LIBRO INSTRUCCIONES 3000 X 4

METALWORKS

CIZALLA HIDRÁULICA CON TOPE MOTORIZADO QC 12Y

METALWORKS

Metalworks presenta la Cizalla **HIDRÁULICA CON TOPE MOTORIZADO.**
diseñada para cortar de manera eficaz distintos materiales férricos y no férrico
Además de conseguir un corte potente, aportan un gran volumen de trabajo y permite reducir no solo los tiempos de producción, sino también los costes.

Características principales

1. Calidad, eficiencia y precio

2. Estructura Electro soldada, evitando vibraciones, eliminando fatiga de material y aportando estabilidad al corte.El accionamiento es hidráulico con corte pendular, el retorno de la cuchilla es suave rápido gracias al acumulador de nitrógeno.

3. Gracias al control digital incorporado en la cizalla se puede programar la bajada de la hoja a la medida deseada.

4. Dispone de ajuste de cuchilla, dependiendo del espesor o calidad de material a cortar, mediante un dial de ajuste.

5. Tope motorizado con husillos de bolas comandado con el panel frontal de la máquina.

6. Fácil programación gracias al control digital, indicando distancias del tope y número de cortes.

7. Tope delantero con escuadra y escala graduada. Incorpora bolas de deslizamiento para ayuda de posicionamiento de la chapa.

8. Protección delantera abatible con micro y fotocelula trasera para evitar acceso de personal no permitido.


METAL
WORKS

Cizalla Hidráulica con tope motorizado
QC 12Y

Barrera frontal abatible

Electrónica Siemens

Sensor fotoeléctrico confiable para seguridad

Válvula O.M.G

Caja de control (con pantalla digital)

Conector Alemán hidráulico JS

Ficha técnica
CIZALLA HIDRÁULICA
QC 12Y

Modelo	Código	Capacidad de corte máximo	Ancho de corte	Ángulo de corte	Potencia eléctrica
4X2000	7131010	4 mm	2000 mm	1°30'	4 KW
4X2500	7131020	4 mm	2500 mm	1°30'	4 KW
4X3200	7131030	4 mm	3200 mm	1°30'	5.5 KW
4×4000	7131040	4 mm	4000 mm	1°12'	5.5 KW
4×5000	7131050	4 mm	5000 mm	1°30'	7.5 KW
6x2000	7131060	6 mm	2000 mm	1°30'	7.5 KW
6X2500	7131070	6 mm	2500 mm	1°30'	7.5 KW
6x3200	7131080	6 mm	3200 mm	1°30'	7.5 KW
6x4000	7131090	6 mm	4000 mm	1°30'	7.5 KW
6×5000	7131100	6 mm	5000 mm	1°30'	11 KW
6×6000	7131110	6 mm	6000 mm	1°30'	11 KW
8x2500	7131120	8 mm	2500 mm	1°30'	11 KW
8x3200	7131130	8 mm	3200 mm	1°30'	11 KW
8×4000	7131140	8 mm	4000 mm	1°30'	11 KW
8x6000	7131150	8 mm	6000 mm	1°30'	22 KW
10X2500	7131160	10 mm	2500 mm	1°30'	18.5 KW
10X3200	7131170	10 mm	3200 mm	1°30'	18.5 KW
12X2500	7131180	12 mm	2500 mm	1°30'	18.5 KW
12X3200	7131190	12 mm	3200 mm	1°30'	18.5 KW
12×4000	7131200	12 mm	4000 mm	1°30'	18.5 KW
12X5000	7131210	12 mm	5000 mm	1°30'	18.5 KW
16X2500	7131220	16 mm	2500 mm	2°	22 KW
16X3200	7131230	16 mm	3200 mm	2°	22 KW
16×4000	7131240	16 mm	4000 mm	2°	22 KW
20X2500	7131250	20 mm	2500 mm	2°30'	30 KW
20X3200	7131260	20 mm	3200 mm	2°30'	37 KW
25×2500	7131270	25 mm	2500 mm	3°12'	45 KW
25X3200	7131280	25 mm	3200 mm	3°	45 KW

Accesorios
Standard y Opcionales

- Control cnc standar E21S ESTUN

Visualizadores Opcionales:

- E10 Pantalla digital
- Pantalla digital Siko
- Pantalla digital NC89

Campos de aplicación

• permiten cortar chapas o metales de diferente grosor de forma rápida y sencilla, y con apenas esfuerzo por parte del operario.

Material de aplicación

distintos materiales férricos y no férricos

Muestras

QC 12Y

Servicios posventa

1. Todas nuestras máquinas son objeto de una inspección exhaustiva por parte de los servicios de control de calidad antes de su envío.Garantizamos un período de garantía de un año para todas nuestras máquinas (con exclusión de las averías).

2. Contenido de la capacitación: principios operativos, estructura de los sistemas, seguridad y mantenimiento, programas informáticos y técnicas de procesamiento, etc.

3. La abundante información recibida de los clientes demuestra que nuestras máquinas funcionan de manera estable y que rara vez funcionan mal.Sin embargo, en caso de fallo, nos ocuparemos de la manera siguiente:

A. Nos comprometemos a darle una respuesta en un plazo de 24/48 horas.

B. El Servicio al cliente le ayudará y le orientará en el análisis de fallos para determinar sus causas.

C. En caso de que el fallo se deba a un error pequeño, como el mal funcionamiento del programa, ayudaremos a resolver el problema online.

D. Prestaremos un gran apoyo online, por ejemplo, proporcionando especificaciones técnicas y de instalación detalladas por correo electrónico, vídeo y teléfono. Formación y puesta en marcha del equipo (opcional).

ASLAK
MACHINES & TOOLS

METALWORKS

Calle Salvador Gil i Vernet, 5 Pol. Ind. Can Torras i Can Llobet, 08192 Sant Quirze del Vallès,
Barcelona, España

QC 12Y

Cizalla Hidráulica con tope motorizado

- Estructura Electro-soldada para evitar vibraciones y eliminar tensión del material gran robustez.
- Accionamiento hidráulico, corte pendular y acumulador de nitrógeno.
- Se puede ajustar el angulo de la cuchilla dependiendo del espesor del material.
- La posición de la cuchilla se puede ajustar a la medida deseada.
- La posición del tope se puede ver en el dial frontal de la máquina.
- Los dispositivos de ajuste de tope y cizallado están en la parte delantera de la cizalla.
- Se puede seleccionar golpe a golpe o golpe continuo.
- Preselección del número de cortes.
- Guía de rodillos para garantizar el manejo de la chapa.
- Protección delantera basculante para poder posicionar la chapa en los pisadores.
- Fotocélulas traseras, para evitar el funcionamiento en el caso de intrusión de personal no autorizado.

Fotocélulas de seguridad

Protector frontal abatible

Conectores hidráulicos

Componentes Siemens

Panel con display digital

OMG valvulas

QC 12Y

Subject to product upgrade and parameter change without prior notice

Especificación

Modelo	Código	Espesor de Corte	Longitud de corte	Angulo de corte	Golpes por minuto	Tope motorizado	Potencia motor	Dimensiones
4x2000	7131010	4 mm	2000 mm	1°30′	22 min-1	20~480 mm	4 KW	2650x1500x1600 mm
4x2500	7131020	4 mm	2500 mm	1°30′	20 min-1	20~480 mm	4 KW	3200x1500x1600 mm
4x3200	7131030	4 mm	3200 mm	1°30′	20 min-1	20~600 mm	5.5 KW	3900x1750x1800 mm
4x4000	7131040	4 mm	4000 mm	1°12′	18 min-1	20~600 mm	5.5 KW	4700x1750x1800 mm
4x5000	7131050	4 mm	5000 mm	1°30′	14 min-1	20~600 mm	7.5 KW	5655x1850x1850 mm
6x2000	7131060	6 mm	2000 mm	1°30′	20 min-1	20~600 mm	7.5 KW	2580x1530x1600 mm
6x2500	7131070	6 mm	2500 mm	1°30′	18 min-1	20~600 mm	7.5 KW	3200x1750x1750 mm
6x3200	7131080	6 mm	3200 mm	1°30′	16 min-1	20~600 mm	7.5 KW	3900x1750x1800 mm
6x4000	7131090	6 mm	4000 mm	1°30′	14 min-1	20~600 mm	7.5 KW	4750x1850x1900 mm
6x5000	7131100	6 mm	5000 mm	1°30′	8 min-1	20~600 mm	11 KW	5690x2000x2100 mm
6x6000	7131110	6 mm	6000 mm	1°30′	6 min-1	20~600 mm	11 KW	6800x2280x2000 mm
8x2500	7131120	8 mm	2500 mm	1°30′	14 min-1	20~600 mm	11 KW	3300x1750x1850 mm
8x3200	7131130	8 mm	3200 mm	1°30′	12 min-1	20~600 mm	11 KW	3900x1750x1850 mm
8x4000	7131140	8 mm	4000 mm	1°30′	10 min-1	20~600 mm	11 KW	4800x1850x1900 mm
8x6000	7131150	8 mm	6000 mm	1°30′	6 min-1	20~900 mm	22 KW	6900x2280x2400 mm
10x2500	7131160	10 mm	2500 mm	1°30′	12 min-1	20~900 mm	18.5 KW	3300x1950x2100 mm
10x3200	7131170	10 mm	3200 mm	1°30′	10min-1	20~900 mm	18.5 KW	4000x2100x2100 mm
12x2500	7131180	12 mm	2500 mm	1°30′	8 min-1	20~800 mm	18.5 KW	3250x2280x2280 mm
12x3200	7131190	12 mm	3200 mm	1°30′	10 min-1	20~800 mm	18.5 KW	3950x2280x2280 mm
12x4000	7131200	12 mm	4000 mm	1°30′	8 min-1	20~900 mm	18.5 KW	4800x2280x2280 mm
12x5000	7131210	12 mm	5000 mm	1°30′	8 min-1	20~800 mm	18.5 KW	5750x2260x2240 mm
16x2500	7131220	16 mm	2500 mm	2°	12 min-1	20~900 mm	22 KW	3300x2280x2280 mm
16x3200	7131230	16 mm	3200 mm	2°	10 min-1	20~900 mm	22 KW	4000x2280x2280 mm
16x4000	7131240	16 mm	4000 mm	2°	8 min-1	20~900 mm	22 KW	4800x2280x2280 mm
20x2500	7131250	20 mm	2500 mm	2°30′	10 min-1	20~900 mm	30 KW	3600x2800x3000 mm
20x3200	7131260	20 mm	3200 mm	2°30′	8 min-1	20~900 mm	37 KW	4400x2700x2600 mm
25x2500	7131270	25 mm	2500 mm	3°12′	8 min-1	20~900 mm	45 KW	3600x2900x3000 mm
25x3200	7131280	25 mm	3200 mm	3°	5 min-1	20~900 mm	45 KW	4400x2900x3000 mm

Accessorios

ASLAK
Salvador Gil i Vernet, 5. (Pol. Ind. Can Torras i Can Llobet)
08192 - Sant Quirze del Vallès. Barcelona.
+34 937 189 091
info@aslak.es

Accesorios Opcionales
·1. E10 digital display
·2. Siko digital display
·3. NC89 digital display

1


2


3

Subject to product upgrade and parameter change without prior notice

CIZALLA HIDRáULICA MOTORIZADA MWQC12Y4 - 4MM 3200MM

REF: 37131030

Descripción

Cizalla Hidráulica Motorizada modelo MWQC12Y4 de Metal Works. Serie industrial.

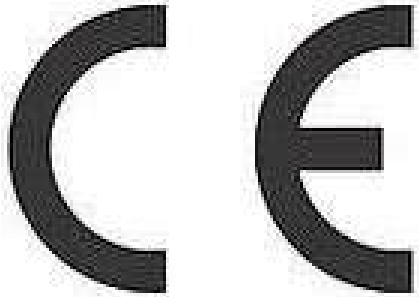
Características:

- **Cuchilla con ángulo ajustable en función del espesor del material**
- **20 golpes por minuto**
- **Permite el trabajo continuo o golpe a golpe**
- **Posición del tope trasero controlada a través del dial frontal de la máquina**
- **Estructura robusta y pesada**

Características técnicas

- **Peso neto: 5.800 kg**
- **Dimensiones (l x an x al): 3.900 x 1.750 x 1.800 mm**
- **Espesor máx. de chapa: 4 mm**
- **Anchura máx. de corte: 3.200 mm**
- **Potencia del motor: 5,5 kW**
- **Ángulo de corte: 1°30'**
- **Longitud de tope: 20 - 600 mm**

Technical Construction Files



Shearing Machine

Model:

QC12K-6×3200, QC12Y, QC12K

According to
2006/42/EC Machinery Directive
2014/30/EU Electromagnetic Compatibility Directive

Jiangsu Jianghai Machinery Group Co., Ltd.

No. 1 Jianghai Road, Libao, Haian, Jiangsu, China

Technical File No.:	Issue Date:	Prepared by:	Approved by:
JH-2021-04-02	2021-04-12		

Documents Reference

1.0 Information about The Manufacturer

Jiangsu Jianghai Machinery Group Co., Ltd. was founded in the early 1970s, and located in Libao industry area, Hai"an, Jiangsu, China. It is footprint 50,000 square meters, construction of 37,000 square meters. It is a shareholding private enterprise after restructuring.

There are 450 workers in our company, with more than one hundred different engineers, and more then 150 types of advanced processing and detection machines. We have the capacity of independent research and development and production of various types of machine tools. Also design development is strong. We introduce CAD computer design and management.

Our products are: Series Q11, QH11D type, QC12Y type, QC12K Shearing Machine, Series WC67Y, WC67K Hydraulic Press Brake, and series CNC T44QK Uncoil, Level and Rolling Machine. Jianghai Group is one of the key enterprises for Press Brake and Shearing Machine. Our company is the high-tech enterprises in Jiangsu Province, with agreed China Import and Export Commodity Quality Certification issued by the Center of Quality System Certification,and quality permit from Exit Inspection and Quarantine.

We can produce the CNC tandem Press Brake under 600 tons, and Shearing Machine with the length smaller than 6 meters. We have an output for Press Brake and Shearing Machine more than 1500 sets. We sell our machines to more than 30 best-selling products provinces in China, and more than 30 countries in the world, such as United States, the Middle East, South Africa, and Southeast Asia.

We consider the "Mold brand, Create brand" as the important objectives during the development of our company. We establish and improve the creation of leaders, create targets, and carry out the details. We operate standardized management, and constantly improve the company the overall strength. We win “Jianghai” brand – Well-known trademarks and brand-name products of Nantong City 2006. And in 2007, we win “Jianghai” brand – Well-known trademarks and brand-name products of Jiangsu Province.

Customers at home and abroad are warmly welcomed to visit our company.

2.0 EC Declaration of Conformity

EC Declaration of conformity

Council Directive
2006/42/EC Machinery Directive
2014/30/EU Electromagnetic Compatibility Directive

Jiangsu Jianghai Machinery Group Co., Ltd.

No. 1 Jianghai Road, Libao, Haian, Jiangsu, China

Tel：+86-513-88212462 Fax：+86-513-88212341

Certify that the product described is in conformity with the Directive
2006/42/EC, 2014/30/EU as amended

Product Name:

Shearing Machine

Model:

QC12K-6×3200, QC12Y, QC12K

The product has been assessed by the application of the following standards:

EN 60204-1:2018, EN ISO 12100:2010, EN 13985:2003+A1:2009,
EN IEC 61000-6-2:2019, EN IEC 61000-6-4:2019

This product (s) which are defined herein was (were) manufactured under the conditions of the European Union directive and standards. This declaration of conformity is issued under the sole responsibility of the manufacturer. Also, this product(s) responsibility is under our firm's guarantee.

Company stamp and Signature: _____

Issue Place: Haian, Jiangsu, China

Date: 2021/04/02

3.0 Machine General Description

This machine is used for shearing steel plates with thickness of 1-6mm and width of2000/2500/3200/4000mm. Basically, this kind of machine belongs to simple machine and with low risk when using it. All possible risk have been analyzed in the risk assessment report and been prevented by suitable ways.
The main risk of this kind of machine could be:
—The risk of access to the in-running nips.
—The risk of access to the power transmission elements.
—The risk of access to the area between moving parts and fixed parts which with crushing hazards.
In order to evaluate the main risks mentioned above, the occupational safety and health risk assessment has been done according to the requirement of EN ISO 12100:2010.
In order to ensure the conformity for CE marking for these machines, some main European and/or International standards have been used for the assessment of conformity, they are:
—EN 60204-1:2018 Safety of machinery—Electrical equipment of machines—General requirements;
—EN ISO 12100:2010 Safety of machinery—General principles for design— Risk assessment and risk reduction;

—EN 13985:2003+A1:2009 Machine tools - Safety - Guillotine shears;

—EN IEC 61000-6-2:2019 Electromagnetic compatibility (EMC) - Part 6-2: Generic standards - Immunity for industrial environments;

—EN IEC 61000-6-4:2019 Electromagnetic compatibility (EMC) - Part 6-4: Generic standards - Emission standard for industrial environments.

The test reports for these applicable standards in detail have been included in the relevant sub-clauses of this technical construction file.
To present the conformity of this series machine with Machinery Directive and Electromagnetic Compatibility Directive, we discuss the conformity systematically with the relative Directive and standards.

4.0 Quality Control System

In order to ensure the conformity of the series production, our company has taken the related procedures mentioned below:

1) The complete technical construction file (TCF) has been established before applying for the CE marking certificate.

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

Before the assemblies of the series production, the QC engineers of our company have to check and inspect the technical specifications and intended functions of parts and components to ensure the correct use of them according to the contents of TCF and principle described in the related technical information.

3) Carry out the inspection & testing for the products before packing

Before packing the products, the QC engineers of our company have to do the necessary inspection and testing to ensure the conformity of related requirements.

4) Carry out the inspection for the packing

5) Provision for the change of design

6) Provision for the Quality Assurance

5.0 Machine Pictures

QC12K-6×3200

6.0 Technical Specifications

QC12K-6×3200

No.	Name		Value	Unit	Remarks
1	Max.Shearing Thickness		6	mm	
2	Max.Shearing Width		2000/2500/3200/4000	mm	
3	Strength of shearing Sheets		450	N/mm^2	
4	Shearing Angle		1° 30′		
5	Max.length of Back Gauge		600	mm	
6	Stroke number		20/18/14/14	min^{-1}	
7	Distance between vertical columns		2170/2700/3420/4220	mm	
8	Blade Length		2050/2600/3300/4100	mm	
9	Height of the work Table		800	mm	
10	Main Motor	Type	Y132M-4		
		Power	7.5	kW	
11	Motor for Back Gauge	Type	Y802-6		
		Power	0.55	kW	
		Speed	910		
12	gear pump	Type	NT3-G25F/NT3-G20F		
		Flow	25/20	mL/r	
		Pressure	32	MPa	
13	Overall dimension	L	2580/3130/3840/4630	mm	
		W	1530/1530/1675/1850	mm	
		H	1600/1600/1620/1700	mm	

7.0 Type/Model Designations

Type	Structure principle
QC12K	CNC
QC12Y	Standard
QC11Y	

8.0 Machine Name Plate Sample

Shearing Machine

QC12K-6×3200

CE

Rated power: 7.5KW

Rated Voltage: 380V

Frequency: 50Hz

Date: 2021/04/28

Serial No.:

Jiangsu Jianghai Machinery Group Co., Ltd.

No. 1 Jianghai Road, Libao, Haian, Jiangsu, China

QC12K-6×3200

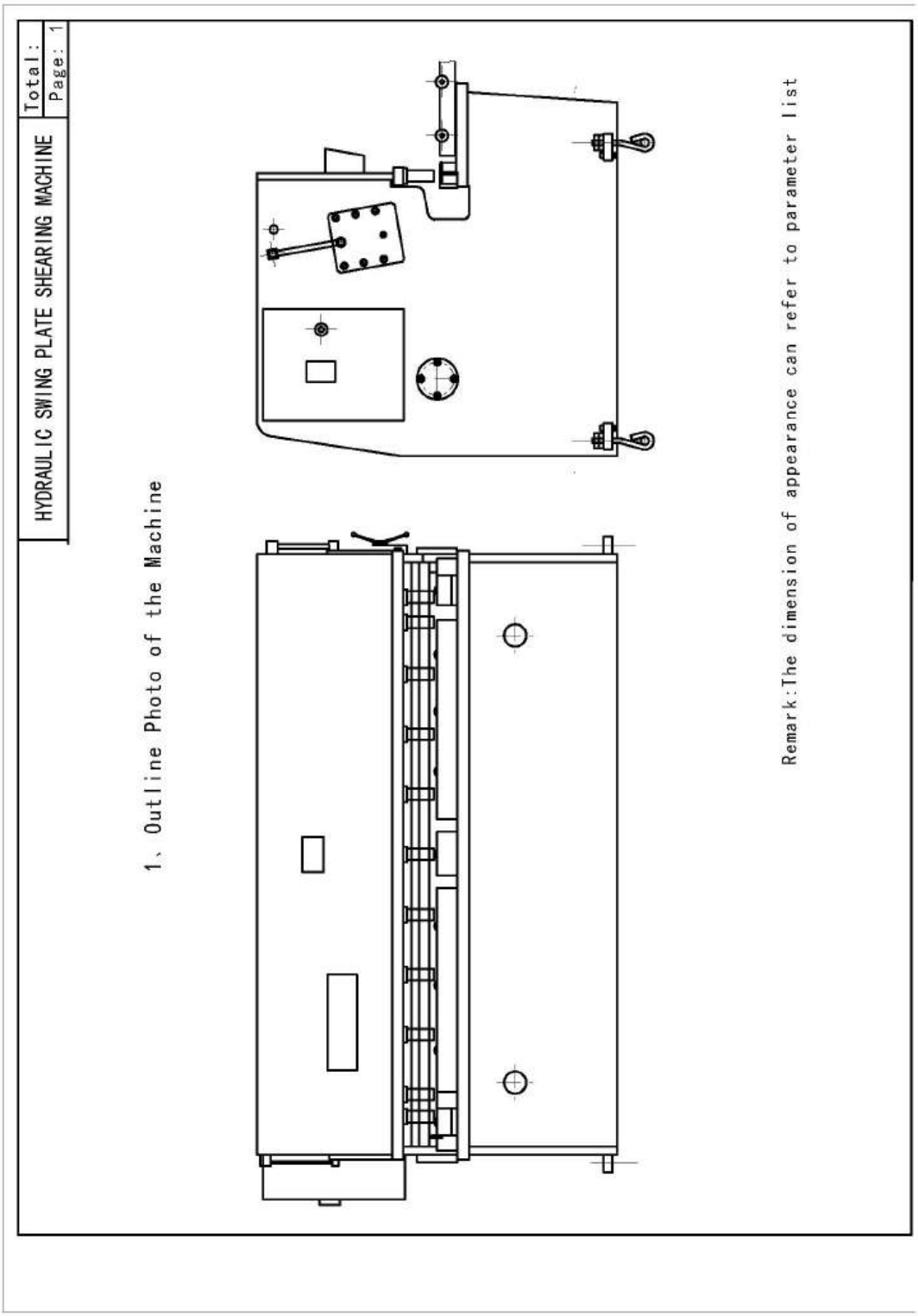
ELECTRICAL COMPONENTS LIST

CODE	NAME	TYPE	QTY	REMARK
QF1	Breaker	DZ20Y-100/330	1	32A
QF2	Breaker	DZ47-63 C6/3P	1	
QF3	Breaker	DZ47-63 C4/2P	1	
QF4-QF6	Breaker	DZ47-63 C4/1P	3	
TC1	Transformer	JBK3-400	1	OUTPUT 220V27V24V
VC1	Switching power	S-145-24	1	
VC2	Rectifier	KBPC1010	1	
KM1	Contactor	3TB4322	1	AC24V
FR	Thermo relay	3UA52	1	10-16A
KA2-KA3	Genernal relay	MY4N-J	2	AC24V
KA5	Genernal relay	MY4N-J	1	AC24V
KA9	Genernal relay	MY4N-J	1	AC24V
KA6-KA8	Genernal relay	MY4N-J	3	DC24V
KA10-KA11	Genernal relay	MY4N-J	2	DC24V
SB1-SB5	Emergency pushbutton	XB2-BS542C	5	
SB6	Button	XB2BA42C	1	
SB7	Button	XB2BW31B1C	1	
SA1	Key selector	XB2BG21C	1	
SA3	Key selector	XB2BG21C	1	

CODE	NAME	TYPE	QTY	REMARK
SA2	Selector	XB2BD21C	1	
HL1	Indicator	XB2BVB1PC	1	AC24V
KT5	Time relay	ST3PA 0-10S	1	AC24V
SYS	CNC System	E21S	1	
INV	Inverter	PI 130	1	
SQ1	Limit switch	JW2-11H/L	1	
SQ2-SQ3	Limit switch	XCK-M115C	2	
SQ4-SQ5	Limit switch	XCKN2118P20C	2	
SF1	Pendal switch	ECFS-H5	1	
XB(PE)	Grounding device	JDGA-4	1	

