronic or programmable electronic part of a machine control system whose failure can result in an immediate increase of the risk(s)

Safety Related Part of a Control System (SRP/CS):

Part of a control system that responds to safety-related input signals and generates safety-related output signals

Diagnostic function:

Function intended to detect faults in the control system and produce a specified output information or activity when a fault is detected.

Safety Integrity:

Probability of a Safety Related Electrical Control System or its subsystem satisfactorily performing the required safety functions under all stated conditions

Task:

Specific activity performed by one or more persons on, or in the vicinity of, the machine during its life cycle.

Reasonably foreseeable misuse:

Use of a machine in a way not intended by the designer, but which can result from readily predictable human behaviour.

Safety of control systems:

Ability of safety-related parts of a control system to perform their safety function(s) for a given time according to their specified category or performance level

Hazardous machine function:

Any function of a machine, which generates a hazard when operating.

Risk reduction, adequate:

Risk reduction at least in accordance with the legal requirements under consideration of the current state of the art.

Protective Measure:

Measure intended to achieve risk reduction.

Inherently Safe Design Measure:

Protective measure which either eliminates hazards or reduces the risks associated with hazards by changing the design or operating characteristics of the machine without the use of guards or protective devices.

Hazard, relevant:

Hazard which is identified (as part of the risk assessment process) as being present at, or associated with the machine.

Hazard, significant:

Hazard which has been identified as relevant and which requires specific action to eliminate or to reduce the risk according to the risk assessment.

Hazardous event:

Event that can cause harm. A hazardous event can occur over a short period of time or over an extended period of time.

Inherently safe design measures:

Protective measure which either eliminates hazards or reduces the risks associated with hazards by changing the design or operating characteristics of the machine without the use of guards or protective devices.

Information for use:

Protective measure consisting of communication links (for example, text, words, signs, signals, symbols, diagrams) used separately or in combination, to convey information to the user.

Intended use:

Use of a machine in accordance with the information for use provided in the instructions.

Risk analysis:

Combination of the specification of the limits of the machine, hazard identification and risk estimation.

Risk estimation:

Defining likely severity of harm and probability of occurrence.

Risk evaluation:

Judgement, on the basis of risk analysis, of whether the risk reduction objectives have been achieved.

APPENDIX 2 Abbreviations

HECP	Hazardous Energy Control Procedure
N/A:	Not Available, Not Applicable
Not Accept:	Not Acceptable
BPCS:	Basic Process Control System
SRS:	Safety Requirement Specification
FDS:	Functional Design Specification
HAZOP:	Hazard and Operability Study
EMC:	Electromagnetic Compatibility
CCF:	Common Cause Failure
PFDF:	The Probability of Failure on Demand
MTBF:	Mean Time Between Failures
MTTF:	Mean Time To Failure
MTTR:	Mean Time To Restoration
PHA:	Preliminary Hazard Analysis
PL:	Performance Level
SIF:	Safety Instrumented Function
SIL:	Safety Integrity Level
SIS:	Safety Instrumented System
SFF:	Safe Failure Fraction
DC:	Diagnostic Coverage
I/O:	Input/Output
FB:	Function Block
PFHD:	Probability of dangerous Failure per Hour
SRCF:	Safety-Related Control Function
SYS:	System
URS:	User Requirement Specification
SRP/CS:	Safety-related part of a control system
SRECS:	Safety-related electrical control system

APPENDIX 3 Legislative References

Reference	Legislation - EU
2006/42/EC:	Machinery Safety
2014/108/EC:	Electromagnetic Compatibility
2014/35/EC:	Low Voltage equipment

Table 9 Legislative references EU

APPENDIX 4 Normative References

Reference	Standards Title
EN ISO 4414: 2010	Pneumatic fluid power - General rules and safety requirements for systems and their components
EN ISO 12100: 2010	Safety of machinery — Basic concepts, 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 ISO 13850: 2015	Safety of machinery - Emergency stop function - Principles for design (ISO 13850:2015)
EN ISO 13849-1: 2015	Safety of machinery - Safety-related parts of control systems - Part 1: General principles for design (ISO 13849-1:2015)
EN ISO 13857: 2008	Safety of machinery - Safety distances to prevent hazard zones being reached by upper and lower limbs
EN ISO 13855: 2010	Safety of machinery - Positioning of safeguards with respect to the approach speeds of parts of the human body (ISO 13855: 2010)
EN ISO 11161: 2007+A1:2010	Safety of machinery - Integrated manufacturing systems - Basic requirements
EN ISO 14119: 2013	Safety of machinery - Interlocking devices associated with guards - Principles for design and selection
EN ISO 7010: 2019	Graphical symbols – Safety colours and safety signs – Registered safety signs
EN ISO 13854: 2017	Safety of machinery – Minimum gaps to avoid crushing of parts of the human body
IEC 61496 : 2020	Safety of machinery - Electro-sensitive protective equipment - Part 1: General requirements and tests
ISO 13851: 2019	Safety of machinery — Two-hand control devices — Principles for design and selection
IEC 62046: 2018	Safety of machinery - Application of protective equipment to detect the presence of persons
EN ISO 14118: 2018	Safety of machinery - Prevention of unexpected start-up (ISO 14118:2017)
EN 842: 1996+A1:2008	Safety of machinery. Visual danger signals. General requirements, design and testing
EN ISO 4871: 2009	Acoustics - Declaration and verification of noise emission values of machinery and equipment
EN ISO 14120: 2015	Safety of machinery - Guards - General requirements for the design and construction of fixed and movable guards
EN ISO 20607: 2019	Safety of machinery - Instruction handbook - General drafting principles (ISO 20607:2019)

Table 10 Normative references