10.0 Machine Drawing

QC12K-6×3200



HYDRAULIC SWING PLATE SHEARING MACHINE | Total: | Page: 6

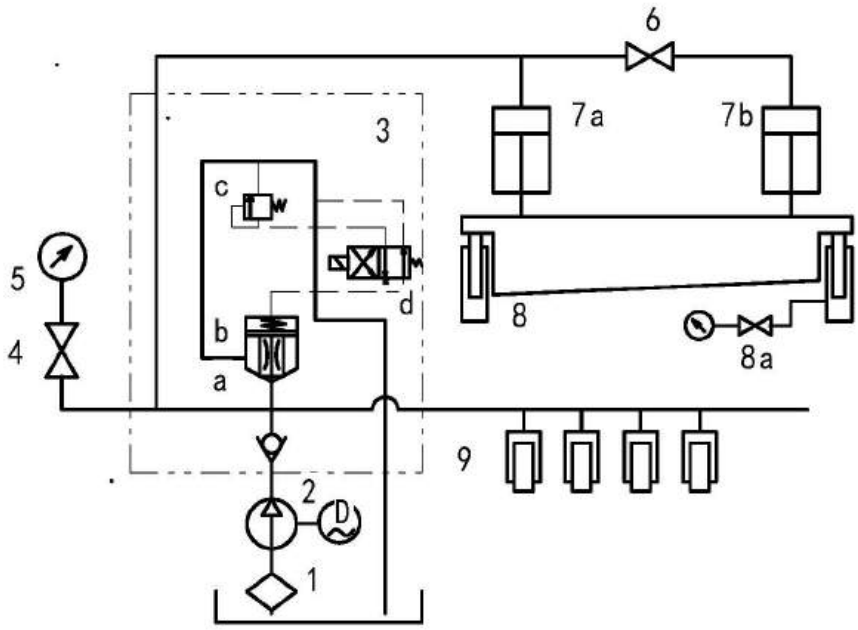


Fig 1,Hydraulic principle drawing

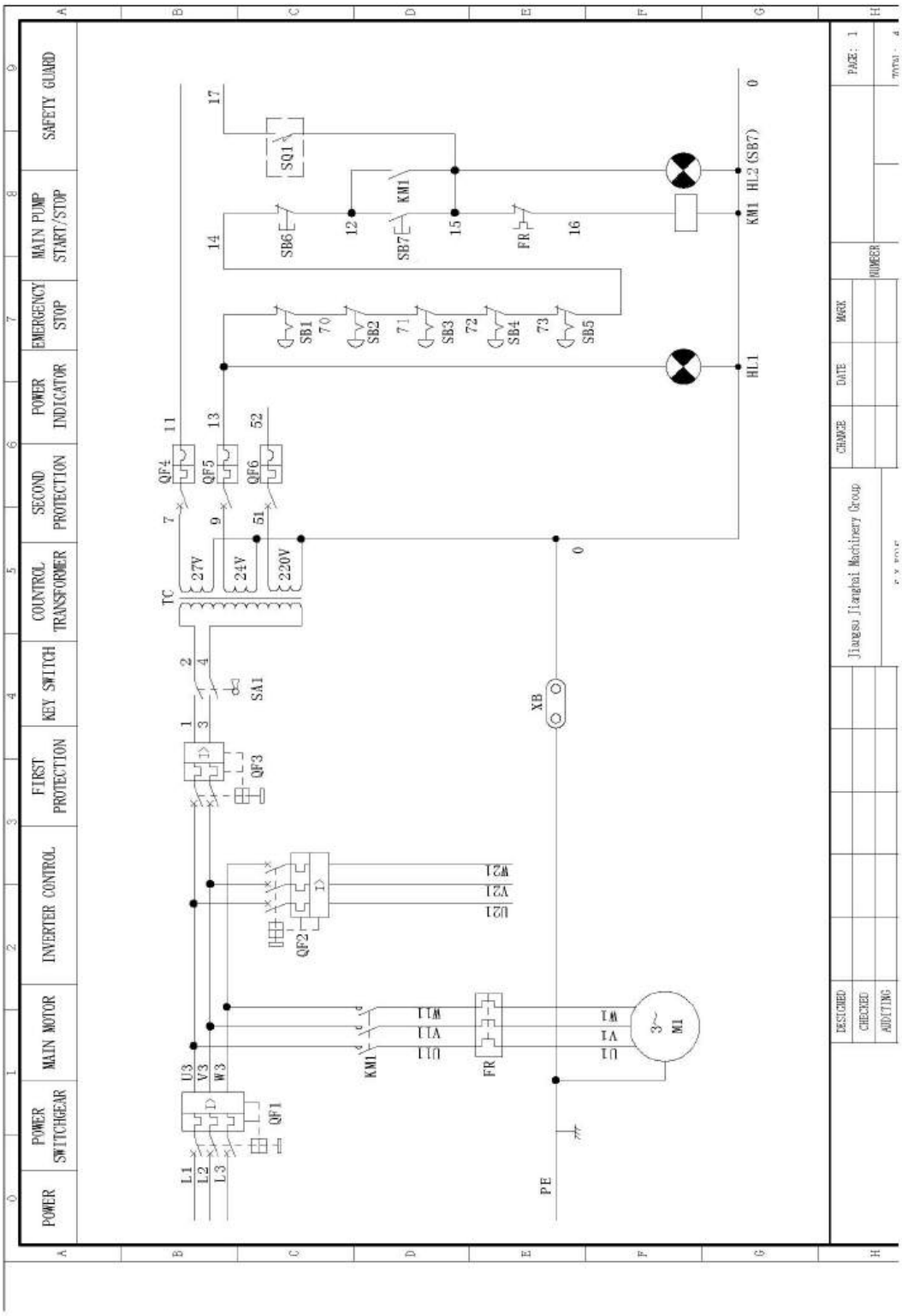
LIST OF HYDRAULIC COMPONENTS

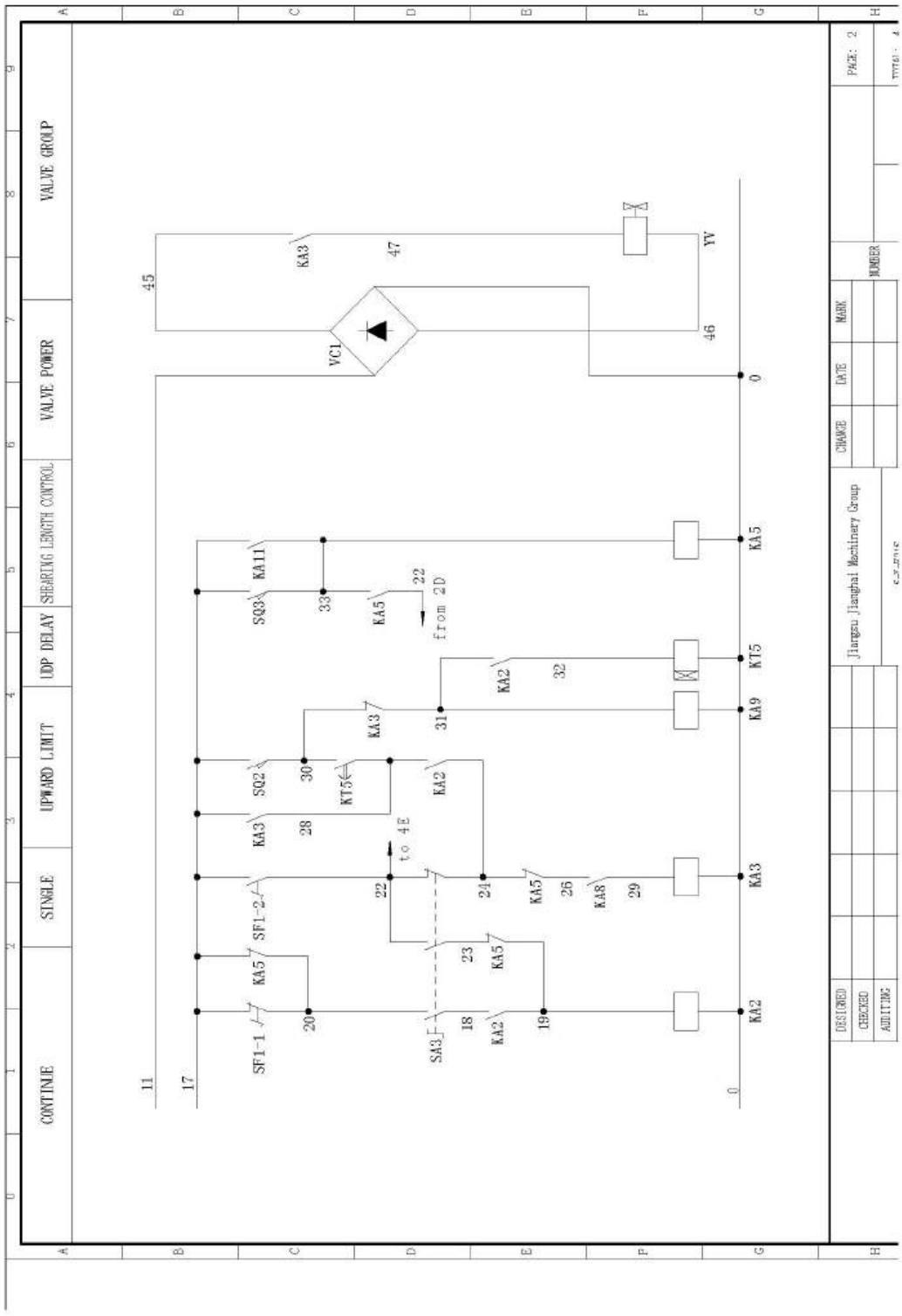
No.	Name	Specifications	Type	Remarks
1	mesh filter	Q=160L/min	WU-160X100F-J	
2	oil pump	P=32MPa		
3	combined valve	DG16		4WE6D50/AG24NZ4
4	manometer switch	d=8mm	KZF-L8H-S	
5	manometer	P=40MPa d=100mm	Y-100	
6	ball valve	d=15	CJZQ-L15H	
7	cylinder			
8	Nitrogen			
9	swaging oil cylinder			

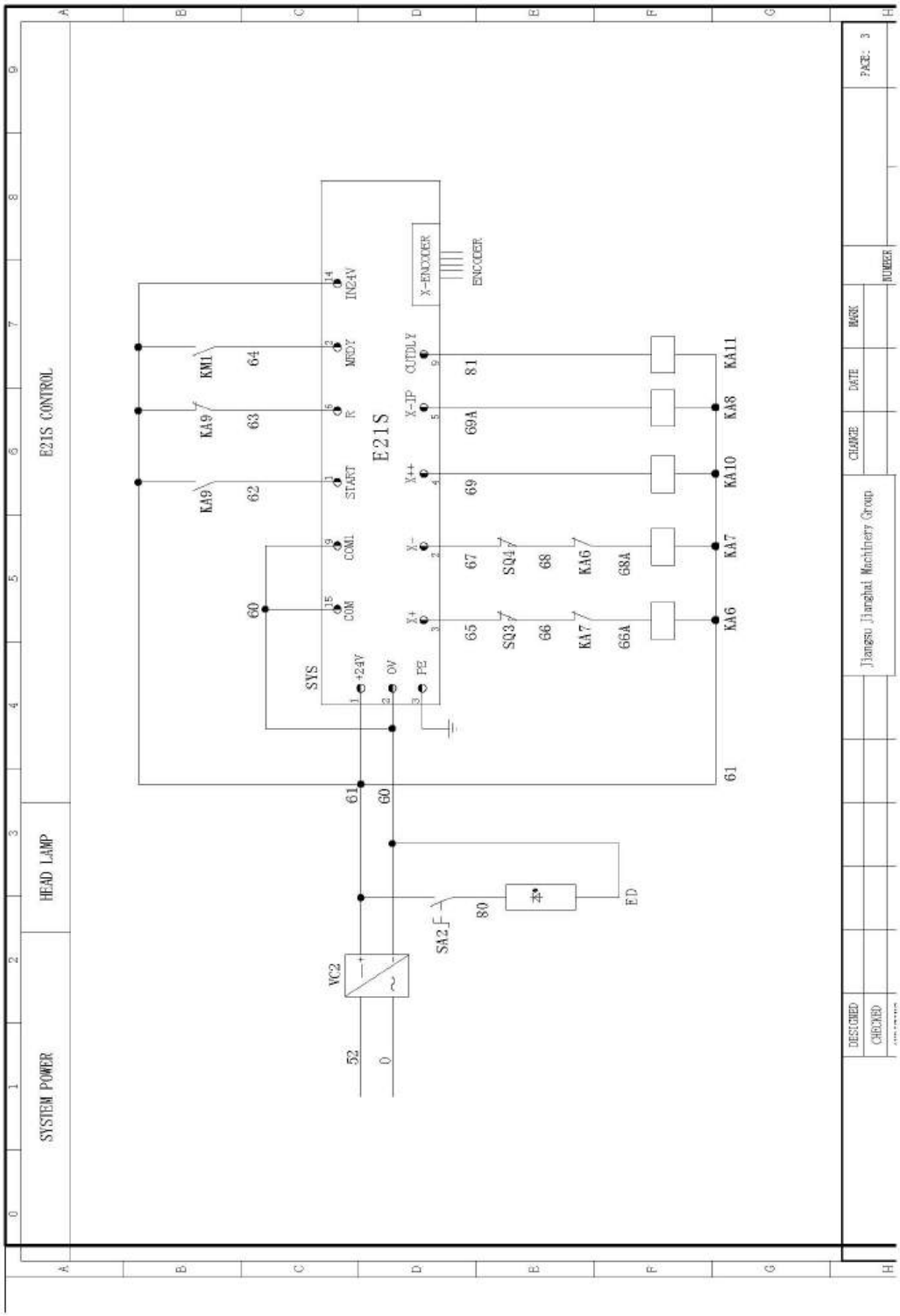
The file has been stored in the quality control system, and its number is JSJH-QR-D- QC12K-6×3200.

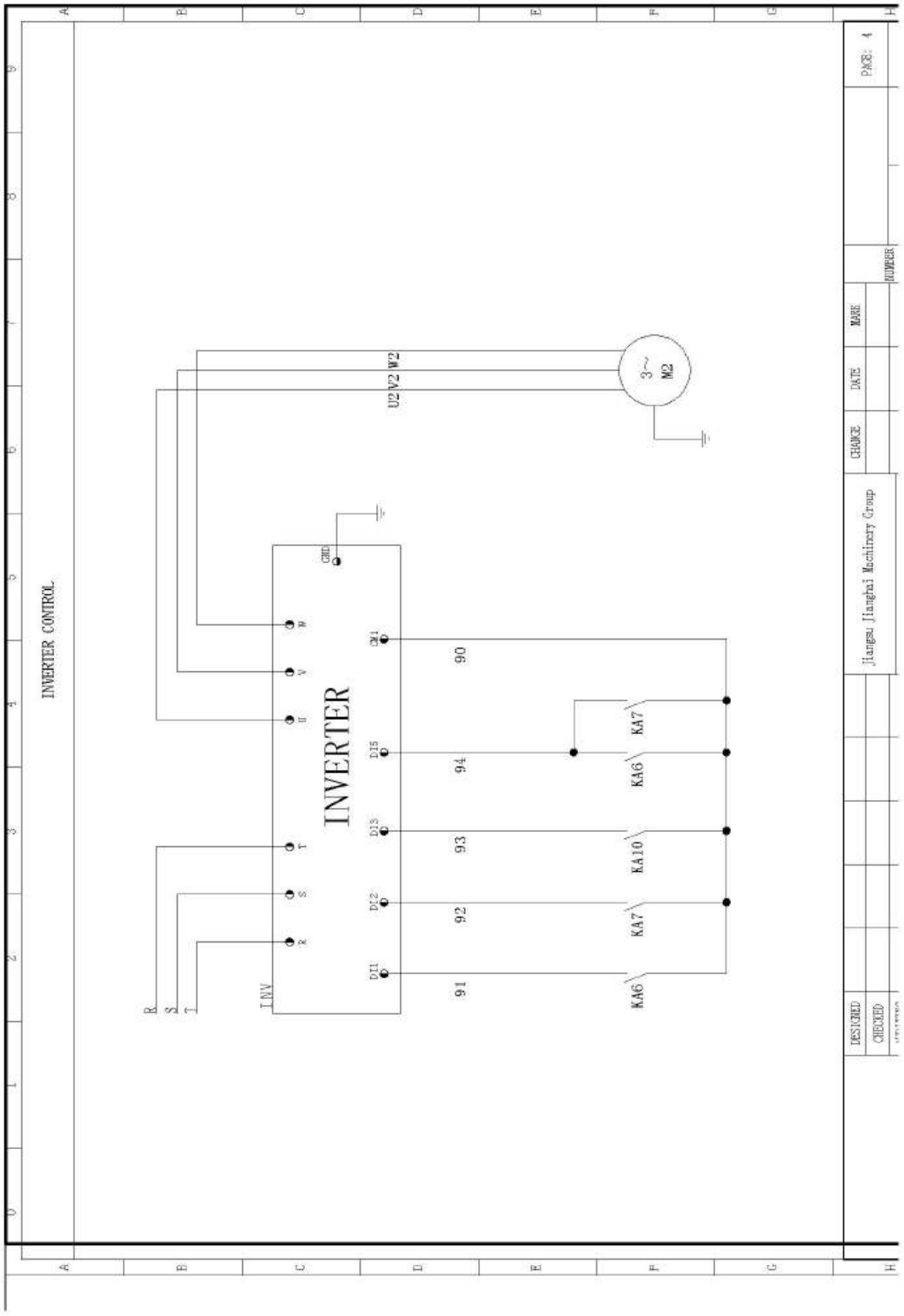
11.0 Machine Circuit Diagram

QC12K-6×3200




CONTINUE
SINGLE
UPWARD LIMIT
UDP DELAY
SHEARING LENGTH CONTROL
VALVE POWER
VALVE GROUP
Jiangsu Jiangtai Machinery Group
DESIGNED
CHECKED
AUDITING
CHANGE
DATE
MARK
NUMBER
PAGE: 2
SF1-1
SF1-2
SA3
KA5
KA3
KA2
KA11
KA8
KA9
SQ2
SQ3
KT5
VC1
YV
to 4E
from 2D


SYSTEM POWER
HEAD LAMP
E21S CONTROL
PAGE: 3
Jiangsu Jianghai Machinery Group
E21S
X-ENCODER
ENCODER
SYS
+24V
0V
PE
COM
COM1
IN24V
MFDY
R
START
X-IP
X++
X-
X+
CUTDLY
KM1
KA9
KA7
KA6
KA8
KA10
KA11
SQ3
SQ4
SA2
VC2
ED
52
0
60
61
62
63
64
65
66
67
68
69
69A
80
81



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QC12K-6 SERIES CNC HYDRAULIC SWING PLATE SHEARING MACHINE

OPERATION MANUAL

Shearing Thickness: 6 mm

Shearing Width: mm

Delivery No.:

THE PEOPLE'S REPUBLIC OF CHINA

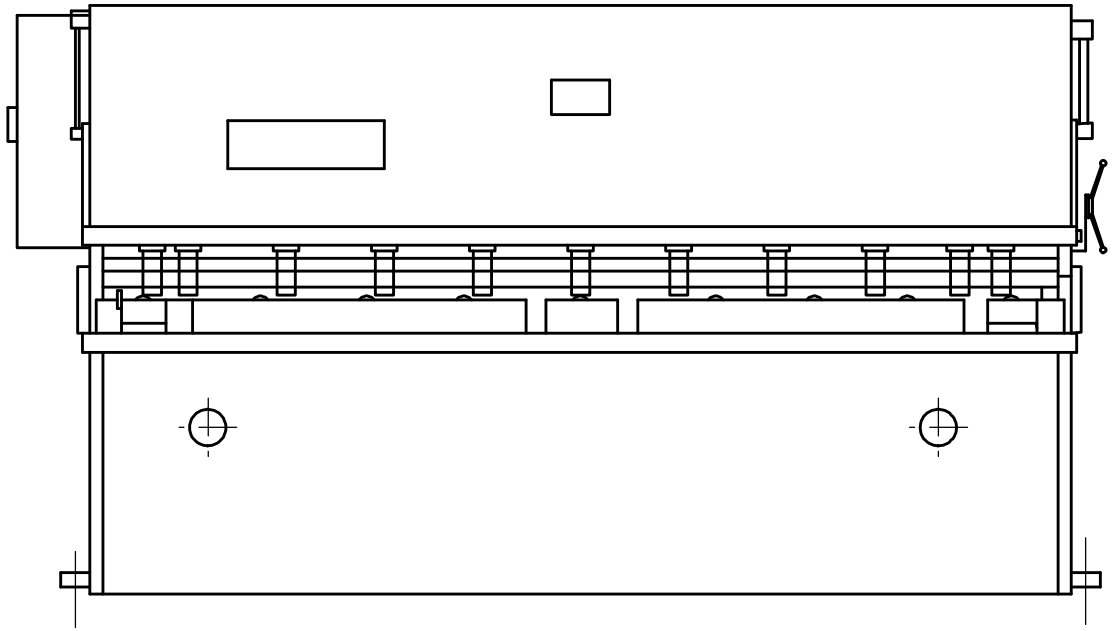
Jiangsu Jianghai Machinery Group Co., Ltd.

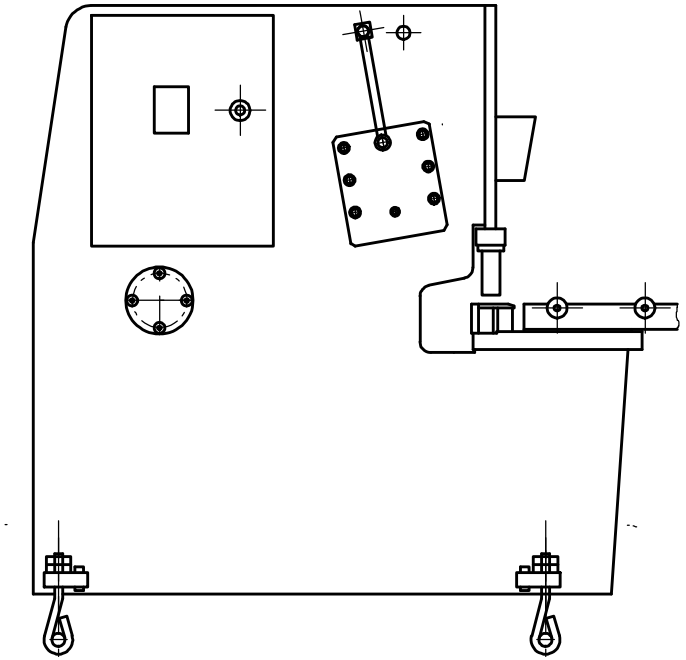
No. 1 Jianghai Road, Libao, Haian, Jiangsu, China

TEL:0513-88212462 http://www.machine-jh.com

CONTENTS

1、Outline Photo of the Machine





Remark:The dimension of appearance can refer to parameter list

2、Fundamental Data

No.	Name		Value	Unit	Remarks
1	Max.Shearing Thickness		6	mm	
2	Max.Shearing Width		2000/2500/3200/4000	mm	
3	Strength of shearing Sheets		450	N/mm^2	
4	Shearing Angle		1° 30′		
5	Max.length of Back Gauge		600	mm	
6	Stroke number		20/18/14/14	min^{-1}	
7	Distance between vertical columns		2170/2700/3420/4220	mm	
8	Blade Length		2050/2600/3300/4100	mm	
9	Height of the work Table		800	mm	
10	Main Motor	Type	Y132M-4		
		Power	7.5	kW	
11	Motor for Back Gauge	Type	Y802-6		
		Power	0.55	kW	
		Speed	910		
12	gear pump	Type	NT3-G25F/NT3-G20F		
		Flow	25/20	mL/r	
		Pressure	32	MPa	
13	Overall dimension	L	2580/3130/3840/4630	mm	
		W	1530/1530/1675/1850	mm	
		H	1600/1600/1620/1700	mm	

3. Main Application ,Functions and Feature

This machine is used for shearing steel plates with thickness of 1-6mm and width of 2000/2500/3200/4000mm.

The strength of the plates to be shorn should be 450N/mm^2, If the plates of other strength are to be shorn, the thickness of them should be reduced.

This machine adopts the whole steel plate-welded structure, hydraulic driving, The nitrogen cylinder return is used. the machine is characterized.by smooth running, little noise, easy operation,good rigidity and high accuracy.

Adjustment the opening-blade clearance is quickly and simply,It has front and back gauge. The equipment of the back gauge is mechanical driven,There is a revolution indicator to show the value,and it can be manually fine adjusted easily and reliably.The front block is counted by the scale and fix position by block.It has installation for lights of cutting,it can random adjust top rest's stroke amount to improve working efficiency for cutting narrow plates.The grating is used as the protective device, The machine will stop working automaticly. When the grating is opened,it is ensuring to operate safely.

4. HYDRAULIC DRIVING SYSTEM

The hydraulic system(figure 1) is mainly made of pump2, combined valve 3,overflow valve 3C,magnetic directional valve 3D.The whole system is reasonable.

The needed pressure oil is provided by pump2. The max working pressure of system is 18MPa.The return stroke of the top rest is finished by nitrogen cylinder8, and the fill pressure is about 5MPa.

The working principle of hydraulic system(see figure1) is: The oil carried from the pipes enters every working cylinder (main cylinder 7, swaging cylinder 9)and combined valve3 while the oil pump is working.After entering the combined valve,the oil is divided into main oilway and controlled oilway.The controlled oilway will enter magnetic directional valve 3d which is always “on” through the throttle hole to the oil tank. and pressure is formed.Because of the throttle hole 3,certain pressure difference is formed.

The pressure to the oil-in through the cone valve 3b will be higher than that at the controlled side.And then the cone valve3b will open after overcoming the effect of the spring. The oil will come back to the oil tank through the return oil-in and main oil route also doesn't form any pressure. so the machine will make no action.When the magnetic directional valve is switched on,the controlled oil will enter the overflow valve 3c through the magnetic directional valve.So The overflow valve 3c is closed under the adjusted pressure,that the oil

route pressure will increase bit by bit.The pressure is the same on each side of the taper valve 3b.But it is closed owing to the area difference of the valve pith and the effect of spring, hole-down cylinder 9 will press down first after overcoming the pulling force of the spring and later. The top rest moves down after the main oil cylinder 7 overcoming the suppo-rting force to return. At this time the hold-down cylinder 9 and top rest beam will work in order in the short time. The top rest moves to the up-limited point. The dot makes the directional valve 3d power off and restore to the throne.The whole oil route is unloaded. The hold-down cylinder 18 will come to the original position because of the effect of the spring.

Failure and Remotion of hydraulic system

Apperance of damage	Reasons	Way of remotion
The oil line is formed without pressure.And No action of the top rest.	the Magnetic Directional valve's electric plug not touch well	Examine and repair the Electric plug
	The pith of the Magnetic Directional valve is blocked up or coarse.And there is no operation. The valve pith of the combined valve has sundries at the mouth of the sealing washer, There is no sealing effect.The throttle hole of the combined valve is blocked up.	Examine,strip and clean.
The return of the top rest is slowly or can't return to top dead point,Top rest and swaging cylinder can't work harmoniously	Nitrogen pressure of nitrogen cylinder is not enough	Fill the Nitrogen cylinder to increase pressure.
	Magnetic valve isn't arriving position	Check the magnetic valve

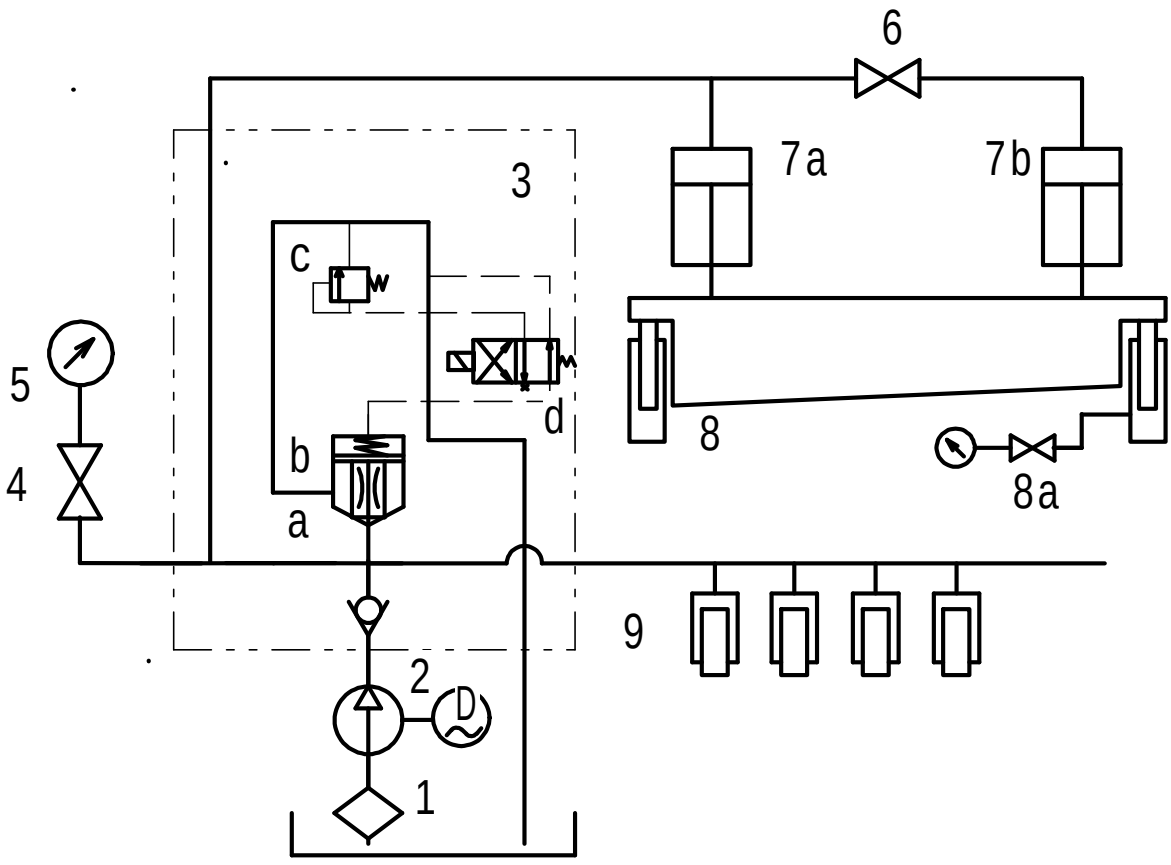


Fig 1. Hydraulic principle drawing

LIST OF HYDRAULIC COMPONENTS

No.	Name	Specifications	Type	Remarks
1	mesh filter	Q=160L/min	WU-160X100F-J	
2	oil pump	P=32MPa		
3	combined valve	DG16		4WE6D50/AG24NZ4
4	manometer switch	d=8mm	KZF-L8H-S	
5	manometer	P=40MPa d=100mm	Y-100	
6	ball valve	d=15	CJZQ-L15H	
7	cylinder			
8	Nitrogen			
9	swaging oil cylinder			

5.The Structure of the Machine

(1)Framwork

This machine is of frame construction joined together by welding with good rigidity.Two cylinders are placed on the left and right of the vertical columns,Movable Blade Beam is placed on the surface of the work table. So that the bottom blade beam can be adjusted slightly. It also has a feed roll ball on work table.Easy to operate.

(2)Top rest

It's made of steel plates joined together by welding. which ensures fine rigidity. it use eccentric sleeve (8) as bearing point to do reciprocal swing to finish cutting plates by driven of two cylinders and return cylinder.

The blade of the Top rest and the supporting surface is vertical,and it forms curve, so that the clearance between the top and bottom blades can be identical.

(3)Swaging Equipment

It consists of several swaging oil cylinders(figure 4)which are fitted on the supporting board in the front of the frame.The swag head will overcome the pulling force of the spring (18) and press down after the swaging oil cylinder is filled with oil. Press the plate tightly. After finishedshearing, it will come back to its original position with the help of the pulling force of the spring.The swag pressure can be increased with the thickness is larger more and more.

(4)Front and Back Gauge

Front gauge:It is placed on the surface of work table.The Value is shown on a measuring scale to adjust moving block,then arriving the needed block value. It is more convenient to use the front gauge in shearing thinner plates.

Back Gauge(figure 6)is fitted on the top rest.And it moves up and down with the top rest.adjust backgauge by motor.through the gear reduces speed and driven by rod.Just pushing adjusting button D+D(orD-D) can adjust moving the gauge plate forward(or backward).If the needed adjustment value not reach by the automatic adjustment.manually turning the hand wheel(41)to manual find adjustment.so that you can reach the needed value. Thus Adjustment of the backgauge is convenient and reliable.when the back gauge fix position by CNC system, input the number, the system will move the back gauge into the position automaticly.

The adjustment range of the back gauge is from 20 to 600mm. When the length of a sheet metal to be sheared is longer than the max distance of the back gauge.The gauge board(29)should be driven to the end position.And the bearing(36) and the oblique plane on supporting beam (33) can raise the gauge board (29).so the plate of different length can be random sheared.

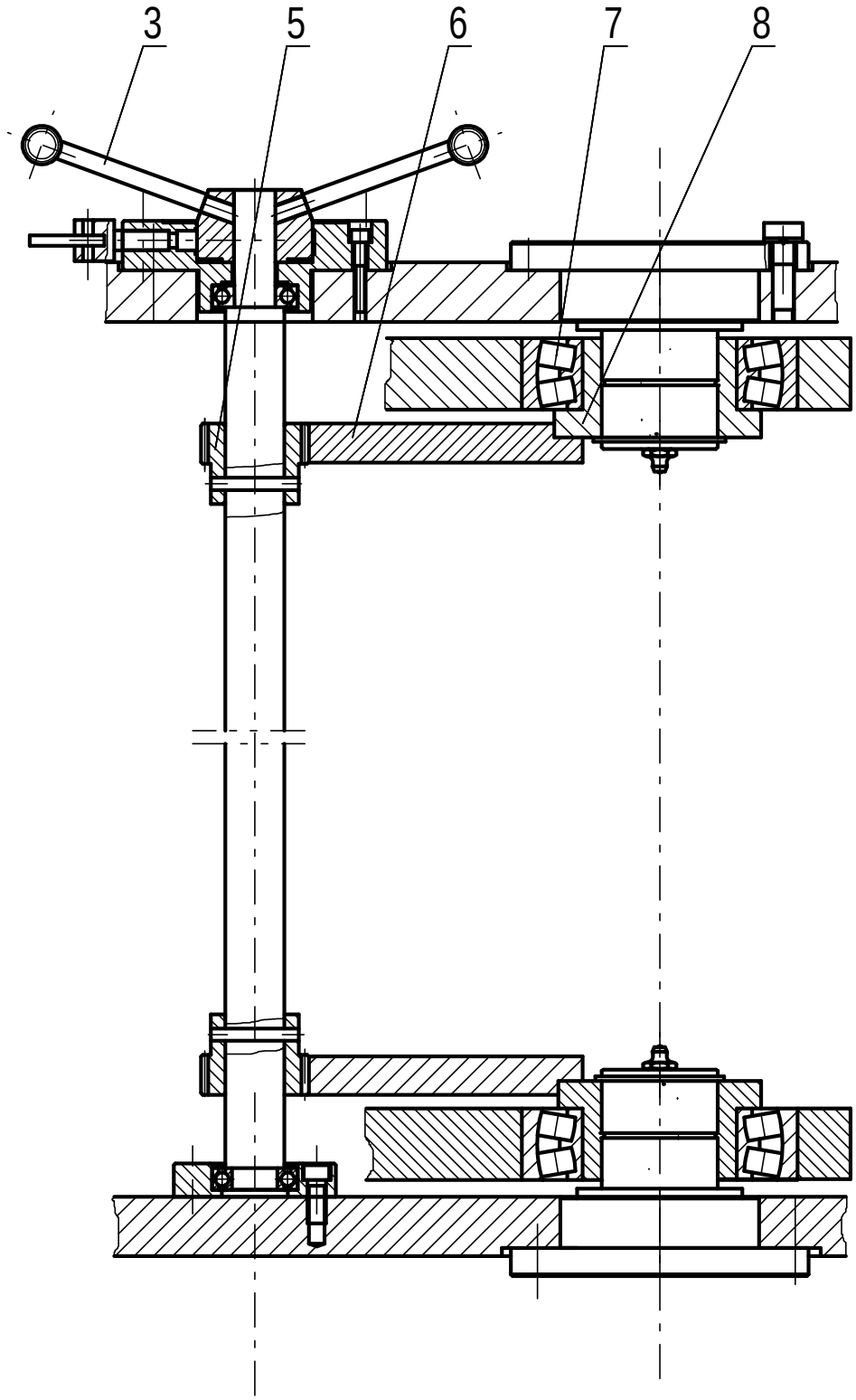


Fig 2 Adjustment for clearance of blades mechanism

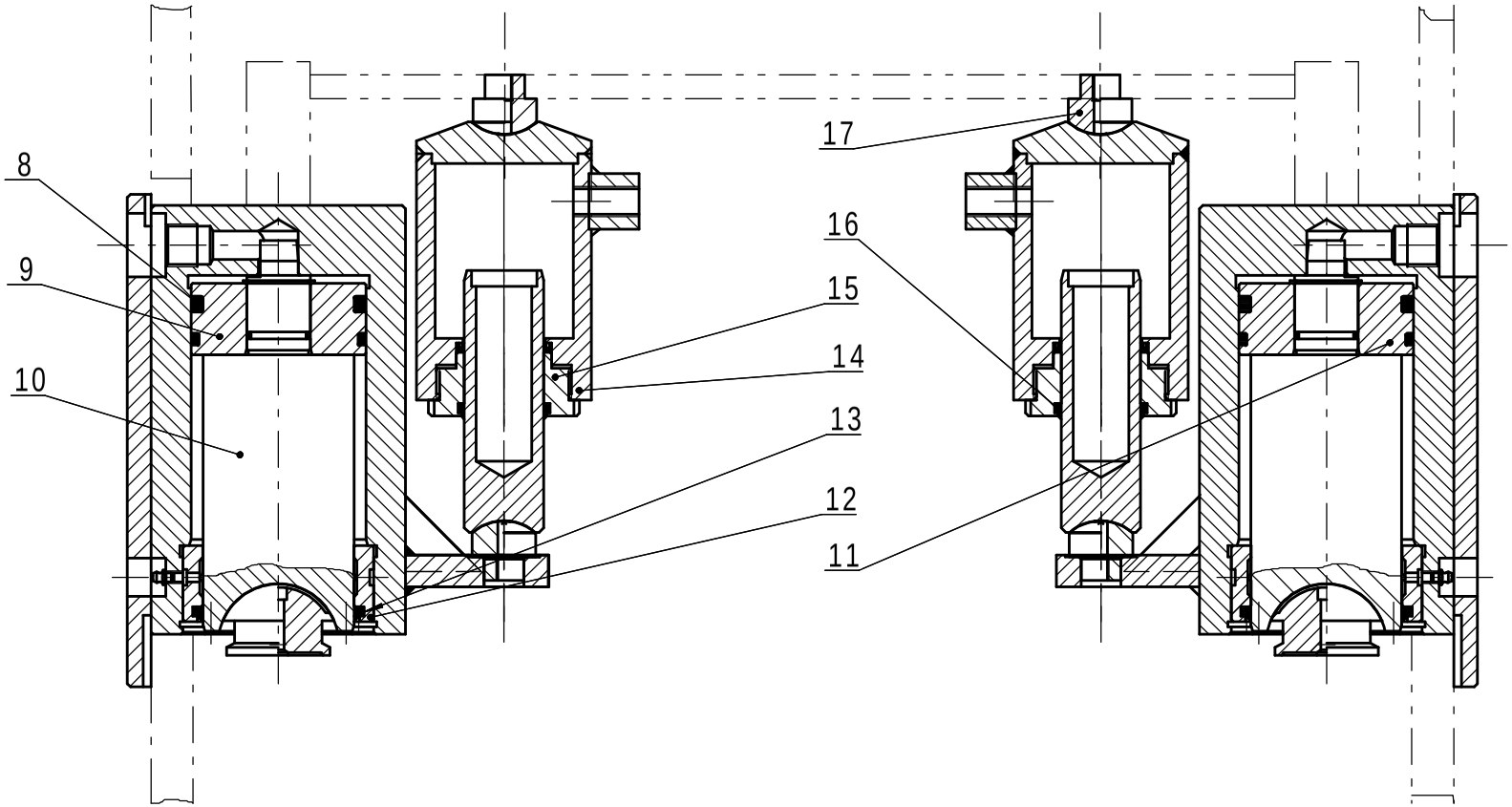


Fig 3 Oil cylinder and return stroke cylinder

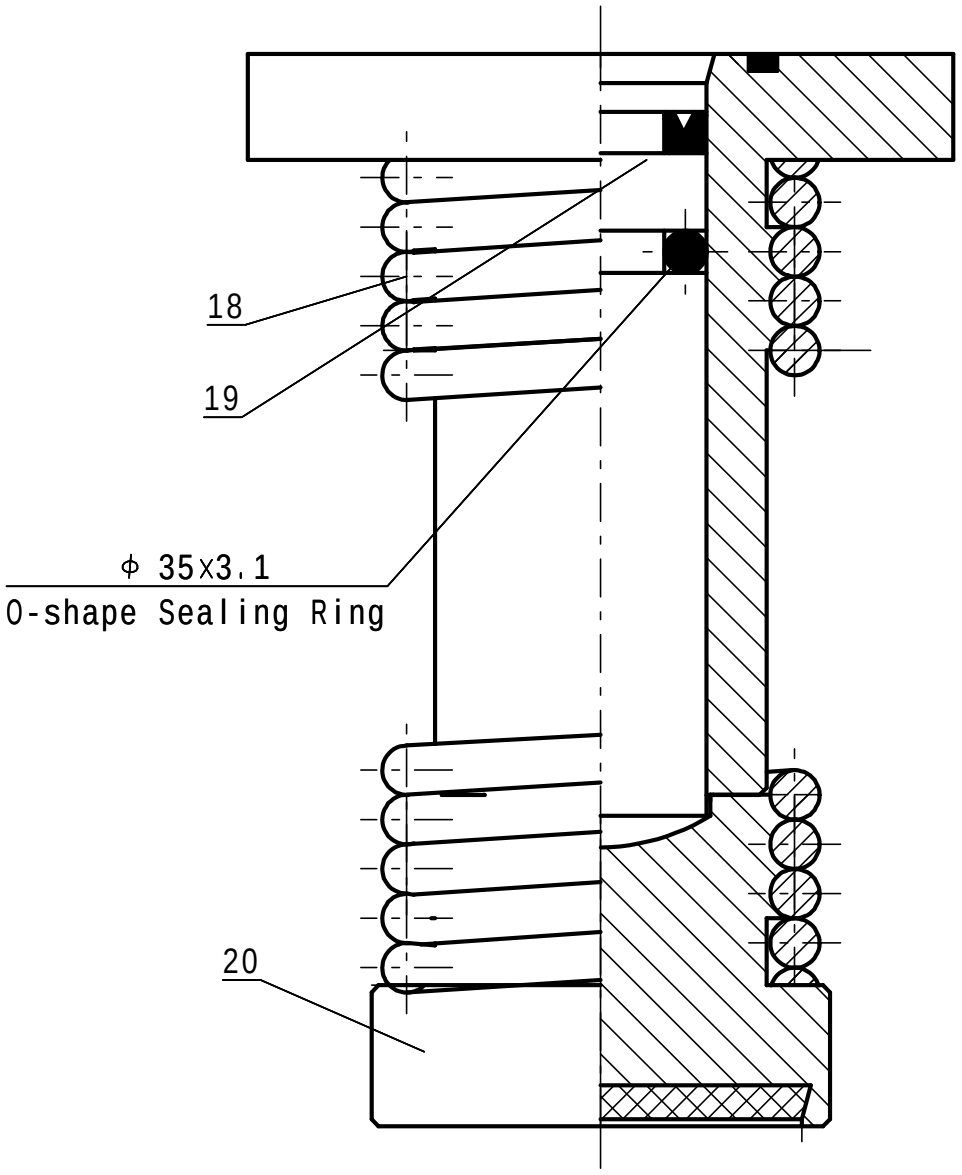
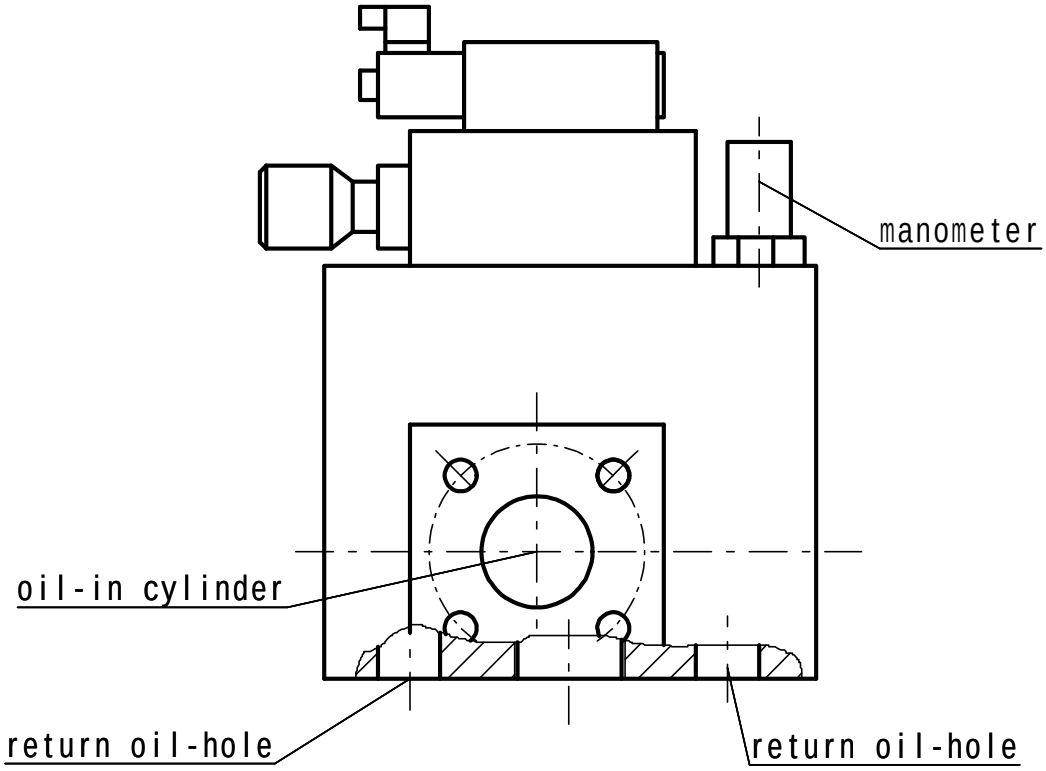


Fig 4 Swaging oil Cylinder



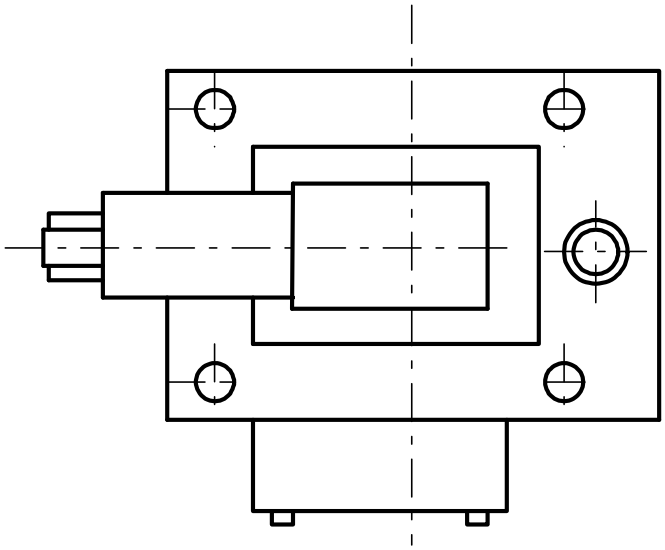


Fig 5 Combined Valve

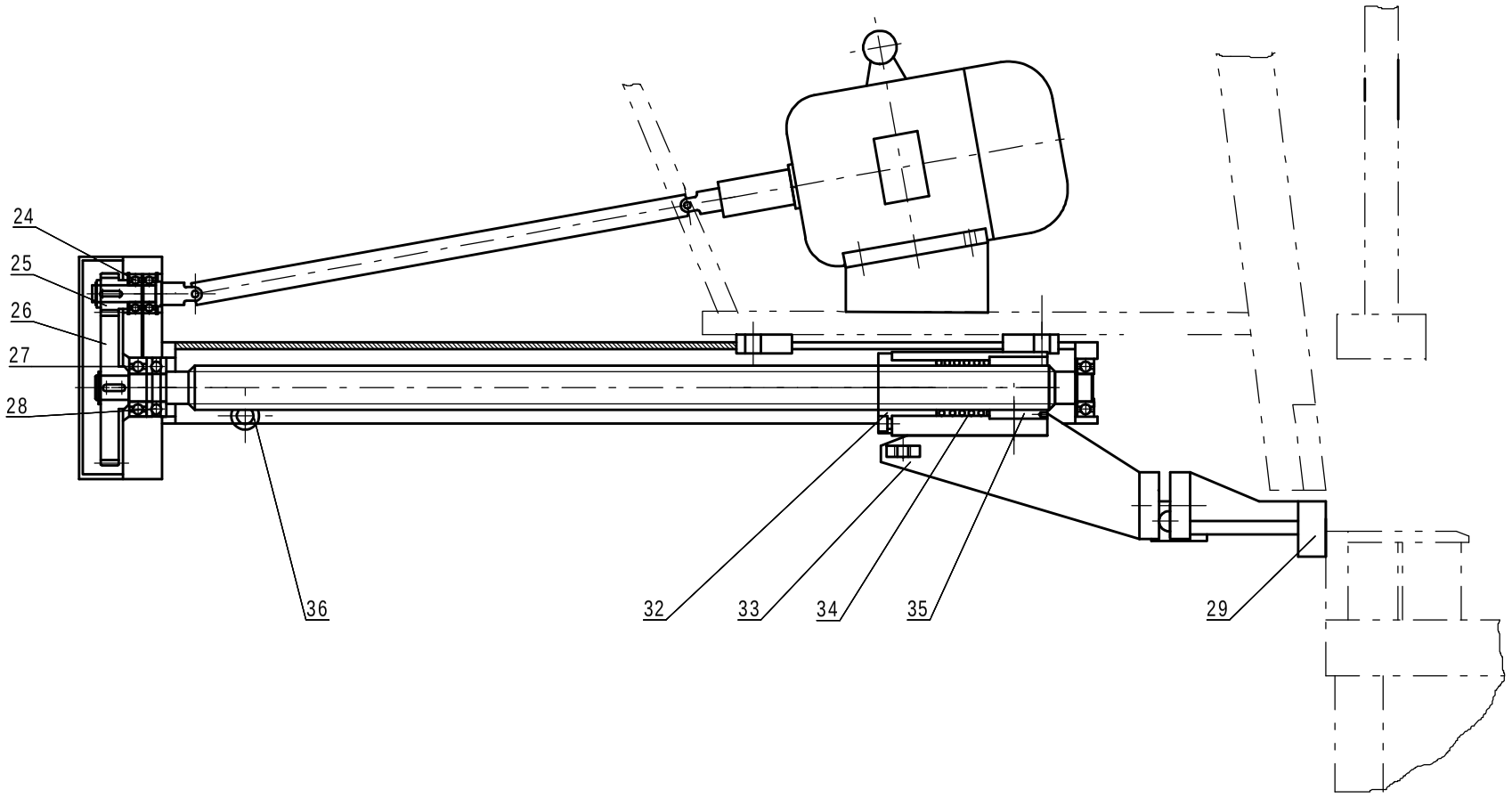


Fig 6 Back Gauge

6.Electric System of the Machine

The details operation please reference to the attached operation manual.

7、Hoist,Conveyance and Installation

(1)Machine is transported by the diagram for hoisting(Fig、10).

(2)Foundation of the Machine: a、The foundations dimension may refer to the Installation Diagram of Foundation(figure 11).

b、The earth around the foundation should be rammed.

The depth depends on the soil texture.

(3)The Installation of the machine

While the machine being installed and fixed、the rolling ball cover should be taken apart and a one-meter straight ruler should measure on the two cushions、It's tolerance can't be more than 0、2mm on the crisscross level for every 1000mm、

8、Lubrication

Oil gun filling form is used to lubricate every main lubricating point、The following are the lubricating points:

No、	Names of oil site	Oil Amount	Filling Time	brand of Lubriating oil
1	Each one point of top and bottom side for left and right return cylinder	small	once for 16 hours	Calcium grease ZG-3(GB491-65) machanical oil N46(GB443-84)
2	Each one point of left and right for the move screw on backgauge	middle	once for 8 hours	
3	The left and right each one point for swing supporting point in top rest	small	once for 24 hours	
4	The left and right each one point of axle sleeve for adjusting clearance axle、	small	one for 48 hours	
5	Each one point of position rod for left and right cylinder	middle	once for 8 hours	
6	Each one point of cushion block for left and right cylinder	middle	once for 8 hours	4# graphite lithium grease(Q/SY 1000-65)

NTOE:1、In practical use grease ZG(50%) should be mixed with mechanical oil(50%)

2、Graphite Lithium grease shoule be mixed with mechanical oil (30%) in use、

3、The oil in the oil tank should be changed once half a year generally

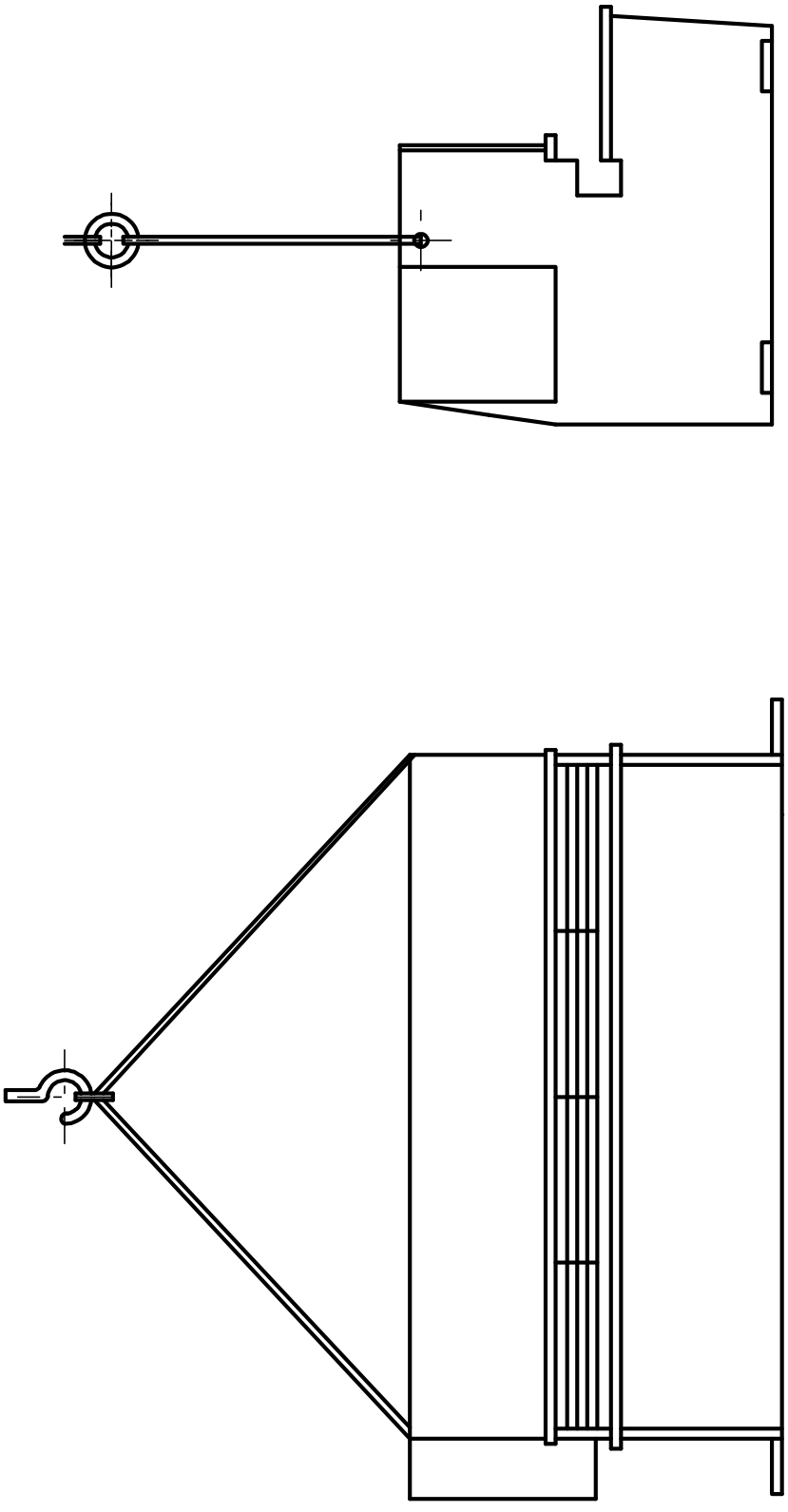
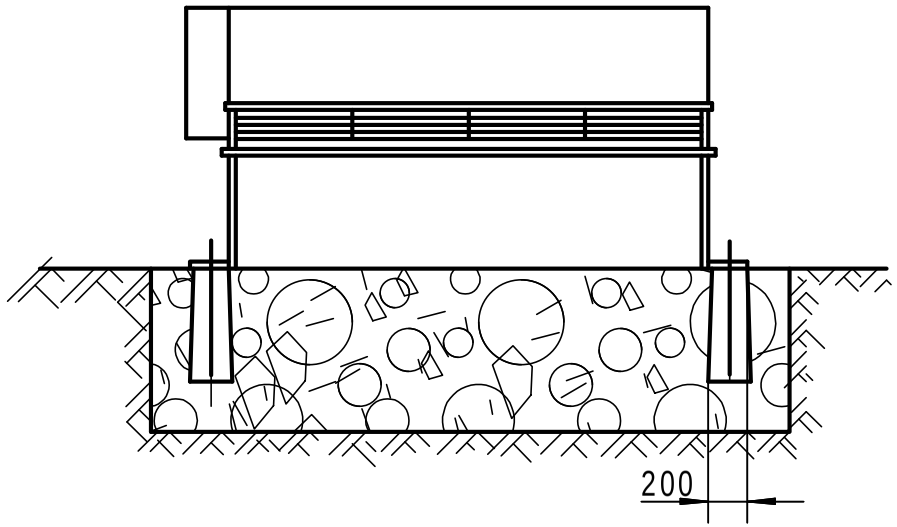
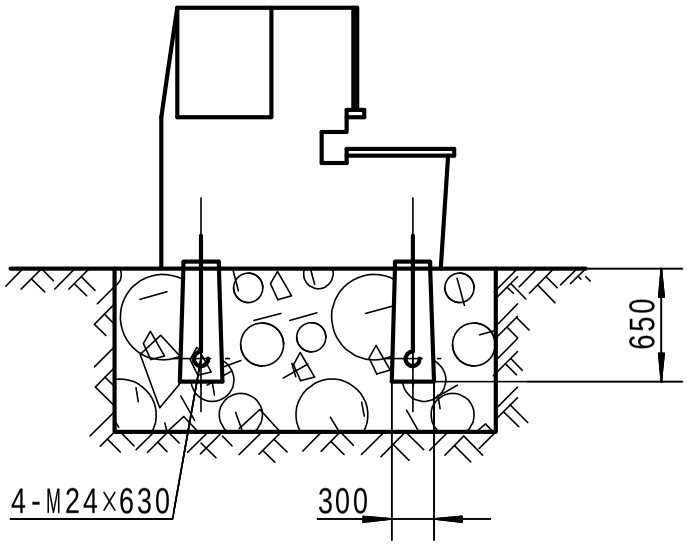
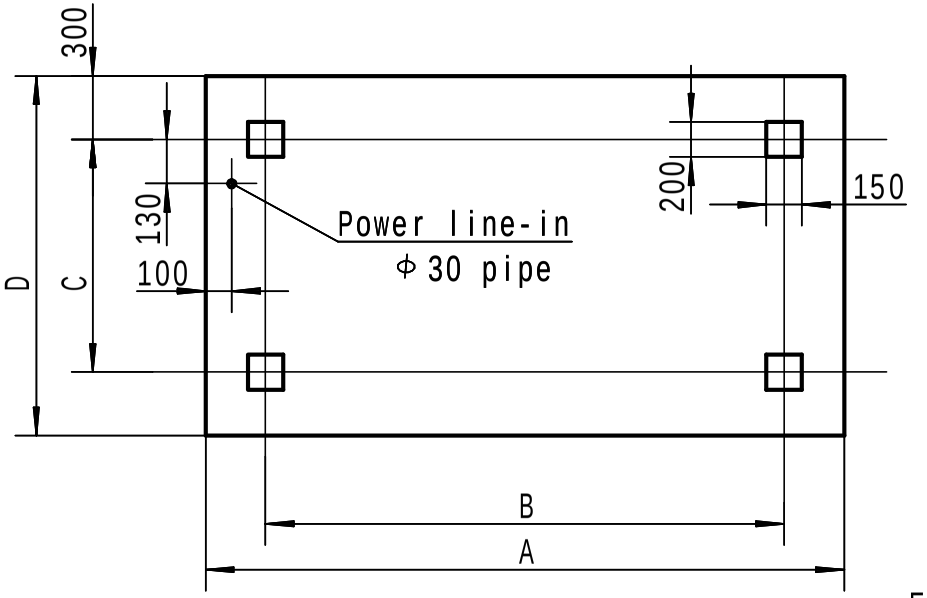


Fig 11 Diagram for Hoisting and Installation







Product / dimension	2000	2500	3200	4000
A	3000	3500	4200	5000
B	2330	2880	3582	4382
C	1150	1150	1350	1500
D	1900	1900	1900	2250

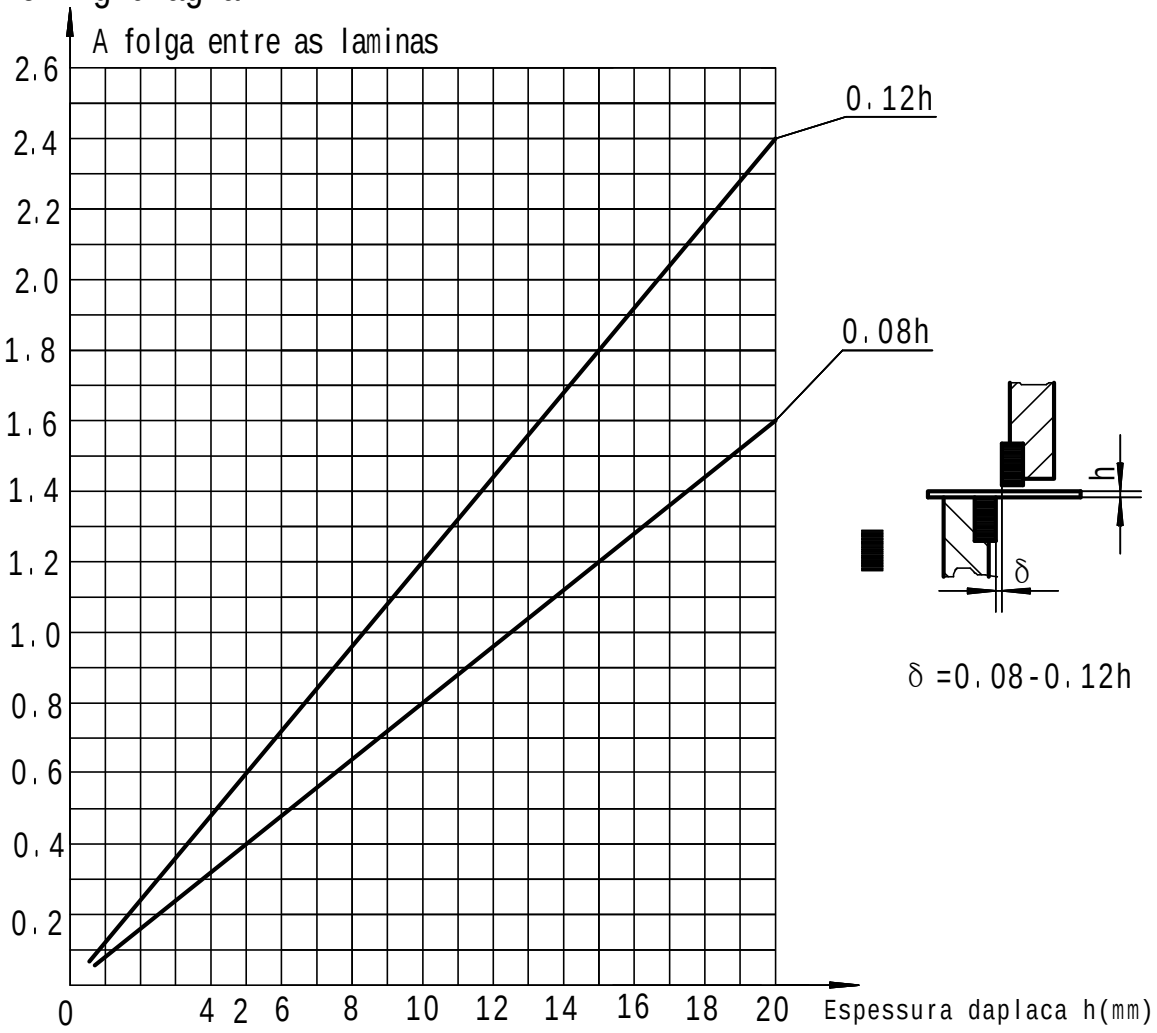
NOTE:The depth of the foundation depends on soil texture

Fig 12 Foundation diagram of installation

9.Adjustment and Operation

1.Adjustment of the clearance of cutting-edges

Whether correct ways to adjust the clearance of cutting edges are the important factors which affect the shearing quality and service life of the blades. selecting the clearance may refer to following diagram.



Loosen screws(3),during adjusting clearance(See 2).Then turn handle to request graduation,and locking screws.last. Ball valve (in the right of machine,outside of cylinders)is used for measure evenness degree for cutting edge clearance on top and bottom blades.The details use:As single-stroke, when top rest move to lower dead point,fast turn ball-valve, close oil-way to let the top rest stop on lower dead point.Then just a little to open and close ball-valve,the top rest will go up more and more. thus, it can measure the evenness degree of cutting-edge clearance.

2、Preparation for operation:

(1)Clean oily soil for each parts,note the index line of ball valve should point to "start" position.

(2)Fill lubricating grease to each part.

(3)Fill HM46 wear oil in the oil box.

(4)The machine earthing,power on,examine the coordination of each electric equipment.

3、Operation

(1)Start machine to do empty running many times,just try to shear different thickness plates (from thin to thick plates) after ensure everything is all OK.

(2)During shearing,open the pressure gauge switch,observe pressure valve of oil-way,If anything abnormal appears,adjust flowover valve to reach the standard.

(3)If anything like abnormal noise or oil tank too hot appears、immediately stop the machine and examine it(the highest temperature for oil tank should be kept below 60℃)

10、Safety Technique and Maintenance

1、Operators must get familiar with the machine's structure and function、The machine is operated by several persons at the same time、So there must be with generally person in charge of it and direct work、

2、Don't put hands into top and bottom blades to avoid accident、

3、Don't put anything on working table to avoid accident、

4、Examine the sharp of blade edge timely,If find blade-edge is blunt in time to sharpen or change it,Just sharpe the blade edge's thickness is ok、

5、Examine each part of the machine at regular intervals、Keep the machine and the ground nearby clean、The insulation should be Ok、

6、Keep the net-shape oil-filter clean which is installed on the oil-in of oil pump、Let the oil-filter keep to oil through amounts, If the oil-filter blocked, oil through amount will reduce,It causes the oil pump empty and affect the life of oil pump、

7、Don't fill Oxygen compressed air or other inflammable gas into Nitrogen Cylinder、Nitrogen must be processed slowly into Nitrogen Cylinder、

8、Fill Nitrogen into Nitrogen Cylinder by filling tool,the filling pressure is about 5MPa、

9、It must discharge Nitrogen first before letting out the Nitrogen Cylinder、

Trouble of electric system

Trouble	Probable cause	Corrective action
Main motor can't start	Emergency stop pressed	Reset emergency stop
	Thermal protection active	Reset thermal protection device
	Emergency stop module not reset	Reset the emergency stop module

Trouble of mechanism

Burr on sheared edge	Dull blades	Turn or sharpen blades-see blade changing see blade changing
	Excessive blade clearance	Adjust the clearance to a correct value See blade adjustment
	Poor grade of material	Second stock that is full of strains cannot be sheared as clean or accurate as high grade steel
Sheared plate not paraller	Back-gauge lost parallelism with blade	Adjust the back-gauge see MAINTENANCE for back-gauge adjustment
	Not enough hold-down force	Increase the back cylinder pressure about 4.5MPa to 5.5MPa
Over or under size cuts	Counter	Adjust the counter
	Back Lash	Check the screw nut of back-gauge
	Improper setup procedure	Alswys bring the back-gauge stop towards the table final setting
Rocking on heavy shearing	Shear not level	See installation-leveling
Will not shear capacity cut	Insufficient ram pressure	See hydraulic problem.Pressure can't increase
	Ball valve be closed	Open the ball valve at the right side of the machine.
Ram can't back to top position	Semicircle ball displacement	Check the end of piston rood on main cylinder Reset the semicircle ball on it.

11.List of Rolling Bearings

No.	Code number of bearing	Name of Bearing	Specification	Precision Grade	Qty.	Fitting Position
7	3518	Double centripetal Ball Surface roll Bearing	d=90,D=160,H=40		2	Top rest
24	80202	Single Centripetal Ball Bearing with Dust Proof	a=15,D=35.H=11		2	Back Gauge
27	80205	-ditto-	a=25,D=52,H=15		4	-ditto-
28	8305	Single Direction Pushing Ball Bearing	a=25.D=52,H=18		2	-ditto-
36	180502	Single Centripetal Ball Bearing with Sealing Ring	a=15,D=35,H=14		2	-ditto-
40	180502	-ditto-	a=15,D=35,H=14		2	-ditto-
30	941/12	Rolling Bearing only with Pressure out Ring	d=12,D=17.B=12		2	-ditto-

12.List of Gear

No.	Name	B	a	m	Z	da	β	fa	H	Precision Grade	Material	Qty	Heat Treatment	Rotating direction
5	Pinion	20	20°	2	25	50		1	4.5	9FHGB10095	45	2		
6	fan Shape Gear	18	20°	2	250	500		1	4.5	9HKGB10095	45	2		
25	Gear	18	20°	2	17	34		1	4.5	8GJGB10095	45	1		
26	Gear	16	20°	2	68	136		1	4.5	8GJGb10095	45	1		

13.List of attached basic accessories for machine

No.	Name	Specification	Qty.	Remark
	Oil Gun	200cm^3	1	
	Filling Tool		1	
	Feeler		1	

14.List of attached easily worn parts for machine

No.	Name	Specification or Mark	Part Belonging to	Qty.
13	Dust ring	d95	Oil cylinder	2
16	Dust ring	d65	Return Stroke cylinder	2
	O-shape seal loop	35×3.5	swaging	8/10/12 /15
	O-shape seal loop	110×5.7	Oil Cylinder	1
	O-shape seal loop	100×5.7	Oil Cylinder	1

15、List of Easily Worn Parts Provided by Subscribers

No.	Name	Material	Weight	Qty.	Parts Belonging to
1	Top Blade	6CrW2Si		2/2/3/4	Tool carrier
2	Bottom Blade	6CrW2Si		2/2/3/4	framenork
3	semicircle block	ZQSn10-1		4	return Cylinder
4	bulb	ZQSn10-1		2	Oil cylinder
32	Screw	ZQSn10-1		2	Back Gauge
35	Screw	ZQSn10-1		2	Back Gauge
20	Cushion block	Ether Polyuerthane		8/10/12/15	swaging cylinder

HYDRAULIC SWING PLATE SHEARING MACHINE	Total:
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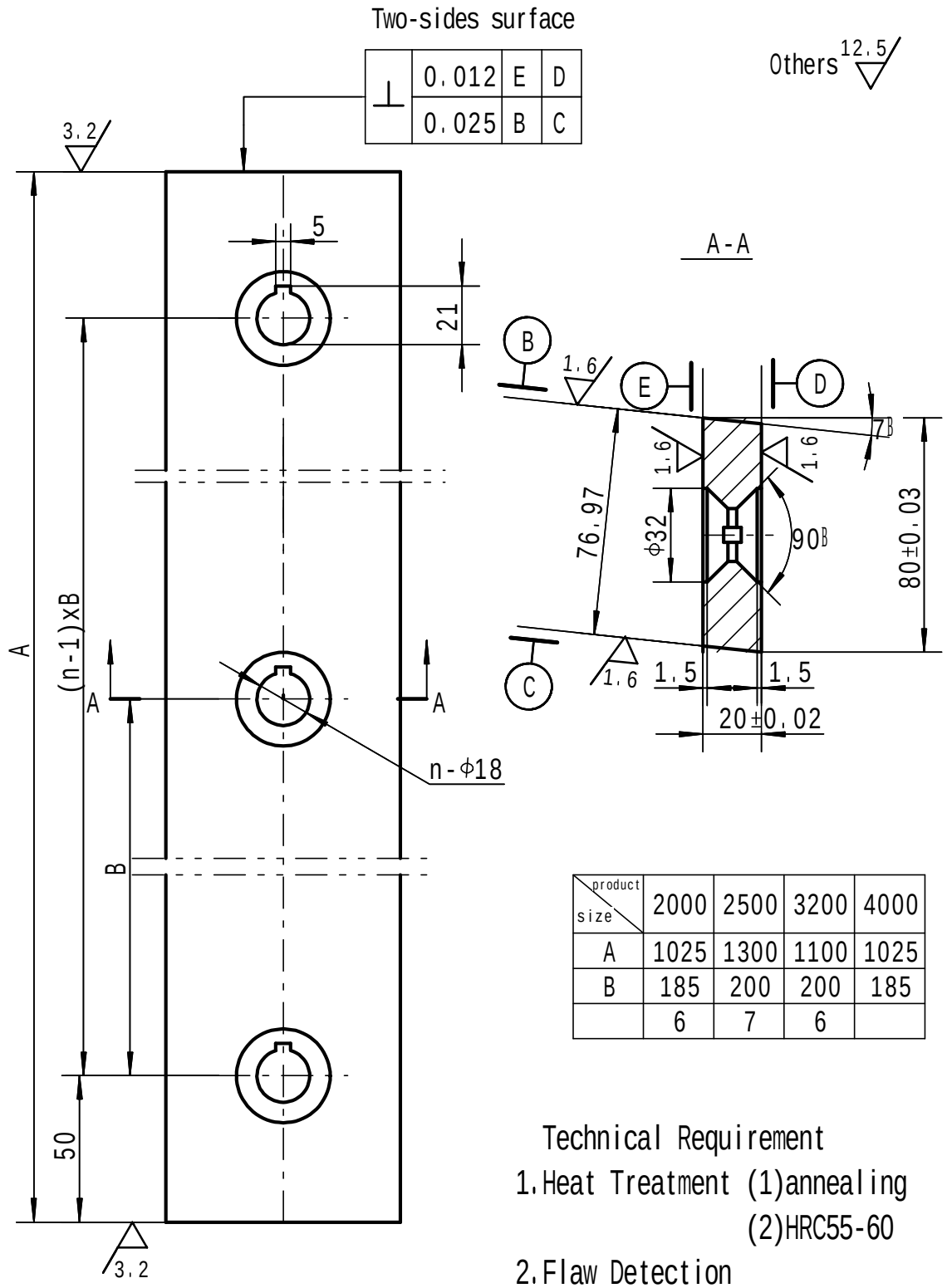

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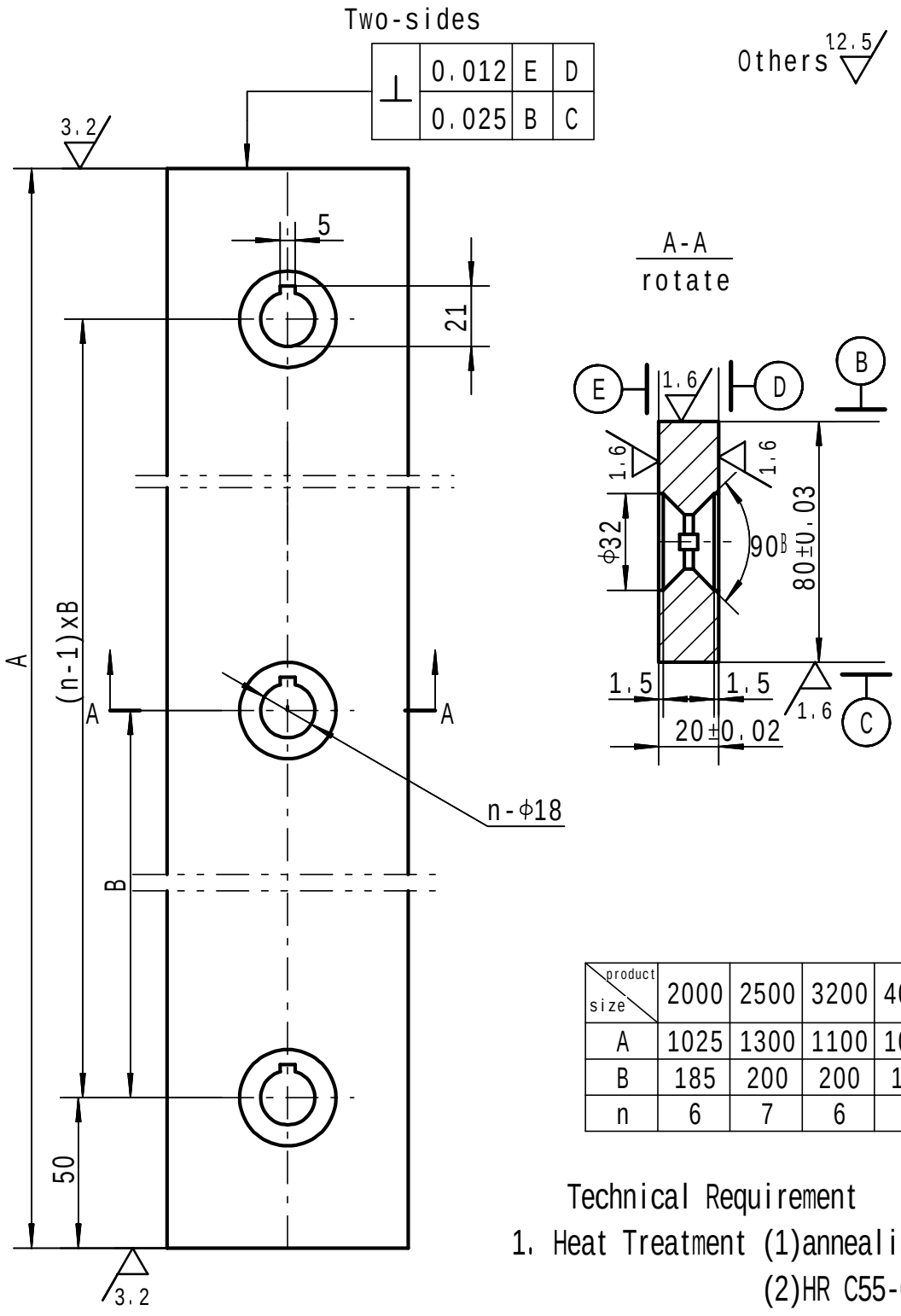
A	1025	1300	1100	1025
B	185	200	200	185
	6	7	6	

Technical Requirement

1. Heat Treatment (1)annealing
   (2)HRC55-60
2. Flaw Detection
3. The blade must not be blunted

1	Top Blade	6CrW2Si	1:2	
No.	Name	Material	Scale	Remark



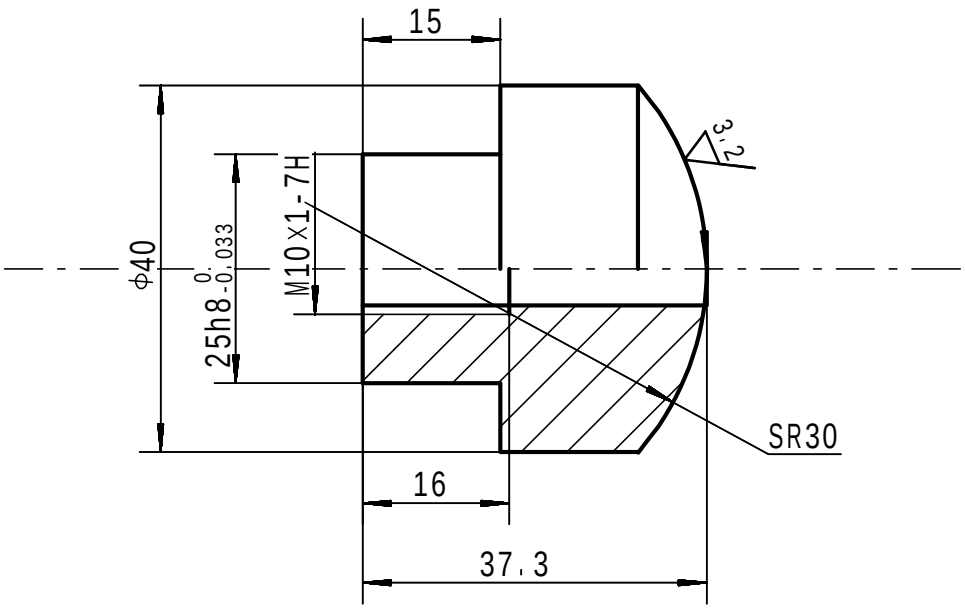
product / size	2000	2500	3200	4000
A	1025	1300	1100	1025
B	185	200	200	185
n	6	7	6	6

Technical Requirement

1. Heat Treatment (1)annealing
   (2)HR C55-60
2. Flaw Detection
3. The blade mustnot be blunted

2	Bottom Blade	6CrW2Si	1:2	
No.	Name	Material	Scale	Remark

Other $\sqrt{6.3}$



3	semicircle block	4# Zine Base Metal	1:1	
No.	Name	Material	Scale	Remark

HYDRAULIC SWING PLATE SHEARING MACHINE	Total:
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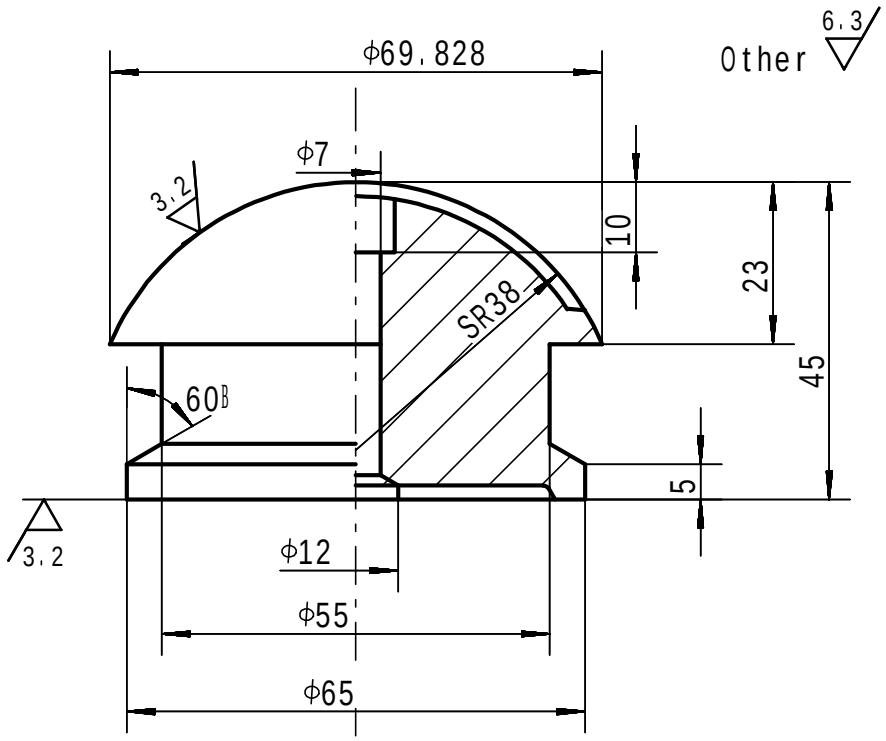
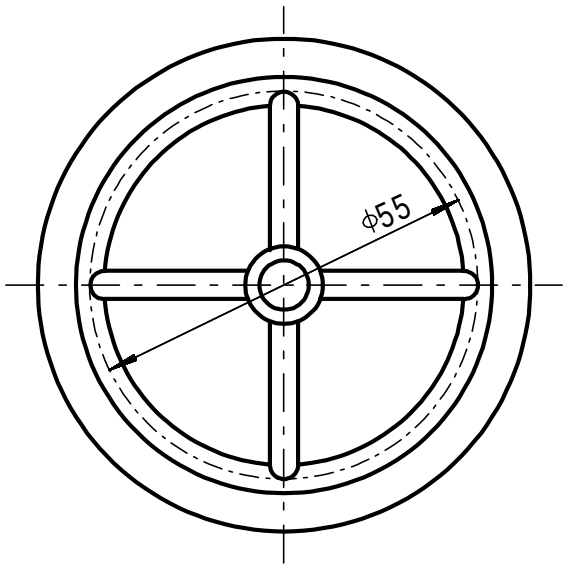
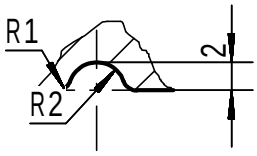
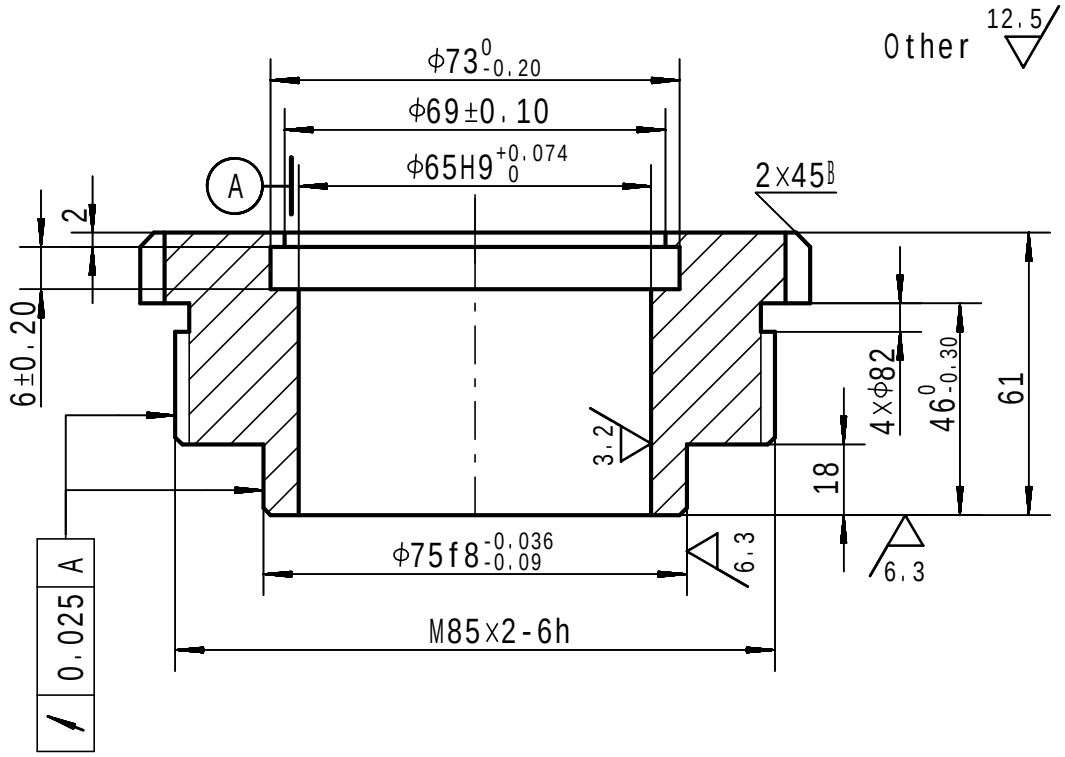


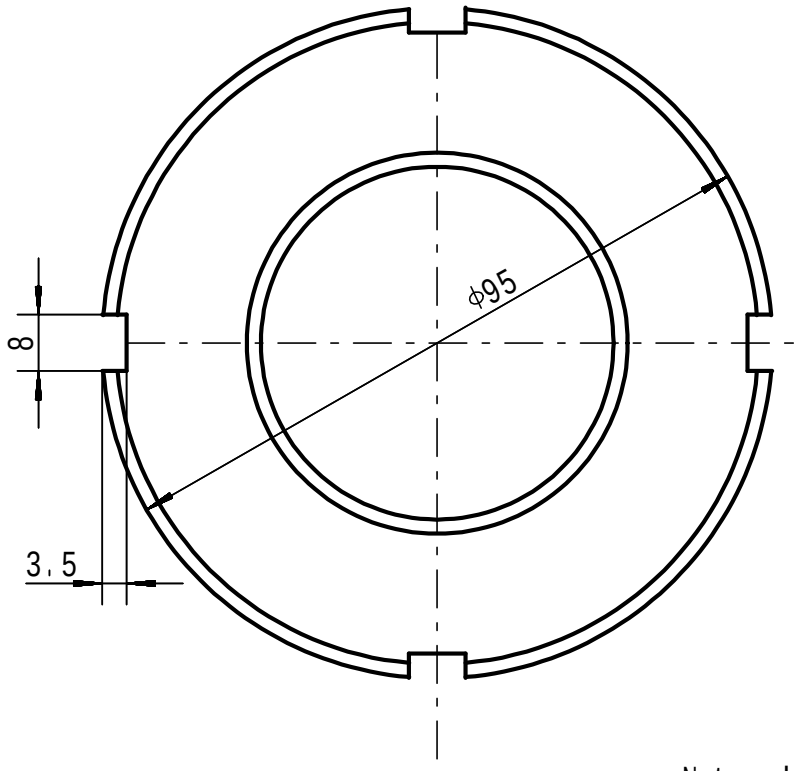


oil pool
2: 1



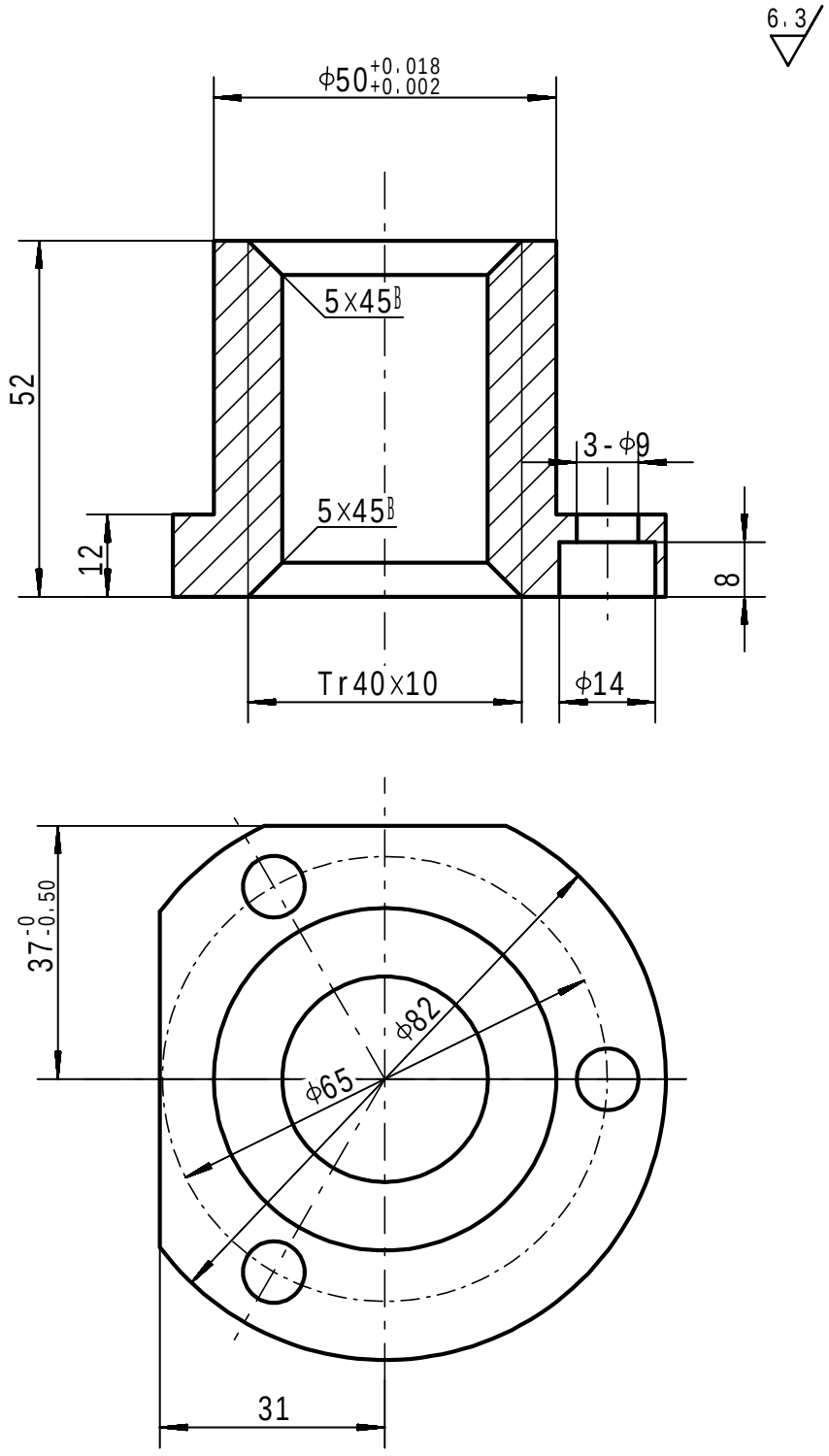
4	Bulb	4# Zinc Base Alloy	1:1	
No.	Name	Material	Scale	Remark





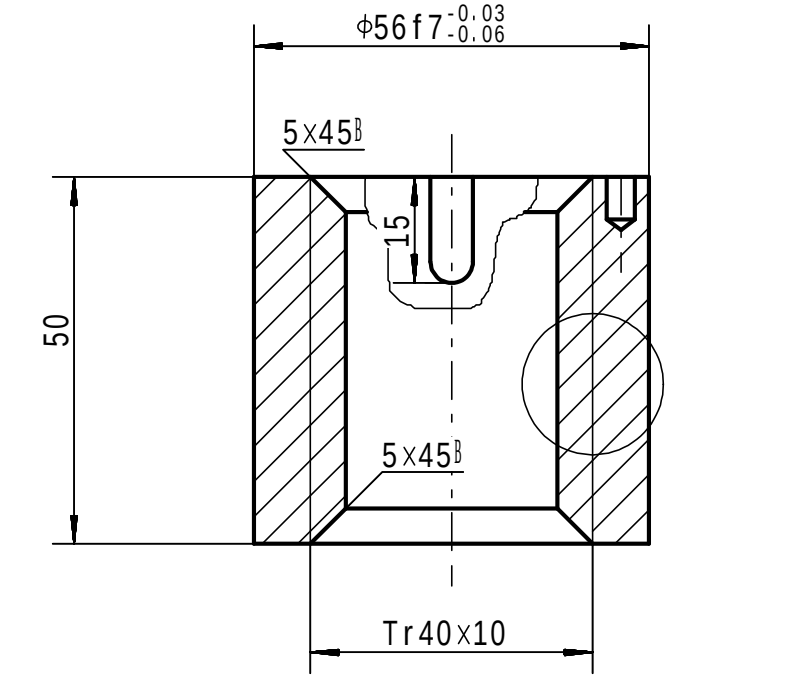
Not mark the fillet 1x45

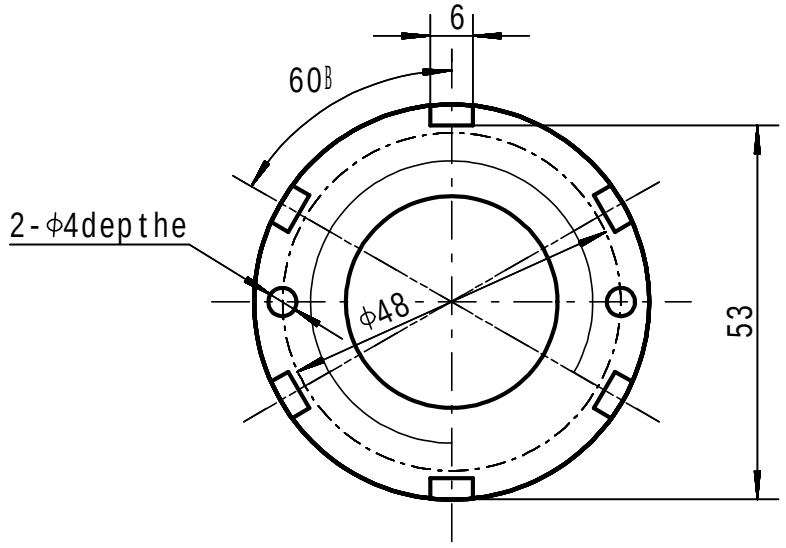
No.	Name	Material	Scale	Remark
15	Leading Sleeve	4# Zinc Base Alloy/Q235-A	1:1	



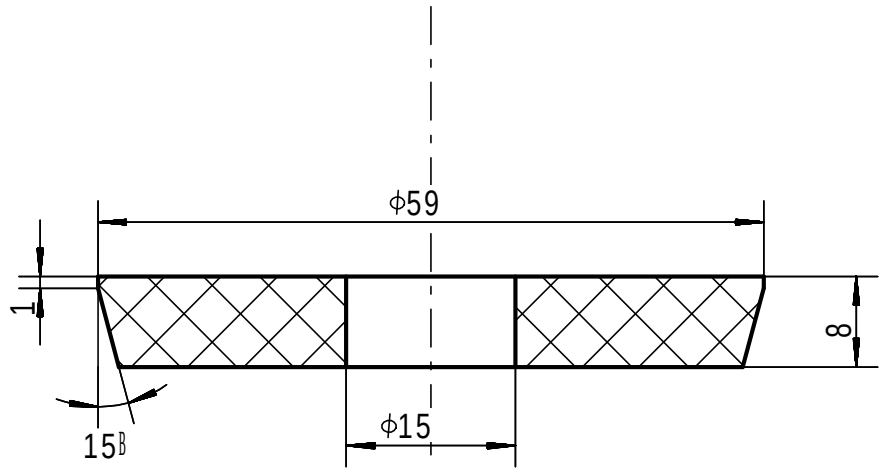
32	Screw	ZQSn10-1	1:1	
No.	Name	Material	Scale	Remark

6.3





35	Screw	ZQSn10-1	1:1	
No.	Name	Material	Scale	Remark



20	Cushion block	Ether Polyurethane	1:1	
No.	Name	Material	Scale	Remark

QC12K-6 SERIES CNC HYDRAULIC SWING PLATE SHEARING MACHINE

CERTIFICATE OF QUALITY

Shearing Thickness: 6 mm

Shearing Width: mm

Delivery No.:

THE PEOPLE'S REPUBLIC OF CHINA

JIANGSU JIANGHAI MACHINERY GROUP

ADD:2# BAOCHANG NORTH ROAD LIBAO HAIAN JIANGSU CHINA

TEL:0513-88212462 http://www.machine-jh.com

QUALITY CERTIFICATE	Total
	Page 1

This machine has been proved excellent through examination and is permitted to out factory.

Inspector:

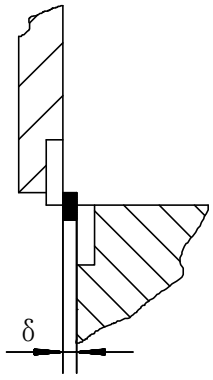
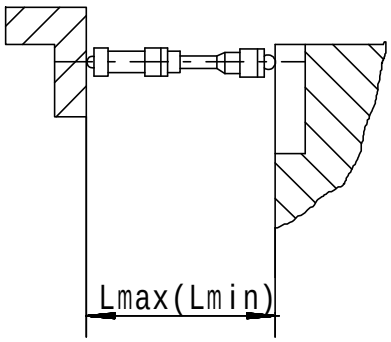
Head of Inspection Department:

Date:

QUALITY CERTIFICATE

I、Geometric accuracy inspection

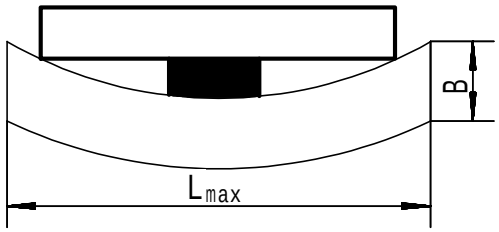
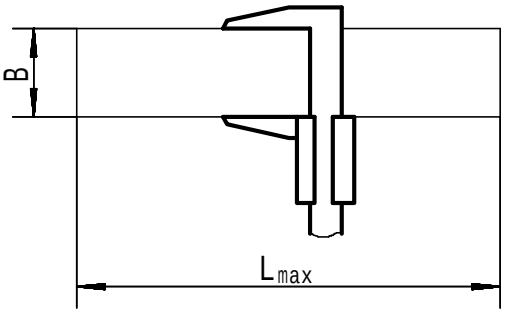
GB/T14404

<table>
<tr><th>No.</th><th>Inspection Item</th><th>Diagram</th><th colspan="3">Tolerance (mm)</th><th>Measurement</th></tr>
<tr><td>1</td><td>Evenness between the clearance of blades edges</td><td> 
</td><td colspan="3"><table>
<tr><td>canshear thickness</td><td colspan="2">At whole length</td></tr>
<tr><td></td><td>Brake Type</td><td>swing Type</td></tr>
<tr><td>≤2.5</td><td>0.02</td><td>0.04</td></tr>
<tr><td>>2.5-8</td><td>0.05</td><td>0.06</td></tr>
<tr><td>>8-16</td><td>0.08</td><td>0.12</td></tr>
<tr><td>>16</td><td>0.10</td><td>0.18-0.26</td></tr>
</table></td><td></td></tr>
<tr><td>2</td><td>Parallelism between bottom blade and gauge</td><td> 
</td><td colspan="3"><table>
<tr><td>accuracy grade</td><td>at the length of 1000</td></tr>
<tr><td>I</td><td>0.10</td></tr>
<tr><td>II</td><td>0.20</td></tr>
<tr><td>III</td><td>0.50</td></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
</table></td><td></td></tr>
</table>

QUALITY CERTIFICATE

Total:
Page: 3

II、Work accuracy

No.	Inspection Item	Inspecting way and Diagram	accuracy	
			Tolerance (mm)	measurement (mm)
1	Bending straightness of workpiece	 Put the workpiece on level table and use the inspecting level ruler on the surface of the sheared plate and measure the clearance by feeler,Error is figured out with the max value within one meter long.	At the length of 1000, Grade: I accuracy:0.25 Grade: II accuracy:0.50 Grade: III accuracy:1.00	
	Parallelism of workpiece	 Measure the width of workpiece by a vernier caliper in many places.Error is figured out with the Grade accuary value within 1000mm long	At the length of 1000, Grade: I accuracy:0.15 Grade: II accuracy:0.30 Grade: III accuracy:0.75	

QC12K-6 SERIES CNC HYDRAULIC SWING PLATE SHEARING MACHINE

PACKING LIST

Shearing Thickness: 6 mm

Shearing Width: mm

Delivery No.:

THE PEOPLE'S REPUBLIC OF CHINA

JIANGSU JIANGHAI MACHINERY GROUP

ADD:2# BAOCHANG NORTH ROAD LIBAO HAIAN JIANGSU CHINA

TEL:0513-88212462 http://www.machine-jh.com

PACKING LIST

Reference NO.:

Case Dimensions(LxWxH):

Gross Weight:

Net Weight:

NO.	Name and Specification	Qty.	Remark
1	Main engine	1 set	
2	Front bracket	3 piece	
3	Pedal Switch	1 set	
4	O-shape Sealing Ring 35×3.5	8/10/12/15	
5	O-shape Sealing Ring 110×5.7	1 set	
6	O-shape Sealing Ring100×5.7	1 set	
7	Dust Ring d95	2 sets	
8	Dust Ring d65	2 sets	
9	Foundation Bolt M24x500	4 group	
10	feeler	1 set	
11	200cm^3 oil gun	1 set	
12	filling Tool	1 set	
13	Power key for key button	2 sets	
14	attached files(operation manual certificate of quality,packing list)	1 piece	
15			

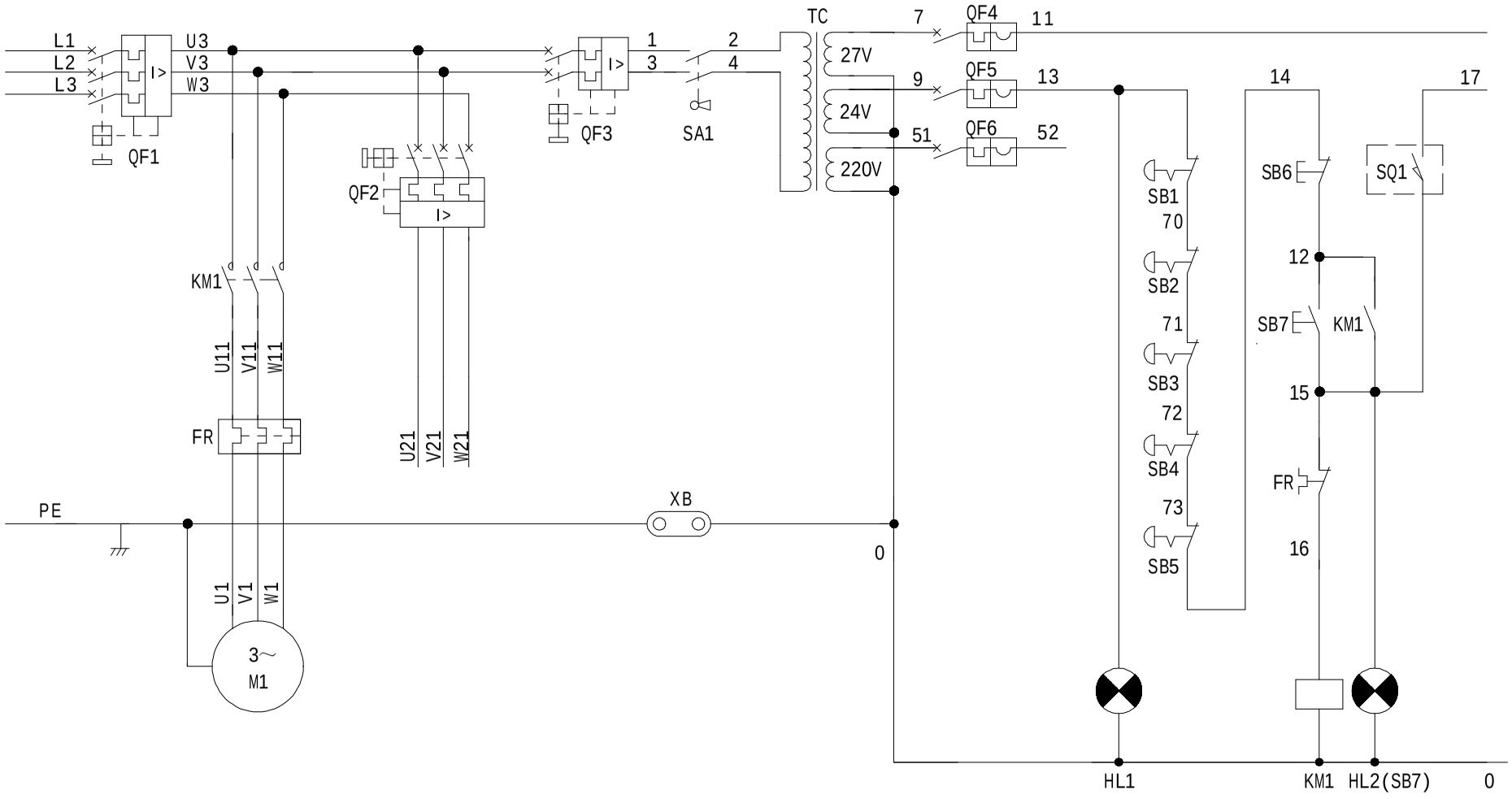
Packing Inspector:

Date:

HYDRAULIC SWING SHEARING

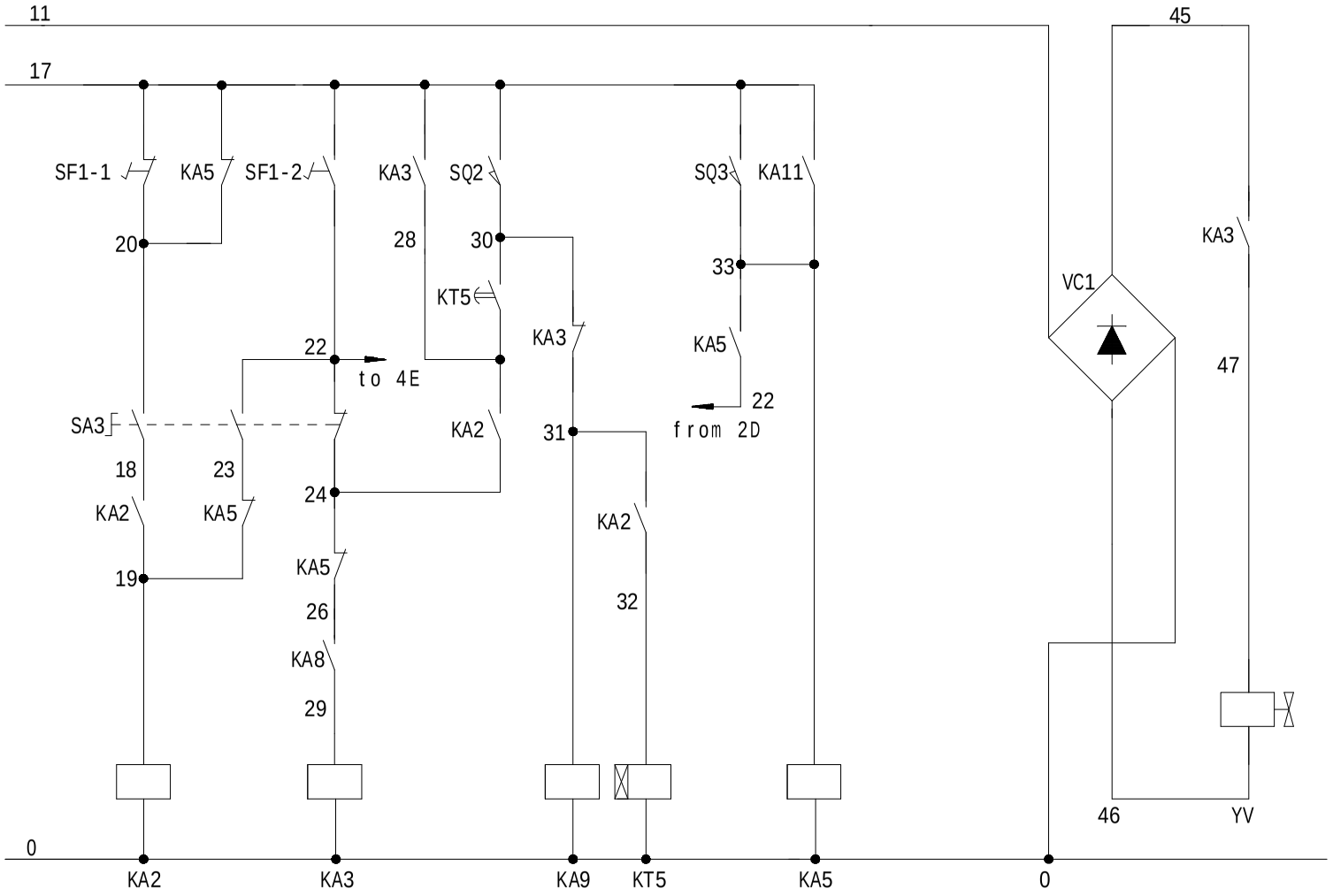
ELECTRIC SYSTEM

0	1	2	3	4	5	6	7	8	9
POWER	POWER SWITCHGEAR	MAIN MOTOR	INVERTER CONTROL	FIRST PROTECTION	KEY SWITCH	COUNTROL TRANSFORMER	SECOND PROTECTION	POWER INDICATOR	EMERGENCY STOP	MAIN PUMP START/STOP	SAFETY GUARD



DESIGNED						Jiangsu Jianghai Machinery Group		CHANGE	DATE	MARK	NUMBER			PAGE: 1	
CHECKED															
AUDITING						S.Y.F21S								TOTAL: 4	

CONTINUE	SINGLE	UPWARD LIMIT	UDP DELAY	SHEARING LENGTH CONTROL	VALVE POWER	VALVE GROUP

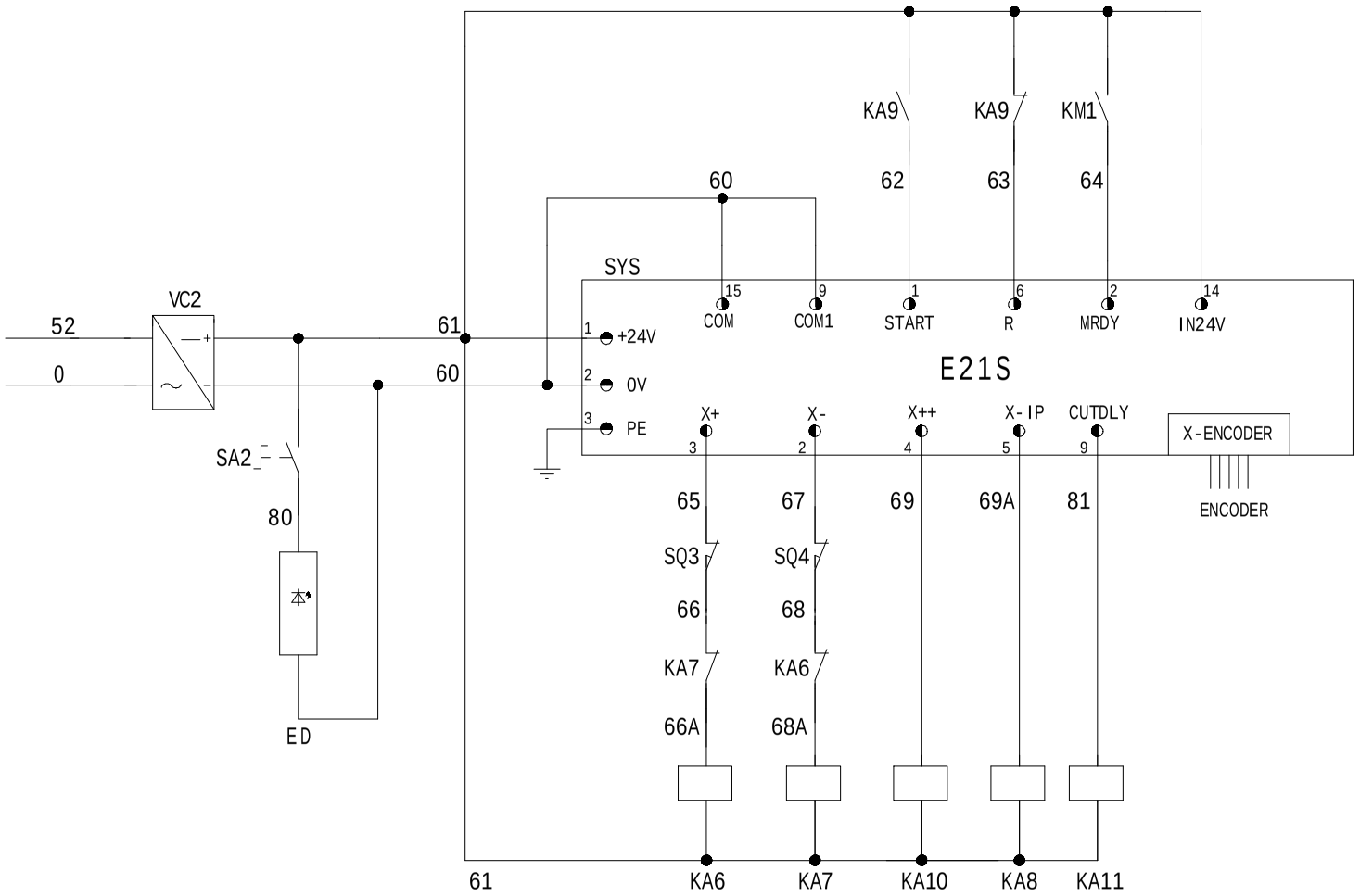


DESIGNED						Jiangsu Jianghai Machinery Group	CHANGE	DATE	MARK	NUMBER
CHECKED										
AUDITING						S.Y.F21S				

PAGE: 2

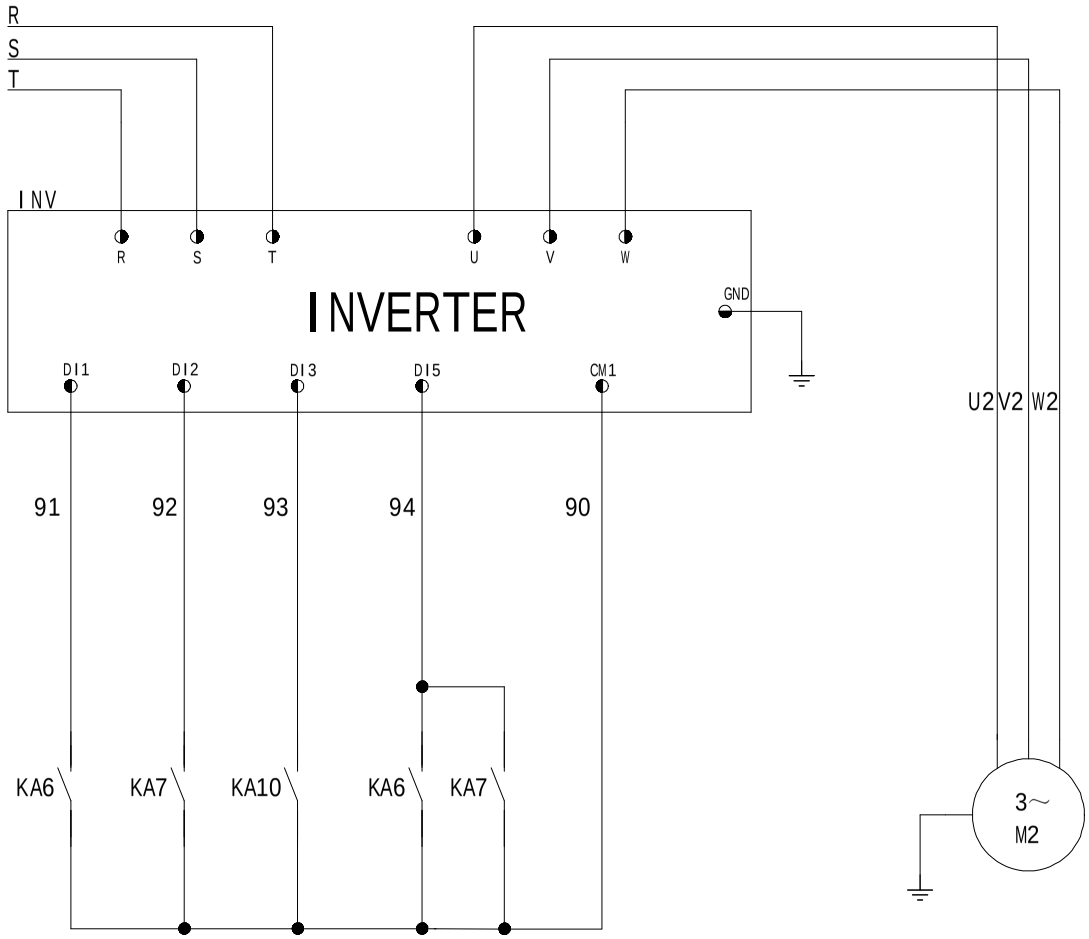
TOTAL: 4

SYSTEM POWER	HEAD LAMP	E21S CONTROL



DESIGNED						Jiangsu Jianghai Machinery Group	CHANGE	DATE	MARK	NUMBER		PAGE: 3
CHECKED												

INVERTER CONTROL



DESIGNED						Jiangsu Jianghai Machinery Group	CHANGE	DATE	MARK	NUMBER		PAGE: 4
CHECKED												
AUDITING												

ELECTRICAL COMPONENTS LIST

CODE	NAME	TYPE	QTY	REMARK
QF1	Breaker	DZ20Y-100/330	1	32A
QF2	Breaker	DZ47-63 C6/3P	1	
QF3	Breaker	DZ47-63 C4/2P	1	
QF4-QF6	Breaker	DZ47-63 C4/1P	3	
TC1	Transformer	JBK3-400	1	OUTPUT 220V27V24V
VC1	Switching power	S-145-24	1	
VC2	Rectifier	KBPC1010	1	
KM1	Contactor	3TB4322	1	AC24V
FR	Thermo relay	3UA52	1	10-16A
KA2-KA3	Genernal relay	MY4N-J	2	AC24V
KA5	Genernal relay	MY4N-J	1	AC24V
KA9	Genernal relay	MY4N-J	1	AC24V
KA6-KA8	Genernal relay	MY4N-J	3	DC24V
KA10-KA11	Genernal relay	MY4N-J	2	DC24V
SB1-SB5	Emergency pushbutton	XB2-BS542C	5	
SB6	Button	XB2BA42C	1	
SB7	Button	XB2BW31B1C	1	
SA1	Key selector	XB2BG21C	1	
SA3	Key selector	XB2BG21C	1	

CODE	NAME	TYPE	QTY	REMARK
SA2	Selector	XB2BD21C	1	
HL1	Indicator	XB2BVB1PC	1	AC24V
KT5	Time relay	ST3PA 0-10S	1	AC24V
SYS	CNC System	E21S	1	
INV	Inverter	PI 130	1	
SQ1	Limit switch	JW2-11H/L	1	
SQ2-SQ3	Limit switch	XCK-M115C	2	
SQ4-SQ5	Limit switch	XCKN2118P20C	2	
SF1	Pendal switch	ECFS-H5	1	
XB(PE)	Grounding device	JDGA-4	1	

DESIGNED						Jiangsu Jianghai Machinery Group	CHANGE	DATE	MARK	NUMBER		PAGE: 1
CHECKED												
AUDITING												

Attention Marks:

Safety mark "Beware of electric shock**": Do not open the junction box of the motor until it is switched off to avoid electrical injury.**

Important safety mark, prompting to avoid hand squeezing and head collision when the screen pressing mechanism is opened.

Operate according to the operating manual.

It is required to wear an auditory guard.

Safety mark "**Beware of injury from the machine**": Do not contact running parts with hands when the machine is running. The inspection, repair, disassembly or replacement etc. can be carried out only after the machine is stopped.

Do not remove the safety guard while the machine is running or before it has completely stopped.

NOTE: The control cabinet keys must be kept and operated by professional repair staff.

13.0 Hazards List

Please check all row and Change Applicable/Not Applicable if is the case.

			Present	
			Yes	**No**
1	**Mechanical hazards** due to: 1) machine's parts or working pieces a) shape; b) related position; c) mass and balancing (potential energy of the element which can fall down under gravity effect); d) mass and speed (kinetic energy of the element which can move under controlled and uncontrolled movement); 2) energy accumulation into the machine due to: e) elastic element (springs); f) fluid and gas under pressure; g) vacuum effect;		X	
1.1	Crushing hazard		X	
1.2	Shearing hazard		X	
1.3	Cutting or severing hazard		X	
1.4	Entanglement hazard		X	
1.5	Drawing-in or trapping hazard		X	
1.6	Impact hazard		X	
1.7	Stabbing or puncture hazard		X	
1.8	Friction or abrasion hazard		X	
1.9	High pressure fluid or gas ejection hazard		X	
1.10	Parts ejection		X	
1.11	Lack of stability		X	
1.12	Slip, trip, fall related to the machine		X	
2	**Electric hazard due to**			
2.1	Direct and indirect electrical contact between people and live parts		X	
2.2	Electrostatic phenomena		X	
2.3	Thermal radiation or other phenomena such as projection of molten particles, and chemical effects from short circuits, overloads, etc.		X	
2.4	External influences		X	
3	**Thermal hazards i.e. resulting in**			
3.1	Burns and scalds, by a possible contact of persons, by flames or explosions and also by the radiator of heat source		X	
3.2	Health-damaging effects by hot or cold work environment		X	
4	**Hazards generated by noise, resulting i.e. in:**			
4.1	Hearing losses (deafness), other physiological disorder (i.e. loss of balance, loss of awareness, etc.)		X	
4.2	Interference with speech communication, acoustic signal, etc.		X	
5	**Hazards generated by vibration (resulting in a variety of neurological and vascular disorders)**		X	
6	**Hazards generated by radiation**			

6.1	Radiation at low frequency, radio frequency, microwaves, electric arcs		X	
6.2	Infrared-ray, light, UV-ray, lasers			X
6.3	X-ray, γ-ray			X
6.4	α-ray, β-ray, electron or ion beam, neutron beam			X
7	**Hazards generated by materials and substances processed, used or exhausted by machinery i.e.**			
7.1	Hazards resulting from contact with or inhalation of harmful fluids, gases, mists, fumes and dusts		X	
7.2	Fire or explosion hazards		X	
7.3	Biological and micro-biological (viral or bacterial) hazards		X	
8	**Hazards generated by neglecting ergonomic principles in machine design (mismatch of machinery with human characteristics and abilities) caused i.e. by**			
8.1	Unhealthy postures or excessive efforts.		X	
8.2	Inadequate consideration of human hand-arm or foot-leg anatomy		X	
8.3	Neglected use of PPE		X	
8.4	Inadequate area lighting		X	
8.5	Mental overload or underload, stress, etc.		X	
8.6	Human error		X	
9	**Hazards combination**		X	
10	**Hazards caused by failure of energy supply, breaking down of machinery parts and other functional disorders, i.e.**			
10.1	Failure, malfunction of control system (unexpected start up, unexpected overrun)		X	
10.2	Unexpected ejection of machine parts or fluids.		X	
10.3	Control malfunctioning		X	
10.4	Error of fitting		X	
10.5	Overturn, unexpected loss of machine stability		X	
11	**Hazardous due to means/devices related to the safety missing or in wrong position**			
11.1	Missing guards		X	
11.2	Missing safety devices		X	
11.3	Starting and stopping devices		X	
11.4	Safety sign		X	
11.5	Information and warning means		X	
11.6	Energy disconnecting devices		X	
11.7	Emergency devices		X	
11.8	Working piece feeding		X	
11.9	Maintenance equipment		X	
11.10	Gas evacuation		X	
	Hazards due to mobility			
12	**Inadequate lighting**		X	
13	**Instability**		X	
14	**Neglected ergonomic of the control position**			
14.1	Hazards due to dangerous environment (contact with moving parts, exhaust, etc.)		X	

14.2	Inadequate visibility by the operators		X	
14.3	Inadequate seating		X	
14.4	Inadequate controls		X	
14.5	Starting in machine with engine		X	
14.6	Road traffic		X	
14.7	Pedestrian control		X	
15	**Mechanical hazards**			
15.1	Uncontrolled movement		X	
15.2	Parts ejection		X	
15.3	Roll over		X	
15.4	Falling objects		X	
15.5	Inadequate access		X	
15.6	Towing		X	
15.7	Batteries			X
16	**Hazards due to lifting operation**			
16.1	Lack of stability		X	
16.2	Derailment		X	
16.3	Loss of mechanical strength of the machine		X	
16.4	Uncontrolled movement		X	
16.5	Falling loads		X	
17	**Inadequate view**		X	
18	**Lighting**		X	
19	**Overloading**		X	

14.0 Essential Health and Safety Requirements (Annex I Machinery Directive 2006/42/EC)

Please check all row and Change Applicable/Not Applicable if is the case.

Ref.	E.H.S.R.	A	NA	Meet the requirement?
1.1	General remarks	X		Y
1.1.1	Definition	X		Y
1.1.2	Principles of safety integration	X		Y
1.1.3	Materials and products	X		Y
1.1.4	Lighting	X		Y
1.1.5	Design of machinery to facilitate its handling	X		Y
1.2	Controls			
1.2.1	Safety and reliability of control systems	X		Y
1.2.2	Control devices	X		Y
1.2.3	Starting	X		Y
1.2.4	Stopping device (normal stopping, emergency stop)	X		Y
1.2.5	Mode selection	X		Y
1.2.6	Failure of the power supply	X		Y
1.2.7	Failure of the control circuit	X		Y
1.2.8	Software	X		

1.3	Protection against mechanical hazards			
1.3.1	Stability	X		Y
1.3.2	Risk of break-up during operation	X		Y
1.3.3	Risks due to falling or ejected objects	X		
1.3.4	Risks due to surfaces, edges or angles	X		Y
1.3.5	Risks related to combined machinery	X		Y
1.3.6	Risks relating to variations in the rotational speed of tools	X		Y
1.3.7	Prevention of risks related to moving parts	X		Y
1.3.8	Choice of protection against risks related to moving parts (transmission parts, moving parts directly involved in the process, etc.)	X		Y
1.4	Required characteristics of guards and protection devices	X		Y
1.4.1	General requirements	X		Y
1.4.2	Special requirements for guards	X		Y
1.4.2.1	Fixed guards	X		Y
1.4.2.2	Movable guards	X		Y
1.4.2.3	Adjustable guards restricting access	X		Y
1.4.3	Special requirements for protection devices	X		Y
1.5	Protection against other hazards	X		Y
1.5.1	Electricity supply	X		Y
1.5.2	Static electricity	X		Y
1.5.3	Energy supply other than electricity	X		Y
1.5.4	Errors of fitting	X		Y
1.5.5	Extreme temperatures	X		Y
1.5.6	Fire		X	Y
1.5.7	Explosion		X	Y
1.5.8	Noise	X		Y
1.5.9	Vibration	X		Y
1.5.10	Radiation		X	
1.5.11	External radiation		X	
1.5.12	Laser equipment		X	
1.5.13	Emissions of dust, gases, etc.		X	Y
1.5.14	Risk of being trapped in a machine	X		Y
1.5.15	Risk of slipping, tripping or falling	X		Y
1.6	Maintenance			
1.6.1	Machinery maintenance	X		Y
1.6.2	Access to operating position and servicing points	X		Y
1.6.3	Isolation of energy sources	X		Y
1.6.4	Operator intervention	X		Y
1.6.5	Cleaning of internal parts	X		Y
1.7	Indicators	X		Y
1.7.0	Information devices	X		Y
1.7.1	Warning devices	X		Y
1.7.2	Warning of residual risks	X		Y
1.7.3	Marking	X		Y

1.7.4	Instructions	X		Y

A = Applicable; NA = Not Applicable

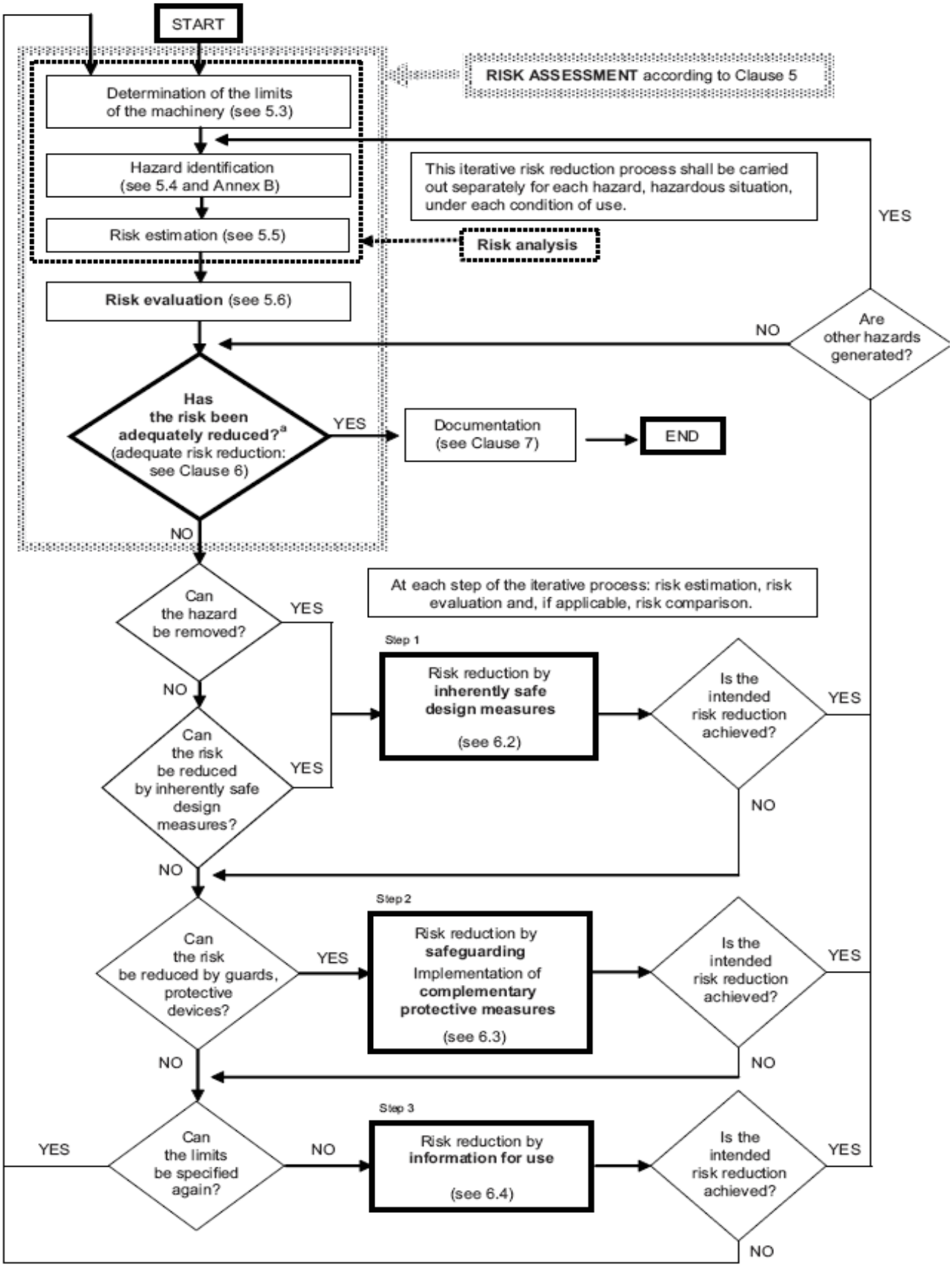
15.0 List of The Applied Norms

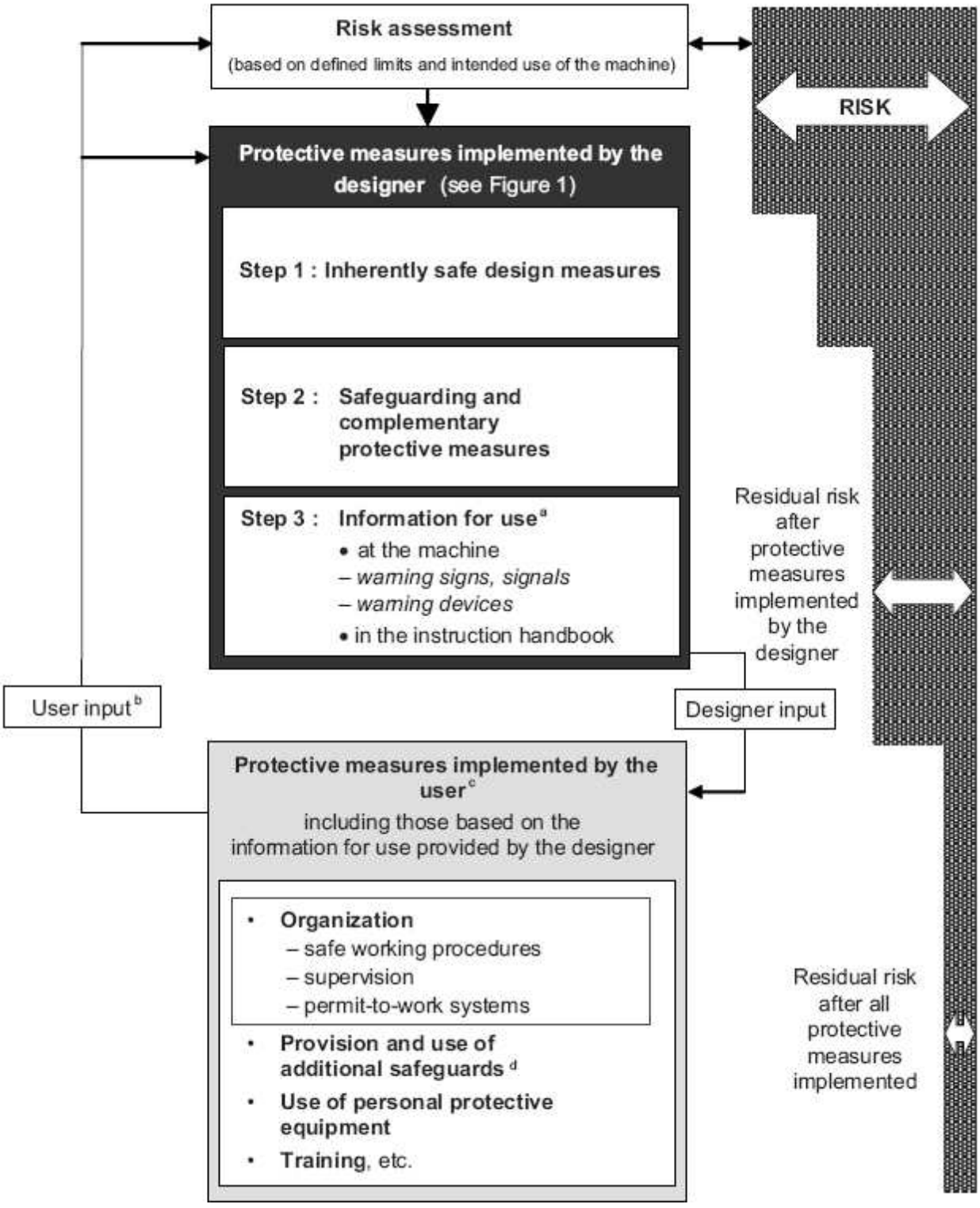
Norms number	Description
EN 60204-1:2018	Safety of machinery—Electrical equipment of machines—General requirements
EN ISO 12100:2010	Safety of machinery—General principles for design—Risk assessment and risk reduction
EN 13985:2003+A1:2009	Machine tools - Safety - Guillotine shears
EN IEC 61000-6-2:2019	Electromagnetic compatibility (EMC) - Part 6-4: Generic standards - Emission standard for industrial environments
EN IEC 61000-6-4:2019	Electromagnetic compatibility (EMC) - Part 6-2: Generic standards - Immunity for industrial environments

Technical File No.:	Issue Date:	Prepared by:	Approved by:
JH-2021-04-02	**2021-04-12**		

16.0 Risk Evaluation Report According to EN ISO 12100:2010

Evaluation Procedure




Risk assessment
(based on defined limits and intended use of the machine)
RISK
Protective measures implemented by the designer (see Figure 1)
Step 1 : Inherently safe design measures
Step 2 : Safeguarding and complementary protective measures
Step 3 : Information for use[a]
• at the machine
– warning signs, signals
– warning devices
• in the instruction handbook
Residual risk after protective measures implemented by the designer
User input[b]
Designer input
Protective measures implemented by the user[c]
including those based on the information for use provided by the designer
• Organization
– safe working procedures
– supervision
– permit-to-work systems
• Provision and use of additional safeguards[d]
• Use of personal protective equipment
• Training, etc.
Residual risk after all protective measures implemented

Determination of limits for machinery		
Use limits	the different machine operating modes and different intervention procedures for the users, including interventions required by malfunctions of the machine:	
	the use of the machinery (for example, industrial, non-industrial and domestic) by persons identified by sex, age, dominant hand usage, or limiting physical abilities (visual or hearing impairment, size, strength, etc.);	Industrial use only
	the anticipated levels of training, experience or ability of users including 1) operators, 2) maintenance personnel or technicians, 3) trainees and apprentices, and 4) the general public;	Licensed operator only Don't overload.
	exposure of other persons to the hazards associated with the machinery where it can be reasonably foreseen: 1 persons likely to have a good awareness of the specific hazards, such as operators of adjacent machinery; 2 persons with little awareness of the specific hazards but likely to have a good awareness of site safety procedures, authorized routes, etc, such as administration staff; 3 persons likely to have very little awareness of the machine hazards or the site safety procedures, such as visitors or members of the general public, including children.	The operator has to been trained and has to been aware of the potential risk of operating the machine. The operator should have due PPE when operate the machine. The operator has to following the instruction when operate the machine. The operator has to pay attention to people who is around the machine when operate the machine.
Space limits	Aspects of space limits to be taken into account include 4 the range of movement, 5 space requirements for persons interacting with the machine, such as during operation and maintenance, 6 human interaction such as the operator–machine interface, and 7 the machine–power supply interface.	

Time limits	Aspects of time limits to be taken into account include 8 the life limit of the machinery and/or of some of its components (tooling, parts that can wear, electromechanical components, etc.), taking into account its intended use and reasonably foreseeable misuse, and 9 recommended service intervals.	None
Other limits	Examples of other limits include 10 properties of the material(s) to be processed, 11 housekeeping — the level of cleanliness required, and 12 environmental — the recommended minimum and maximum temperatures, whether the machine can be operated indoors or outdoors, in dry or wet weather, in direct sunlight, tolerance to dust and wet, etc.	

Risk Level			**P^3=3**	**P^3=2**	**P^3=1**
E^1=1			1	---	---
E^1=2	E^2=1	A^4=1	2	1	---
		A^4=2	3	2	1
		A^4=3	4	3	2
	E^2=2	A^4=1	5	4	3
		A^4=2	6	5	4
		A^4=3	7	6	5
	E^2=3	A^4=1	8	7	6
		A^4=2	9	8	7
		A^4=3	10	9	8
E^1=3	E^2=1	A^4=1	11	10	9
		A^4=2	12	11	10
		A^4=3	13	12	11
	E^2=2	A^4=1	14	13	12

		A^4=2	15	14	13
		A^4=3	16	15	14
	E^2=3	A^4=1	17	16	15
		A^4=2	18	17	16
		A^4=3	19	18	17
E^1=4			20	19	18
Parameters: E1, Effect (degree of possible harm). 1 Minor, 2 Moderate, 3 Severe, 4 Death or Catastrophic E2, Exposure to danger 1 Seldom, 2 Frequent, 3 Continuous			P3, Probability of occurrence of harm 1 Low, 2 Medium, 3 High A4, possibility of Avoiding or limiting harm 1 Easily, 2 Possible, 3 Impossible If risk level＞9, Means a special safety measured scheme is required		

	Type of Hazards	Life of Cycle	Identified hazards		ISO 12100	Risk evaluation					Safety Measured scheme	Protective Measure	Adequate ?
			Origin[a]	Potential consequences[b]		E^1	E^2	P^3	A^4	Risk Level			
1	**Mechanical hazards**	☐transport ☒assembly and installation ☐commissioning ☒use ☐dismantling, disabling and scrapping.	☐acceleration, deceleration; ☐angular parts; ☐approach of a moving element to a fixed part; ☐cutting parts; ☐elastic elements; ☐falling objects; ☐gravity; ☐height from the	☒being run over; ☐being thrown; ☐crushing; ☒cutting or severing; ☒drawing-in or trapping; ☐entanglement; ☐friction or abrasion; ☐impact;	6.2.2.1 6.2.2.2 6.2.3 a) 6.2.3 b) 6.2.6 6.2.10 6.3.1 6.3.2 6.3.3 6.3.5.2 6.3.5.4	3	1	1	2	10	Required	Set up obvious warning sign. Machines designed according to EN ISO 12100:2010, And EN 13985:2003+A1:2009. Operation under instruction Due PPE been used	**Adequate**

			ground; ☒high pressure; ☒instability; ☐kinetic energy; ☐machinery mobility; ☐moving elements; ☐rotating elements; ☐rough, slippery surface; ☐sharp edges; ☐stored energy; ☐vacuum.	☐injection; ☒shearing; ☐slipping, tripping and falling; ☐stabbing or puncture; ☐Suffocation.	6.3.5.5 6.3.5.6 6.4.1 6.4.3 6.4.4 6.4.5							
2	**Electrical hazards**	☐transport ☐assembly and installation ☐commissioning ☒use ☐dismantling, disabling and scrapping.	☐arc; ☐electromagnetic phenomena; ☐electrostatic phenomena; ☒live parts; ☒not enough distance to live parts under high voltage; ☐overload; ☐parts which have	☐burn; ☐chemical effects; ☐effects on medical implants; ☐electrocution; ☒falling, being thrown; ☐fire; ☐projection of molten particles; ☒shock.	6.2.9 6.3.2 6.3.3.2 6.3.5.4 6.4.4 6.4.5	3	1	1	2	10	Required	Machines designed according to EN 60204-1 Due PPE been used Operation under instruction	**Adequate**

			become live under fault conditions; ☒short-circuit; ☐thermal radiation.										
3	**Thermal hazards**	☐transport ☐assembly and installation ☐commissioning ☒use ☐dismantling, disabling and scrapping.	☐explosion; ☐flame; ☐objects or materials with a high ☐or low temperature; ☐radiation from heat sources.	☐burn; ☐dehydration; ☐discomfort; ☐frostbite; ☐injuries by the radiation of heat sources; ☒scald.	6.2.4 b) 6.2.8 c) 6.3.2.7 6.3.3.2.1 6.3.4.5	2	2	3	1	5	Not required	Operation under instruction	
4	**Noise hazards**	☐transport ☐assembly and installation ☐commissioning ☒use ☐dismantling, disabling and scrapping.	☐cavitation phenomena; ☒exhausting system; ☐gas leaking at high speed; ☐manufacturing process (stamping, cutting, etc.); ☐moving parts; ☐scraping surfaces; ☐unbalanced rotating parts; ☐whistling pneumatics;	☒discomfort; ☐loss of awareness; ☐loss of balance; ☒permanent hearing loss; ☐stress; ☐tinnitus; ☐tiredness; ☐any other (for example, mechanical, electrical) as a consequence of	6.2.2.2 6.2.3 c) 6.2.4 c) 6.2.8 c) 6.3.1 6.3.2.1 b) 6.3.2.5.1 6.3.3.2.1 6.3.4.2 6.4.3 6.4.5.1 b) and c)	2	2	2	2	5	Not required	Due PPE been used	

			☐worn parts.	an interference with speech communication or with acoustic signals.									
5	**Vibration hazards**	☐transport ☐assembly and installation ☐commissioning ☐use ☐dismantling, disabling and scrapping.	☐cavitation phenomena; ☐misalignment of moving parts; ☐mobile equipment; ☐scraping surfaces; ☐unbalanced rotating parts; ☐vibrating equipment; ☐worn parts.	☐discomfort; ☐low-back morbidity; ☐neurological disorder; ☐osteo-articular disorder; ☐trauma of the spine; ☐vascular disorder.	6.2.2.2 6.2.3 c) 6.2.8 c) 6.3.3.2.1 6.3.4.3 6.4.5.1 c)	2	2	2	2	5	Not required		
6	**Radiation hazards**	☐transport ☐assembly and installation ☐commissioning ☐use ☐dismantling, disabling and scrapping.	☐ionizing radiation source; ☐low frequency electromagnetic radiation; ☐optical radiation (infrared, visible and ultraviolet), including laser; ☐radio frequency	☐burn; ☐damage to eyes and skin; ☐effects on reproductive capability; ☐mutation; ☐headache, insomnia, etc.	6.2.2.2 6.2.3 c) 6.3.3.2.1 6.3.4.5 6.4.5.1 c)	2	1	1	1	---	Not required		

			Electromagnetic radiation.										
7	**Material/ substance hazards**	☐transport ☐assembly and installation ☐commissioning ☒use ☐dismantling, disabling and scrapping.	☐aerosol; ☐biological and microbiological (viral or bacterial) agent; ☐combustible; ☒dust; ☐explosive; ☐fibre; ☐flammable; ☒fluid; ☐fume; ☒gas; ☐mist; ☐oxidizer.	☒breathing difficulties, suffocation; ☒cancer; ☐corrosion; ☐effects on reproductive capability; ☐explosion; ☐fire; ☐infection; ☐mutation; ☐poisoning; ☐sensitization.	6.2.2.2 6.2.3 b) 6.2.3 c) 6.2.4 a) 6.2.4 b) 6.3.1 6.3.3.2.1 6.3.4.4 6.4.5.1 c) 6.4.5.1 g)	3	3	2	2	14	Required	Due PPE been used	
8	**Ergonomic hazards**	☐transport ☐assembly and installation ☐commissioning ☐use ☐dismantling, disabling and scrapping.	☐access; ☐design or location of indicators and visual displays units; ☐design, location or identification of control devices; ☐effort;	☐discomfort; ☐fatigue; ☐musculoskeletal disorder; ☐stress; ☐any other (for example, mechanical, electrical) as a	6.2.2.1 6.2.7 6.2.8 6.2.11.8 6.3.2.1 6.3.3.2.1	2	2	2	3	1	Not required		

			☐flicker, dazzling, shadow, stroboscopic effect; ☐local lighting; ☐mental overload/under load; ☐posture; ☐repetitive activity; ☐visibility.	consequence of a human error.								
9	**Hazards associated with the environment in which the machine is used**	☐transport ☐assembly and installation ☐commissioning ☒use ☐dismantling, disabling and scrapping.	☐dust and fog; ☐electromagnetic disturbance; ☐lightning; ☐moisture; ☐pollution; ☒snow; ☐temperature; ☒water; ☐wind; ☐lack of oxygen.	☐burn; ☐slight disease; ☒slipping, falling; ☐suffocation; ☐any other as a consequence of the effect caused by the sources of the hazards on the machine or parts of the machine.	6.2.6 6.2.11.11 6.3.2.1 6.4.5.1 b)	2	2	2	3	1	Not required		
10	**Combination of hazards**	☐transport ☐assembly and installation ☐commissioning	☐for example, repetitive activity +effort + high environmental	☐for example, dehydration, loss of awareness, heat stroke	___	2	2	2	3	1	Not required		

		☐use ☐dismantling, disabling and scrapping.	temperature										

a A single origin of a hazard can have several potential consequences.

b For each type of hazard or group of hazards, some potential consequences can be related to several origins of hazard.

Conclusions: From risk evaluation results that if the machine is used under normal safety condition and following what is written in the use and maintenance manual, there are not situation with strong risk. For each dangerous situation some warning and precaution are listed in the manual, which allow the operators to work with low risk, also in the manual there is a list of safety advices to reduce the risks.

Technical File No.:	Issue Date:	Prepared by:	Approved by:
JH-2021-04-02	2021-04-12		

17.0 General Test Report

INFORMATION	
Applicant Name:	Jiangsu Jianghai Machinery Group Co., Ltd.
Address:	No. 1 Jianghai Road, Libao, Haian, Jiangsu, China
Manufacturer Name:	Jiangsu Jianghai Machinery Group Co., Ltd.
Address:	No. 1 Jianghai Road, Libao, Haian, Jiangsu, China

PROJECT INFORMATION	
Product name:	Shearing Machine
Model(s)	QC12K-6×3200, QC12Y, QC12K
Standard/Edition	EN 60204-1:2018, EN ISO 12100:2010, EN 13985:2003+A1:2009, EN IEC 61000-6-2:2019, EN IEC 61000-6-4:2019
Requested Service	☒ Full or partial pre-test for the following certification [■]CE- MD [ ]CE- LVD [■]CE- EMC [ ] Others

SAMPLE RECORDS		
Sample	**Quantity**	**Description**
QC12K-6×3200	**1**	**Complete, Well for testing**

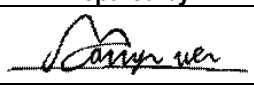
Conclusion:
The sample(s) were tested according to the standard(s) specified above and found COMPLIANCE with the applicable requirements.
April 12th, 2021

Testing Introduction

Test item particulars:
Equipment mobility.....movable
1 Practical tests for Type Testing Procedure
2 Practical tests for fitness for purpose test when QC12K-6×3200 has been type tested

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

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 testing laboratory.
The test results presented in this report relate only to the item(s) tested,
"(see remark #)" refers to a remark appended to the report,
"(see Annex #)" refers to an annex appended to the report.
Throughout this report a comma is used as the decimal separator.

Technical File No.:	Issue Date:	Prepared by:	Approved by:
JH-2021-04-02	2021-04-12		

Standard: EN 60204-1:2018, EN ISO 12100:2010, EN 13985:2003+A1:2009			
Clause	**Requirement-Test**	**Result**	**Verdict**
EN ISO 12100			
6	**Risk reduction**		
	The objective of risk reduction can be achieved by the elimination of hazards, or by separately or simultaneously reducing each of the two elements that determine the associated risk: —severity of harm from the hazard under consideration; —probability of occurrence of that harm. All protective measures intended for reaching this objective shall be applied in the following sequence, referred to as the three-step method (see also Figures 1 and 2). **Step 1: Inherently safe design measures** **Step 2: Safeguarding and/or complementary protective measures** **Step 3: Information for use**	P	
6.2 Inherently safe design measures			
6.2.1	**General**		
	Inherently safe design measures are the first and most important step in the risk reduction process. This is because protective measures inherent to the characteristics of the machine are likely to remain effective, whereas experience has shown that even well-designed safeguarding can fail or be violated and information for use may not be followed. Inherently safe design measures are achieved by avoiding hazards or reducing risks by a suitable choice of design features for the machine itself and/or interaction between the exposed persons and the machine.	P	
6.2.2 Consideration of geometrical factors and physical aspects			
6.2.2.1	**Geometrical factors**		
	Such factors include the following. a)The form of machinery is designed to maximize direct visibility of the working areas and hazard zones from the control position — reducing blind spots, for example — and choosing and locating means of indirect vision where necessary (mirrors, etc.) so as to take into account the characteristics of human vision, particularly when safe operation requires permanent direct control by the operator, for example: —the travelling and working area of mobile machines; —the zone of movement of lifted loads or of the carrier of machinery for lifting persons; —the area of contact of the tool of a hand-held or hand-guided machine with the material being worked. The design of the machine shall be such that, from the main control position, the operator is able to ensure that there are no exposed persons in the danger zones. b) The form and the relative location of the mechanical components parts: for instance, crushing and shearing hazards are avoided by increasing the minimum gap between the moving parts, such that the part of the body under consideration can enter the gap safely, or by reducing the gap so that no part of the body can enter it (see ISO 13854 and ISO 13857). c) Avoiding sharp edges and corners, protruding parts: in so far as their purpose allows, accessible parts of the machinery shall have no sharp edges, no sharp angles, no rough surfaces, no protruding parts likely to cause injury, and no openings which can “trap” parts of the body or clothing. In particular, sheet metal edges shall be deburred, flanged or trimmed, and open ends of tubes which can cause a “trap” shall be capped. d) The form of the machine is designed so as to achieve a suitable working position and provide	P	

	accessible manual controls (actuators).		
6.2.2.2	**Physical aspects**		
	Such aspects include the following: a) limiting the actuating force to a sufficiently low value so that the actuated part does not generate a mechanical hazard; b) limiting the mass and/or velocity of the movable elements, and hence their kinetic energy; c) limiting the emissions by acting on the characteristics of the source using measures for reducing 1) noise emission at source (see ISO/TR 11688-1), 2) the emission of vibration at source, such as redistribution or addition of mass and changes of process parameters [for example, frequency and/or amplitude of movements (for hand-held and hand-guided machinery, see CR 1030-1)], 3) the emission of hazardous substances, including the use of less hazardous substances or dust-reducing processes (granules instead of powders, milling instead of grinding), and 4) radiation emissions, including, for example, avoiding the use of hazardous radiation sources, limiting the power of radiation to the lowest level sufficient for the proper functioning of the machine, designing the source so that the beam is concentrated on the target, increasing the distance between the source and the operator or providing for remote operation of the machinery [measures for reducing emission of non-ionizing radiation are given in 6.3.4.5 (see also EN 12198-1 and EN 12198-3)].	P	
6.2.3	**Taking into account general technical knowledge of machine design**		
	This general technical knowledge can be derived from technical specifications for design (standards, design codes, calculation rules, etc.), which should be used to cover a) mechanical stresses such as —stress limitation by implementation of correct calculation, construction and fastening methods as regards, for example, bolted assemblies and welded assemblies, —stress limitation by overload prevention (bursting disk, pressure-limiting valves, breakage points,torque-limiting devices, etc.), —avoiding fatigue in elements under variable stresses (notably cyclic stresses), and —static and dynamic balancing of rotating elements, b) materials and their properties such as —resistance to corrosion, ageing, abrasion and wear, —hardness, ductility, brittleness, —homogeneity, —toxicity, and —flammability, and c) emission values for —noise, —vibration, —hazardous substances, and —radiation. When the reliability of particular components or assemblies is critical for safety (for example, ropes, chains,lifting accessories for lifting loads or persons), stress limits shall be multiplied by appropriate workingcoefficients.	P	

6.2.4	**Choice of appropriate technology**		
	One or more hazards can be eliminated or risks reduced by the choice of the technology to be used in certainapplications such as the following: a)on machines intended for use in explosive atmospheres, using —appropriately selected pneumatic or hydraulic control system and machine actuators, —intrinsically safe electrical equipment (see IEC 60079-11); b)for particular products to be processed (for example, by a solvent), by using equipment that ensures thetemperature will remain far below the flash point; c)the use of alternative equipment to avoid high noise levels, such as —electrical instead of pneumatic equipment, —in certain conditions, water-cutting instead of mechanical equipment.	P	
6.2.5	**Applying principle of positive mechanical action**		
	Positive mechanical action is achieved when a moving mechanical component inevitably moves another component along with it, either by direct contact or via rigid elements. An example of this is positive openingoperation of switching devices in an electrical circuit (see IEC 60947-5-1 and ISO 14119).	P	
6.2.6	**Provisions for stability**		
	Machines shall be designed so that they have sufficient stability to allow them to be used safely in their specified conditions of use. Factors to be taken into account include —the geometry of the base, —the weight distribution, including loading, —the dynamic forces due to movements of parts of the machine, of the machine itself or of elements held by the machine which can result in an overturning moment, —vibration, —oscillations of the centre of gravity, —characteristics of the supporting surface in case of travelling or installation on different sites (ground conditions, slope, etc.), and —external forces, such as wind pressure and manual forces. Stability shall be considered in all phases of the life cycle of the machine, including handling, travelling, installation, use, dismantling, disabling and scrapping. Other protective measures for stability relevant to safeguarding are given in 6.3.2.6.	P	
6.2.7	**Provisions for maintainability**		
	When designing a machine, the following maintainability factors shall be taken into account to enable maintenance of the machine: —accessibility, taking into account the environment and the human body measurements, including the dimensions of the working clothes and tools used; —ease of handling, taking into account human capabilities; —limitation of the number of special tools and equipment.	P	
6.2.8	**Observing ergonomic principles**		
	Ergonomic principles shall be taken into account in designing machinery so as to reduce the mental or physical stress of, and strain on, the operator. These principles shall be considered when allocating functions to operator and machine (degree of automation) in the basic design. NOTE Also improved are the performance and reliability of operation and hence the reduction in the probability of errors at all stages of machine use.	P	

	Account shall be taken of body sizes likely to be found in the intended user population, strengths and postures, movement amplitudes, frequency of cyclic actions (see ISO 10075 and ISO 10075-2). All elements of the operator–machine interface, such as controls, signalling or data display elements shall be designed to be easily understood so that clear and unambiguous interaction between the operator and the machine is possible. See EN 614-1, EN 13861 and IEC 61310-1. The designer's attention is particularly drawn to following ergonomic aspects of machine design. a) Avoid the necessity for stressful postures and movements during the use of the machine (for example, providing facilities to adjust the machine to suit the various operators). b) Design machines, especially hand-held and mobile machines, so as to enable them to be operated easily, taking into account human effort, actuation of controls and hand, arm and leg anatomy. c) Limit as far as possible noise, vibration and thermal effects such as extreme temperatures. d) Avoid linking the operator's working rhythm to an automatic succession of cycles. e) Provide local lighting on or in the machine for the illumination of the working area and of adjusting, setting-up and frequent maintenance zones when the design features of the machine and/or its guards render the ambient lighting inadequate. Flicker, dazzling, shadows and stroboscopic effects shall be avoided if they can cause a risk. If the position or the lighting source has to be adjusted, its location shall be such that it does not cause any risk to persons making the adjustment. f) Select, locate and identify manual controls (actuators) so that —they are clearly visible and identifiable, and appropriately marked where necessary (see 6.4.4), —they can be safely operated without hesitation or loss of time and without ambiguity (for example, a standard layout of controls reduces the possibility of error when an operator changes from a machine to another one of similar type having the same pattern of operation), —their location (for push-buttons) and their movement (for levers and hand wheels) are consistent with their effect (see IEC 61310-3), and —their operation cannot cause additional risk. See also ISO 9355-3.		
6.2.9	**Electrical hazards**		
	For the design of the electrical equipment of machines, IEC 60204-1 gives general provisions about disconnection and switching of electrical circuits and for protection against electric shock. For requirements related to specific machines, see corresponding IEC standards (for example, IEC 61029, IEC 60745 or IEC 60335).	P	
6.2.10	**Pneumatic and hydraulic hazards**		
	Pneumatic and hydraulic equipment of machinery shall be designed so that —the maximum rated pressure cannot be exceeded in the circuits (using, for example, pressure-limiting devices), —no hazard results from pressure fluctuations or increases, or from loss of pressure or vacuum, —no hazardous fluid jet or sudden hazardous movement of the hose (whiplash) results from leakage or component failures, —air receivers, air reservoirs or similar vessels (such as in gas-loaded accumulators) comply with the applicable design standard codes or regulations for these elements, —all elements of the equipment, especially pipes and hoses, are protected against harmful	N	

	external effects, —as far as possible, reservoirs and similar vessels (for example, gas-loaded accumulators) are automatically depressurized when isolating the machine from its power supply (see 6.3.5.4) and, if not possible, means are provided for their isolation, local depressurizing and pressure indication (see also ISO 14118:2000, Clause 5), and —all elements which remain under pressure after isolation of the machine from its power supply are provided with clearly identified exhaust devices, and there is a warning label drawing attention to the necessity of depressurizing those elements before any setting or maintenance activity on the machine.		
6.2.11 Applying inherently safe design measures to control systems			
6.2.11.1	**General**		
	The design measures of the control system shall be chosen so that their safety-related performance provides a sufficient amount of risk reduction (see ISO 13849-1 or IEC 62061). The correct design of machine control systems can avoid unforeseen and potentially hazardous machine behaviour. Typical causes of hazardous machine behaviour are —an unsuitable design or modification (accidental or deliberate) of the control system logic, —a temporary or permanent defect or failure of one or several components of the control system, —a variation or a failure in the power supply of the control system, and —inappropriate selection, design and location of the control devices. Typical examples of hazardous machine behaviour are —unexpected start-up (see ISO 14118), —uncontrolled speed change, —failure to stop moving parts, —dropping or ejection of part of the machine or of a workpiece clamped by the machine, and —machine action resulting from inhibition (defeating or failure) of protective devices. In order to prevent hazardous machine behaviour and to achieve safety functions, the design of control systems shall comply with the principles and methods presented in this subclause (6.2.11) and in 6.2.12. These principles and methods shall be applied singly or in combination as appropriate to the circumstances (see ISO 13849-1, IEC 60204-1 and IEC 62061). Control systems shall be designed to enable the operator to interact with the machine safely and easily. This requires one or several of the following solutions: —systematic analysis of start and stop conditions; —provision for specific operating modes (for example, start-up after normal stop, restart after cycle interruption or after emergency stop, removal of the workpieces contained in the machine, operation of a part of the machine in case of a failure of a machine element); —clear display of the faults; —measures to prevent accidental generation of unexpected start commands (for example, shrouded start device) likely to cause dangerous machine behaviour (see ISO 14118:2000, Figure 1);	P	

	—maintained stop commands (for example, interlock) to prevent restarting that could result in dangerous machine behaviour (see ISO 14118:2000, Figure 1). An assembly of machines may be divided into several zones for emergency stopping, for stopping as a result of protective devices and/or for isolation and energy dissipation. The different zones shall be clearly defined and it shall be obvious which parts of the machine belong to which zone. Likewise, it shall be obvious which control devices (for example, emergency stop devices, supply disconnecting devices) and/or protective devices belong to which zone. The interfaces between zones shall be designed such that no function in one zone creates hazards in another zone which has been stopped for an intervention. Control systems shall be designed to limit the movements of parts of the machinery, the machine itself, or workpieces and/or loads held by the machinery, to the safe design parameters (for example, range, speed, acceleration, deceleration, load capacity). Allowance shall be made for dynamic effects (swinging of loads, etc.). For example: —the travelling speed of mobile pedestrian controlled machinery other than remote-controlled shall be compatible with walking speed; —the range, speed, acceleration and deceleration of movements of the person-carrier and carrying vehicle for lifting persons shall be limited to non-hazardous values, taking into account the total reaction time of the operator and the machine; —the range of movements of parts of machinery for lifting loads shall be kept within specified limits. When the machinery contains various elements that can be operated independently, the control system shall be designed to prevent risks arising out of a lack of coordination (for example, collision prevention system).		
6.2.11.2	**Starting of an internal power source/switching on an external power supply**		
	The starting of an internal power source or switching-on of an external power supply shall not result in a hazardous situation. For example: —starting the internal combustion engine shall not lead to movement of a mobile machine; —connection to mains electricity supply shall not result in the starting of working parts of a machine. See IEC 60204-1:2005, 7.5 (see also Annexes A and B).	P	EN 60204-1
6.2.11.3	**Starting/stopping of a mechanism**		
	The primary action for starting or accelerating the movement of a mechanism should be performed by the application or an increase of voltage or fluid pressure, or — if binary logic elements are considered — by passage from state 0 to state 1 (where state 1 represents the highest energy state). The primary action for stopping or slowing down should be performed by removal or reduction of voltage or fluid pressure, or — if binary logic elements are considered — by passage from state 1 to state 0 (where state 1 represents the highest energy state). In certain applications, such as high-voltage switchgear, this principle cannot be followed, in which case other measures should be applied to achieve the same level of confidence for the stopping or slowing down.	P	

	When, in order for the operator to maintain permanent control of deceleration, this principle is not observed (for example, a hydraulic braking device of a self-propelled mobile machine), the machine shall be equipped with a means of slowing and stopping in case of failure of the main braking system.		
6.2.11.4	**Restart after power interruption**		
	If a hazard could be generated, the spontaneous restart of a machine when it is re-energized after power interruption shall be prevented (for example, by use of a self-maintained relay, contactor or valve).	P	
6.2.11.5	**Interruption of power supply**		
	Machinery shall be designed to prevent hazardous situations resulting from interruption or excessive fluctuation of the power supply. At least the following requirements shall be met: —the stopping function of the machinery shall remain; —all devices whose permanent operation is required for safety shall operate in an effective way to maintain safety (for example, locking, clamping devices, cooling or heating devices, power-assisted steering of self-propelled mobile machinery); —parts of machinery or workpieces and/or loads held by machinery which are liable to move as a result of potential energy shall be retained for the time necessary to allow them to be safely lowered.	P	
6.2.11.6	**Use of automatic monitoring**		
	Automatic monitoring is intended to ensure that a safety function or functions implemented by a protective measure do not fail to be performed if the ability of a component or an element to perform its function is diminished, or if the process conditions are changed such that hazards are generated. Automatic monitoring either detects a fault immediately or carries out periodic checks so that a fault is detected before the next demand upon the safety function. In either case, the protective measure can be initiated immediately or delayed until a specific event occurs (for example, the beginning of the machine cycle). The protective measure may be, for example, —the stopping of the hazardous process, —preventing the restart of this process after the first stop following the failure, or —the triggering of an alarm.	P	
6.2.11.7 Safety functions implemented by programmable electronic control systems			
6.2.11.7.1	**General**		
	A control system that includes programmable electronic equipment (for example, programmable controllers) can, where appropriate, be used to implement safety functions at machinery. Where a programmable electronic control system is used, it is necessary to consider its performance requirements in relation to the requirements for the safety functions. The design of the programmable electronic control system shall be such that the probability of random hardware failures and the likelihood of systematic failures that can adversely affect the performance of the safety-related control function(s) is sufficiently low. Where a programmable electronic control system performs a monitoring function, the system behavior on detection of a fault shall be considered (see also the IEC 61508 series for further guidance). NOTE Both ISO 13849-1 and IEC 62061, specific to machinery safety, provide guidance applicable to programmable electronic control systems.	P	

	The programmable electronic control system should be installed and validated to ensure that the specified performance [for example, safety integrity level (SIL) in IEC 61508] for each safety function has been achieved. Validation comprises testing and analysis (for example, static, dynamic or failure analysis) to show that all parts interact correctly to perform the safety function and that unintended functions do not occur.		
6.2.11.7.2	**Hardware aspects**		
	The hardware (including, for example, sensors, actuators and logic solvers) shall be selected, and/or designed and installed, to meet both the functional and performance requirements of the safety function(s) to be performed, in particular, by means of —architectural constraints (the configuration of the system, its ability to tolerate faults, its behaviour on detection of a fault, etc.), —selection, and/or design, of equipment and devices with an appropriate probability of dangerous random hardware failure, and —the incorporation of measures and techniques within the hardware so as to avoid systematic failures and control systematic faults.	N	
6.2.11.7.3	**Software aspects**		
	The software, including internal operating software (or system software) and application software, shall be designed so as to satisfy the performance specification for the safety functions (see also IEC 61508-3). Application software should not be reprogrammable by the user. This may be achieved by use of embedded software in a non-reprogrammable memory [for example, micro-controller, application-specific integrated circuit (ASIC)]. When the application requires reprogramming by the user, the access to the software dealing with safety functions should be restricted (for example, by locks or passwords for the authorized persons).	N	
6.2.11.8	**Principles relating to manual control**		
	These are as follows. a) Manual control devices shall be designed and located according to the relevant ergonomic principles given in 6.2.8, item f). b) A stop control device shall be placed near each start control device. Where the start/stop function is performed by means of a hold-to-run control, a separate stop control device shall be provided when a risk can result from the hold-to-run control device failing to deliver a stop command when released. c) Manual controls shall be located out of reach of the danger zones (see IEC 61310-3), except for certain controls where, of necessity, they are located within a danger zone, such as emergency stop or teach pendant. d) Whenever possible, control devices and control positions shall be located so that the operator is able to observe the working area or hazard zone. 1) The driver of a ride-on mobile machine shall be able to actuate all control devices required to operate the machine from the driving position, except for functions which can be controlled more safely from other positions. 2) On machinery intended for lifting persons, controls for lifting and lowering and, if appropriate, for moving the carrier shall generally be located in the carrier. If safe operation requires controls to be situated outside the carrier, the operator in the carrier shall be provided with the	P	

	means of preventing hazardous movements. e) If it is possible to start the same hazardous element by means of several controls, the control circuit shall be so arranged that only one control is effective at a given time. This applies especially to machines which can be manually controlled by means of, among others, a portable control unit (such as a teach pendant), with which the operator can enter danger zones. f) Control actuators shall be designed or guarded so that their effect, where a risk is involved, cannot occur without intentional operation (see ISO 9355-1, ISO 9355-3 and ISO 447). g) For machine functions whose safe operation depends on permanent, direct control by the operator, measures shall be implemented to ensure the presence of the operator at the control position (for example, by the design and location of control devices). h) For cableless control, an automatic stop shall be performed when correct control signals are not received, including loss of communication (see IEC 60204-1).		
6.2.11.9	**Control mode for setting, teaching, process changeover, fault-finding, cleaning or maintenance**		
	Where, for setting, teaching, process changeover, fault-finding, cleaning or maintenance of machinery, a guard has to be displaced or removed and/or a protective device has to be disabled, and where it is necessary for the purpose of these operations for the machinery or part of the machinery to be put into operation, the safety of the operator shall be achieved using a specific control mode which simultaneously a) disables all other control modes, b) permits operation of the hazardous elements only by continuous actuation of an enabling device, a two-hand control device or a hold-to-run control device, c) permits operation of the hazardous elements only in reduced risk conditions (for example, reduced speed, reduced power/force, step-by-step, for example, with a limited movement control device), and d) prevents any operation of hazardous functions by voluntary or involuntary action on the machine's sensors. NOTE For some special machinery other protective measures can be appropriate. This control mode shall be associated with one or more of the following measures: —restriction of access to the danger zone as far as possible; —emergency stop control within immediate reach of the operator; —portable control unit (teach pendant) and/or local controls (allowing sight of the controlled elements). See IEC 60204-1.	P	
6.2.11.10	**Selection of control and operating modes**		
	If machinery has been designed and built to allow for its use in several control or operating modes requiring different protective measures and/or work procedures (for example, to allow for adjustment, setting, maintenance, inspection), it shall be fitted with a mode selector which can be locked in each position. Each position of the selector shall be clearly identifiable and shall exclusively allow one control or operating mode. The selector may be replaced by another selection means which restricts the use of certain functions of the machinery to certain categories of operators (for example, access codes for certain numerically controlled functions).	P	
6.2.11.11	**Applying measures to achieve electromagnetic compatibility (EMC)**		

	For guidance on electromagnetic compatibility, see IEC 60204-1 and IEC 61000-6.	N	
6.2.11.12	**Provision of diagnostic systems to aid fault-finding**		
	Diagnostic systems to aid fault-finding should be included in the control system so that there is no need to disable any protective measure. NOTE Such systems not only improve availability and maintainability of machinery, they also reduce the exposure of maintenance staff to hazards.	N	
6.2.12 Minimizing probability of failure of safety functions			
6.2.12.1	**General**		
	Safety of machinery is not only dependent on the reliability of the control systems but also on the reliability of all parts of the machine. The continued operation of the safety functions is essential for the safe use of the machine. This can be achieved by the measures given in 6.2.12.2 to 6.2.12.4.	P	
6.2.12.2	**Use of reliable components**		
	"Reliable components" means components which are capable of withstanding all disturbances and stresses associated with the usage of the equipment in the conditions of intended use (including the environmental conditions), for the period of time or the number of operations fixed for the use, with a low probability of failures generating a hazardous malfunctioning of the machine. Components shall be selected taking into account all factors mentioned above (see also 6.2.13). NOTE 1 "Reliable components" is not a synonym for "well-tried components" (see ISO 13849-1:2006, 6.2.4). NOTE 2 Environmental conditions for consideration include impact, vibration, cold, heat, moisture, dust, corrosive and/or abrasive substances, static electricity and magnetic and electric fields. Disturbances which can be generated by those conditions include insulation failures and temporary or permanent failures in the function of control system components.	P	
6.2.12.3	**Use of "oriented failure mode" components**		
	"Oriented failure mode" components or systems are those in which the predominant failure mode is known in advance and which can be used so that the effect of such a failure on the machine function can be predicted. NOTE In some cases, it will be necessary to take additional measures to limit the negative effects of such a failure. The use of such components should always be considered, particularly in cases where redundancy (see 6.2.12.4) is not employed.	N	
6.2.12.4	**Duplication (or redundancy) of components or subsystems**		
	In the design of safety-related parts of the machine, duplication (or redundancy) of components may be used so that, if one component fails, another component or components continue to perform the respective function(s), thereby ensuring that the safety function remains available. In order to allow the proper action to be initiated, component failure shall be detected by automatic monitoring (see 6.2.11.6) or in some circumstances by regular inspection, provided that the inspection interval is shorter than the expected lifetime of the components. Diversity of design and/or technology can be used to avoid common cause failures (for example, from electromagnetic disturbance) or common mode failures.	N	
6.2.13	**Limiting exposure to hazards through reliability of equipment**		

	Increased reliability of all component parts of machinery reduces the frequency of incidents requiring intervention, thereby reducing exposure to hazards. This applies to power systems (operative part, see Annex A) as well as to control systems, and to safety functions as well as to other functions of machinery. Safety-related components (for example, certain sensors) of known reliability shall be used. The elements of guards and of protective devices shall be especially reliable, as their failure can expose persons to hazards, and also because poor reliability would encourage attempts to defeat them.	P	
6.2.14	**Limiting exposure to hazards through mechanization or automation of loading (feeding)/unloading (removal) operations**		
	Mechanization and automation of machine loading/unloading operations and, more generally, of handling operations — of workpieces, materials or substances — limits the risk generated by these operations by reducing the exposure of persons to hazards at the operating points. Automation can be achieved by, for example, robots, handling devices, transfer mechanisms and air-blast equipment. Mechanization can be achieved by, for example, feeding slides, push-rods and hand-operated indexing tables. While automatic feeding and removal devices have much to offer in preventing accidents to machine operators, they can create danger when any faults are being corrected. Care shall be taken to ensure that the use of these devices does not introduce further hazards, such as trapping or crushing, between the devices and parts of the machine or workpieces/materials being processed. Suitable safeguards (see 6.3) shall be provided if this cannot be ensured. Automatic feeding and removal devices with their own control systems and the control system of the associated machine shall be interconnected after thorough study of how all safety functions are performed in all the control and operation modes of the entire equipment.	N	
6.2.15	**Limiting exposure to hazards through location of setting and maintenance points outside danger zones**		
	The need for access to danger zones shall be minimized by locating maintenance, lubrication and setting points outside these zones.	N	
6.3 Safeguarding and complementary protective measures			
6.3.1	**General**		
	Guards and protective devices shall be used to protect persons whenever an inherently safe design measure does not reasonably make it possible either to remove hazards or to sufficiently reduce risks. Complementary protective measures involving additional equipment (for example, emergency stop equipment) may have to be implemented. NOTE The different kinds of guards and protective devices are defined in 3.27 and 3.28. Certain safeguards may be used to avoid exposure to more than one hazard. EXAMPLE A fixed guard preventing access to a zone where a mechanical hazard is present used to reduce noise levels and collect toxic emissions.	P	
6.3.2 Selection and implementation of guards and protective devices			
6.3.2.1	**General**		
	This subclause gives guidelines for the selection and the implementation of guards and protective devices the primary purpose of which is to protect persons against hazards generated by moving parts, according to the nature of those parts (see Figure 4) and to the need for access to the danger zone(s). The exact choice of a safeguard for a particular machine shall be made on the basis of the risk	P	

	assessment for that machine. In selecting an appropriate safeguard for a particular type of machinery or hazard zone, it shall be borne in mind that a fixed guard is simple and shall be used where the access of an operator into a danger zone is not required during the normal operation (operation without malfunction) of the machinery. As the need for frequency of access increases, this inevitably leads to the fixed guard not being replaced. This requires the use of an alternative protective measure (movable interlocking guard, sensitive protective equipment). A combination of safeguards can sometimes be required. For example, where, in conjunction with a fixed guard, a mechanical loading (feeding) device is used to feed a workpiece into a machine, thereby removing the need for access to the primary hazard zone, a trip device can be required to protect against the secondary drawing-in or shearing hazard between the mechanical loading (feeding) device, when reachable, and the fixed guard. Consideration shall be given to the enclosure of control positions or intervention zones to provide combined protection against several hazards including a) hazards from falling or ejected objects, using, for example, protection in the form of a falling object protection structure (FOPS), b) emission hazards (protection against noise, vibration, radiation, substances hazardous to health, etc.), c) hazards due to the environment (protection against heat, cold, foul weather, etc.), d) hazards due to tipping over or rolling over of machinery, using, for example, protection in the form of roll-over or tip-over protection structures (ROPS and TOPS). The design of enclosed work stations, such as cabs and cabins, shall take into account ergonomic principles concerning visibility, lighting, atmospheric conditions, access, posture.		
6.3.2.2	**Where access to the hazard zone is not required during normal operation**		
	Where access to the hazard zone is not required during normal operation of the machinery, safeguards should be selected from the following: a) fixed guards (see also ISO 14120); b) interlocking guards with or without guard locking (see also 6.3.3.2.3, ISO 14119 and ISO 14120); c) self-closing guards (see ISO 14120:2002, 3.3.2); d) sensitive protective equipment, such as electrosensitive protective equipment (see IEC 61496) or pressure-sensitive protective devices (see ISO 13856).	N	
6.3.2.3	**Where access to the hazard zone is required during normal operation**		
	Where access to the hazard zone is required during normal operation of the machinery, safeguards should be selected from the following: a) interlocking guards with or without guard locking (see also ISO 14119, ISO 14120 and 6.3.3.2.3 of this document); b) sensitive protective equipment, such as electrosensitive protective equipment (see IEC 61496); c) adjustable guards; d) self-closing guards (see ISO 14120:2002, 3.3.2); e) two-hand control devices (see ISO 13851); f) interlocking guards with a start function (control guard) (see 6.3.3.2.5).	P	

6.3.2.4	**Where access to the hazard zone is required for machine setting, teaching, process changeover, fault-finding, cleaning or maintenance**		
	production operator also ensure the protection of personnel carrying out setting, teaching, process changeover, fault-finding, cleaning or maintenance, without hindering them in the performance of their task. Such tasks shall be identified and considered in the risk assessment as parts of the use of the machine (see 5.2). NOTE Isolation and energy dissipation for machine shut-down (see 6.3.5.4, and also ISO 14118:2000, 4.1 and Clause 5) ensure the highest level of safety when carrying out tasks (especially maintenance and repair tasks) that do not require the machine to remain connected to its power supply.	P	
6.3.2.5 Selection and implementation of sensitive protective equipment1)			
6.3.2.5.1	**Selection**		
	Due to the great diversity of the technologies on which their detection function is based, all types of sensitive protective equipment are far from being equally suitable for safety applications. The following provisions are intended to provide the designer with criteria for selecting, for each application, the most suitable device(s). Types of sensitive protective equipment include —light curtains, —scanning devices, for example, laser scanners, —pressure-sensitive mats, and —trip bars, trip wires. Sensitive protective equipment can be used —for tripping purposes, —for presence sensing, —for both tripping and presence sensing, or —to re-initiate machine operation — a practice subject to stringent conditions. NOTE Some types of sensitive protective equipment can be unsuitable either for presence sensing or for tripping purposes. The following characteristics of the machinery, among others, can preclude the sole use of sensitive protectiveequipment: —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.	P	
6.3.2.5.2	**Implementation**		
	Consideration should be given to a) the size, characteristics and positioning of the detection zone (see ISO 13855, which deals with the positioning of some types of sensitive protective equipment), b) the reaction of the device to fault conditions (see IEC 61496 for electrosensitive protective equipment), c) the possibility of circumvention, and d) detection capability and its variation over the course of time (as a result, for example, of its susceptibility to different environmental conditions such as the presence of reflecting surfaces,	P	

	other artificial light sources and sunlight or impurities in the air). NOTE 1 IEC 61496 defines the detection capability of electrosensitive protective equipment. Sensitive protective equipment shall be integrated in the operative part and associated with the control system of the machine so that —a command is given as soon as a person or part of a person is detected, —the withdrawal of the person or part of a person detected does not, by itself, restart the hazardous machine function(s), and therefore the command given by the sensitive protective equipment ismaintained by the control system until a new command is given, —restarting the hazardous machine function(s) results from the voluntary actuation by the operator of a control device placed outside the hazard zone, where this zone can be observed by the operator, —the machine cannot operate during interruption of the detection function of the sensitive protective equipment, except during muting phases, and —the position and the shape of the detection field prevents, possibly together with fixed guards, a person or part of a person from entering or being present in the hazard zone without being detected. NOTE 2 Muting is the temporary automatic suspension of a safety function(s) by safety-related parts of the control system (see ISO 13849-1). For detailed consideration of the fault behaviour of, for example, active optoelectronic protective devices, IEC 61496 should be taken into account.		
6.3.2.5.3	**Additional requirements for sensitive protective equipment when used for cycle initiation**		
	In this exceptional application, the starting of the machine cycle is initiated by the withdrawal of a person or of the detected part of a person from the sensing field of the sensitive protective equipment, without any additional start command, hence deviating from the general requirement given in the second point of the dashed list in 6.3.2.5.2, above. After switching on the power supply, or when the machine has been stopped by the tripping function of the sensitive protective equipment, the machine cycle shall be initiated only by voluntary actuation of a start control. Cycle initiation by sensitive protective equipment shall be subject to the following conditions: a) only active optoelectronic protective devices (AOPDs) complying with IEC 61496 series shall be used; b) the requirements for an AOPD used as a tripping and presence-sensing device (see IEC 61496) are satisfied — in particular, location, minimum distance (see ISO 13855), detection capability, reliability and monitoring of control and braking systems; c) the cycle time of the machine is short and the facility to re-initiate the machine upon clearing of the sensing field is limited to a period commensurate with a single normal cycle; d) entering the sensing field of the AOPD(s) or opening interlocking guards is the only way to enter the hazard zone; e) if there is more than one AOPD safeguarding the machine, only one of the AOPDs is capable of cycle re-initiation; f) with regard to the higher risk resulting from automatic cycle initiation, the AOPD and the associated control system comply with a higher safety-related performance than under normal conditions. NOTE 1 The hazard zone as referred to in d) is any zone where the hazardous function	P	

	(including ancillary equipment and transmission elements) is initiated by clearing of the sensing field. NOTE 2 See also IEC/TS 62046.		
6.3.2.6	**Protective measures for stability**		
	If stability cannot be achieved by inherently safe design measures such as weight distribution (see 6.2.6), it shall be maintained by the use of protective measures such as —anchorage bolts, —locking devices, —movement limiters or mechanical stops, —acceleration or deceleration limiters, —load limiters, and —alarms warning of the approach to stability or tipping limits.	P	
6.3.2.7	**Other protective devices**		
	error of the operator can generate a hazardous situation, this machine shall be equipped with the necessary devices to enable the operation to remain within specified limits, in particular —when the operator has insufficient visibility of the hazard zone, —when the operator lacks knowledge of the actual value of a safety-related parameter (distance, speed,mass, angle, etc.), and — when hazards can result from operations other than those controlled by the operator. The necessary devices include a) devices for limiting parameters of movement (distance, angle, velocity, acceleration), b) overloading and moment limiting devices, c) devices to prevent collisions or interference with other machines, d) devices for preventing hazards to pedestrian operators of mobile machinery or other pedestrians, e) torque limiting devices, and breakage points to prevent excessive stress of components and assemblies, f) devices for limiting pressure or temperature, g) devices for monitoring emissions, h) devices to prevent operation in the absence of the operator at the control position, i) devices to prevent lifting operations unless stabilizers are in place, j) devices to limit inclination of the machine on a slope, and k) devices to ensure that components are in a safe position before travelling. Automatic protective measures triggered by such devices that take operation of the machinery out of the control of the operator (for example, automatic stop of hazardous movement) should be preceded or accompanied by a warning signal to enable the operator to take appropriate action (see 6.4.3).	P	
6.3.3 Requirements for design of guards and protective devices			
6.3.3.1	**General requirements**		
	Guards and protective devices shall be designed to be suitable for the intended use, taking into account mechanical and other hazards involved. Guards and protective devices shall be compatible with the working environment of the machine and designed so that they cannot be easily defeated. They shall provide the minimum possible interference with activities during operation and other phases of machine life, in order to reduce any incentive to defeat them.	P	

	NOTE For additional information, see ISO 14120, ISO 13849-1, ISO 13851, ISO 14119, ISO 13856, IEC 61496 and IEC 62061. Guards and protective devices shall a) be of robust construction, b) not give rise to any additional hazard, c) not be easy to bypass or render non-operational, d) be located at an adequate distance from the danger zone (see ISO 13855 and ISO 13857), e) cause minimum obstruction to the view of the production process, and f) enable essential work to be carried out for the installation and/or replacement of tools and for maintenance by allowing access only to the area where the work has to be carried out — if possible, without the guard having to be removed or protective device having to be disabled. For openings in the guards, see ISO 13857.		
6.3.3.2 Requirements for guards			
6.3.3.2.1	**Functions of guards**		
	The functions that guards can achieve are —prevention of access to the space enclosed by the guard, and/or —containment/capture of materials, workpieces, chips, liquids which can be ejected or dropped by the machine, and reduction of emissions (noise, radiation, hazardous substances such as dust, fumes, gases) that can be generated by the machine. Additionally, they could need to have particular properties relating to electricity, temperature, fire, explosion, vibration, visibility (see ISO 14120) and operator position ergonomics (for example, usability, operator's movements, postures, repetitive movements).	P	
6.3.3.2.2	**Requirements for fixed guards**		
	Fixed guards shall be securely held in place either —permanently (for example by welding), or —by means of fasteners (screws, nuts) making removal/opening impossible without using tools; they should not remain closed without their fasteners (see ISO 14120). NOTE A fixed guard can be hinged to assist in its opening.	P	
6.3.3.2.3	**Requirements for movable guards**		
	Movable guards which provide protection against hazards generated by moving transmission parts shall a) as far as possible when open remain fixed to the machinery or other structure (generally by means of hinges or guides), and b) be interlocking (with guard locking when necessary) (see ISO 14119). See Figure 4. Movable guards against hazards generated by non-transmission moving parts shall be designed and associated with the machine control system so that —moving parts cannot start up while they are within the operator's reach and the operator cannot reach moving parts once they have started up, with this able to be achieved by interlocking guards, with guard locking when necessary, —they can be adjusted only by an intentional action, such as the use of a tool or a key, and —the absence or failure of one of their components either prevents starting of the moving parts or stops them, with this able to be achieved by automatic monitoring (see 6.2.11.6). See Figure 4 and ISO 14119.	P	

6.3.3.2.4	**Requirements for adjustable guards**		
	Adjustable guards may only be used where the hazard zone cannot for operational reasons be completely enclosed. Manually adjustable guards shall be —designed so that the adjustment remains fixed during a given operation, and —readily adjustable without the use of tools.	P	
6.3.3.2.5	**Requirements for interlocking guards with a start function (control guards)**		
	An interlocking guard with a start function may only be used provided that a) all requirements for interlocking guards are satisfied (see ISO 14119), b) the cycle time of the machine is short, c) the maximum opening time of the guard is preset to a low value (for example, equal to the cycle time) and, when this time is exceeded, the hazardous function(s) cannot be initiated by the closing of the interlocking guard with a start function and resetting is necessary before restarting the machine, d) the dimensions or shape of the machine do not allow a person, or part of a person, to stay in the hazard zone or between the hazard zone and the guard while the guard is closed (see ISO 14120), e) all other guards, whether fixed (removable type) or movable, are interlocking guards, f) the interlocking device associated with the interlocking guard with a start function is designed such that —for example, by duplication of position detectors and use of automatic monitoring (see 6.2.11.6) — its failure cannot lead to an unintended/unexpected start-up, and g) the guard is securely held open (for example, by a spring or counterweight) such that it cannot initiate a start while falling by its own weight.	P	
6.3.3.2.6	**Hazards from guards**		
	Care shall be taken to prevent hazards which could be generated by —the guard construction (sharp edges or corners, material, noise emission, etc.), —the movements of the guards (shearing or crushing zones generated by power-operated guards and by heavy guards which are liable to fall).	P	
6.3.3.3	**Technical characteristics of protective devices**		
	Protective devices shall be selected or designed and connected to the control system such that correct implementation of their safety function(s) is ensured. Protective devices shall be selected on the basis of their having met the appropriate product standard (for example, IEC 61496 for active optoelectronic protective devices) or shall be designed according to one or several of the principles formulated in ISO 13849-1 or IEC 62061. Protective devices shall be installed and connected to the control system so that they cannot be easily defeated.	P	
6.3.3.4	**Provisions for alternative types of safeguards**		
	Provisions should be made to facilitate the fitting of alternative types of safeguards on machinery where it is known that it will be necessary to change the safeguards because of the range of work to be carried out.	P	
6.3.4	**Safeguarding to reduce emissions**		
6.3.4.1	**General**		
	If the measures for the reduction of emissions at source specified in 6.2.2.2 are not adequate, the machine shall be provided with additional protective measures (see 6.3.4.2 to 6.3.4.5).	N	

6.3.4.2	**Noise**		
	Additional protective measures against noise include —enclosures (see ISO 15667), —screens fitted to the machine, and —silencers (see ISO 14163).	N	
6.3.4.3	**Vibration**		
	Additional protective measures against vibration include —vibration isolators, such as damping devices placed between the source and the exposed person, —resilient mounting, and —suspended seats. For measures for vibration isolation of stationary industrial machinery see EN 1299.	N	
6.3.4.4	**Hazardous substances**		
	Additional protective measures against hazardous substances include —encapsulation of the machine (enclosure with negative pressure), —local exhaust ventilation with filtration, —wetting with liquids, and —special ventilation in the area of the machine (air curtains, cabins for operators). See ISO 14123-1.	N	
6.3.4.5	**Radiation**		
	Additional protective measures against radiation include —use of filtering and absorption, and —use of attenuating screens or guards.	N	
6.3.5	**Complementary protective measures**		
6.3.5.1	**General**		
	Protective measures which are neither inherently safe design measures, nor safeguarding (implementation of guards and/or protective devices), nor information for use, could have to be implemented as required by the intended use and the reasonably foreseeable misuse of the machine. Such measures include, but are not limited to, those dealt with in 6.3.5.2 to 6.3.5.6.	P	
6.3.5.2	**Components and elements to achieve emergency stop function**		
	If, following a risk assessment, a machine needs to be fitted with components and elements to achieve an emergency stop function for enabling actual or impending emergency situations to be averted, the following requirements apply: —the actuators shall be clearly identifiable, clearly visible and readily accessible; —the hazardous process shall be stopped as quickly as possible without creating additional hazards, but if this is not possible or the risk cannot be reduced, it should be questioned whether implementation of an emergency stop function is the best solution; —the emergency stop control shall trigger or permit the triggering of certain safeguard movements where necessary. NOTE For more detailed provisions, see ISO 13850. 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 the location where the emergency stop command has been initiated. The reset of the device shall not restart the machinery, but shall 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.		
6.3.5.3	**Measures for the escape and rescue of trapped persons**		
	Measures for the escape and rescue of trapped persons may consist, among others, of —escape routes and shelters in installations generating operator-trapping hazards, —arrangements for moving some elements by hand, after an emergency stop, —arrangements for reversing the movement of some elements, —anchorage points for descender devices, —means of communication to enable trapped operators to call for help.	P	
6.3.5.4	**Measures for isolation and energy dissipation**		
	Machines shall be equipped with the technical means to achieve isolation from power supply(ies) and dissipation of stored energy by means of the following actions: a) isolating (disconnecting, separating) the machine (or defined parts of the machine) from all power supplies; b) locking (or otherwise securing) all the isolating units in the isolating position; c) dissipating or, if this is not possible or practicable, restraining (containing) any stored energy which can give rise to a hazard; d) verifying, by means of safe working procedures, that the actions taken according to a), b) and c) above have produced the desired effect. See ISO 14118:2000, Clause 5, and IEC 60204-1:2005, 5.5 and 5.6.	P	
6.3.5.5	**Provisions for easy and safe handling of machines and their heavy component parts**		
	Machines and their component parts which cannot be moved or transported by hand shall be provided or be capable of being provided with suitable attachment devices for transport by means of lifting gear. These attachments may be, among others, —standardized lifting appliances with slings, hooks, eyebolts, or tapped holes for appliance fixing, —appliances for automatic grabbing with a lifting hook when attachment is not possible from the ground, —fork locating devices for machines to be transported by a lift truck, —lifting and stowing gear and appliances integrated into the machine. Parts of machinery which can be removed manually in operation shall be provided with means for their safe removal and replacement. See also 6.4.4 c), item 3).	P	
6.3.5.6	**Measures for safe access to machinery**		
	Machinery shall be so designed as to enable operation and all routine tasks relating to setting and/or maintenance to be carried out as far as possible by a person remaining at ground level. Where this is not possible, machines shall have built-in platforms, stairs or other facilities to provide safe access for those tasks; however, care should be taken to ensure that such platforms or stairs do not give access to danger zones of machinery. The walking areas shall be made from materials which remain as slip resistant as practicable under working conditions and, depending on the height from the ground, shall be provided with suitable guard-rails (see ISO 14122-3). In large automated installations, particular attention shall be given to safe means of access, such	P	

	as walkways, conveyor bridges or crossover points. Means of access to parts of machinery located at height shall be provided with collective means of protection against falls (for example, guard-rails for stairways, stepladders and platforms and/or safety cages for ladders). As necessary, anchorage points for personal protective equipment against falls from height shall also be provided (for example, in carriers of machinery for lifting persons or with elevating control stations). Openings shall, whenever possible, open towards a safe position. They shall be designed to prevent hazards due to unintended opening. The necessary aids for access shall be provided (steps, handholds, etc.). Control devices shall be designed and located to prevent their being used as aids for access. When machinery for lifting goods and/or persons includes landings at fixed levels, these shall be equipped with interlocking guards for preventing falls when the platform is not present at a level. Movement of the lifting platform shall be prevented while the guards are open. For detailed provisions see ISO 14122.		
6.4 Information for use			
6.4.1	**General requirements**		
6.4.1.1	Drafting information for use is an integral part of the design of a machine (see Figure 2).Information for use consists of communication links, such as texts, words, signs, signals, symbols or diagrams,used separately or in combination to convey information to the user. Information for use is intended for professional and/or non-professional users. NOTE See also IEC 62079 for structuring and presentation of information for use.	P	
6.4.1.2	Information shall be provided to the user about the intended use of the machine, taking into account, notably, all its operating modes. The information shall contain all directions required to ensure safe and correct use of the machine. With this in view, it shall inform and warn the user about residual risk. The information shall indicate, as appropriate, —the need for training, —the need for personal protective equipment, and —the possible need for additional guards or protective devices (see Figure 2, Footnote d). It shall not exclude uses of the machine that can reasonably be expected from its designation and description and shall also warn about the risk which would result from using the machine in other ways than the ones described in the information, especially considering its reasonably foreseeable misuse.	P	
6.4.1.3	Information for use shall cover, separately or in combination, transport, assembly and installation, commissioning, use of the machine (setting, teaching/programming or process changeover, operation, cleaning, fault-finding and maintenance) and, if necessary, dismantling, disabling and scrapping.	P	
6.4.2	**Location and nature of information for use**		
	Depending on the risk, the time when the information is needed by the user and the machine design, it shall be decided whether the information — or parts thereof — are to be given a) in/on the machine itself (see 6.4.3 and 6.4.4), b) in accompanying documents (in particular instruction handbook, see 6.4.5), c) on the packaging,	P	

	d) by other means such as signals and warnings outside the machine. Standardized phrases shall be considered where important messages such as warnings are given (see also IEC 62079).		
6.4.3	**Signals and warning devices**		
	Visual signals, such as flashing lights and audible signals such as sirens may be used to warn of an impending hazardous event such as machine start-up or overspeed. Such signals may also be used to warn the operator before the triggering of automatic protective measures (see 6.3.2.7). It is essential that these signals a) be emitted before the occurrence of the hazardous event, b) be unambiguous, c) be clearly perceived and differentiated from all other signals used, and d) be clearly recognized by the operator and other persons. The warning devices shall be designed and located such that checking is easy. The information for use shall prescribe regular checking of warning devices. The attention of designers is drawn to the possibility of “sensorial saturation”, which can result from too many visual and/or acoustic signals and which can also lead to defeating the warning devices. NOTE Consultation of the user on this subject is often necessary.	P	
6.4.4	**Markings, signs (pictograms) and written warnings**		
	Machinery shall bear all markings which are necessary a) for its unambiguous identification, including at least 1) the name and address of the manufacturer, 2) the designation of series or type, and 3) the serial number, if any, b) in order to indicate its compliance with mandatory requirements, comprising 1) marking, and 2) written indications, such as the authorized representative of the manufacturer, designation of the machinery, year of construction, and intended use in potentially explosive atmospheres), c) for its safe use, for example, 1) maximum speed of rotating parts, 2) maximum diameter of tools, 3) mass (in kilograms) of the machine itself and/or of removable parts, 4) maximum working load, 5) necessity of wearing personal protective equipment, 6) guard adjustment data, and 7) frequency of inspection. Information printed directly on the machine should be permanent and remain legible throughout the expected life of the machine. Signs or written warnings indicating only “Danger” shall not be used. Markings, signs and written warnings shall be readily understandable and unambiguous, especially as regards the part of the function(s) of the machine to which they are related. Readily understandable signs (pictograms) should be used in preference to written warnings.	P	

	Signs and pictograms should only be used if they are understood in the culture in which the machinery is to be Used. 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. NOTE In some countries the use of specific language(s) is covered by legal requirements. Markings shall comply with recognized standards (for example, ISO 2972 or ISO 7000, for pictograms,symbols and colours in particular). See IEC 60204-1 as regards marking of electrical equipment. See ISO 4413 and ISO 4414 for hydraulic and pneumatic equipment.		
6.4.5	**Accompanying documents (in particular — instruction handbook)**		
6.4.5.1	**Contents**		
	The instruction handbook or other written instructions (for example, on the packaging) shall contain, among others, the following: a) information relating to transport, handling and storage of the machine, such as 1) storage conditions for the machine, 2) dimensions, mass value(s), position of the centre(s) of gravity, and 3) indications for handling (for example, drawings indicating application points for lifting equipment); b) information relating to installation and commissioning of the machine, such as 1) fixing/anchoring and dampening of noise and vibration requirements, 2) assembly and mounting conditions, 3) space needed for use and maintenance, 4) permissible environmental conditions (for example, temperature, moisture, vibration, electromagnetic radiation), 5) instructions for connecting the machine to power supply (particularly on protection against electrical overloading), 6) advice on waste removal/disposal, and 7) if necessary, recommendations related to protective measures which have to be implemented by the user — for example, additional safeguards (see Figure 2, Footnote d), safety distances, safety signs and signals; c) information relating to the machine itself, such as 1) detailed description of the machine, its fittings, guards and/or protective devices, 2) the comprehensive range of applications for which the machine is intended, including prohibited usages, if any, taking into account variations of the original machine if appropriate, 3) diagrams (especially schematic representation of safety functions), 4) data on noise and vibration generated by the machine, and on radiation, gases, vapours and dust emitted by it, with reference to the measuring methods (including measurement uncertainties) used, 5) technical documentation of electrical equipment (see IEC 60204), and 6) documents attesting that the machine complies with mandatory requirements; d) information relating to the use of the machine, such as that related to or describing 1) intended use, 2) manual controls (actuators), 3) setting and adjustment,	P	

	4) modes and means for stopping (especially emergency stop), 5) risks which could not be eliminated by the protective measures implemented by the designer, 6) particular risks which can be generated by certain applications, by the use of certain fittings, and about specific safeguards necessary for such applications, 7) reasonably foreseeable misuse and prohibited applications, 8) fault identification and location, for repair and for restarting after an intervention, and 9) personal protective equipment needed to be used and the training that is required; e) information for maintenance, such as 1) the nature and frequency of inspections for safety functions, 2) specification of the spare parts to be used when these can affect the health and safety of operators, 3) instructions relating to maintenance operations which require a definite technical knowledge or particular skills and hence need to be carried out exclusively by skilled persons (for example, maintenance staff, specialists), 4) instructions relating to maintenance actions (replacement of parts, etc.) which do not require specific skills and hence may be carried out by users (for example, operators), and 5) drawings and diagrams enabling maintenance personnel to carry out their task rationally (especially fault-finding tasks); f) information relating to dismantling, disabling and scrapping; g) information for emergency situations, such as 1) the operating method to be followed in the event of accident or breakdown, 2) the type of fire-fighting equipment to be used, and 3) a warning of possible emission or leakage of hazardous substance(s) and, if possible, an indication of means for fighting their effects; h) maintenance instructions provided for skilled persons [item e) 3) above] and maintenance instructions provided for unskilled persons [item e) 4) above], that need to appear clearly separated from each other.		
6.4.5.2	**Production of instruction handbook**		
	The following applies to the production and presentation of the instruction handbook. a) The type fount and size of print shall ensure the best possible legibility. Safety warnings and/or cautions should be emphasized by the use of colours, symbols and/or large print. b) The information for use shall be given in the language(s) of the country in which the machine will be used for the first time and in the original version. If more than one language is to be used, each should be readily distinguished from another, and efforts should be made to keep the translated text and relevant illustration together. NOTE In some countries the use of specific language(s) is covered by legal requirements. c) Whenever helpful to the understanding, text should be supported by illustrations. These illustrations should be supplemented with written details enabling, for example, manual controls (actuators) to be located and identified. They should not be separated from the accompanying text and should follow sequential operations. d) Consideration should be given to presenting information in tabular form where this will aid understanding.Tables should be adjacent to the relevant text. e) The use of colours should be considered, particularly in relation to components requiring quick identification.	P	

	f) When information for use is lengthy, a table of contents and/or an index should be provided. g) Safety-relevant instructions which involve immediate action should be provided in a form readily available to the operator.		
6.4.5.3	**Drafting and editing information for use**		
	The following applies to the drafting and editing of information for use. a) Relationship to model: the information shall clearly relate to the specific model of machine and, if necessary, other appropriate identification (for example, by serial number). b) Communication principles: when information for use is being prepared, the communication process "see – think – use" should be followed in order to achieve the maximum effect and should follow sequential operations. The questions, "How?" and "Why?" should be anticipated and the answers provided. c) Information for use shall be as simple and as brief as possible, and should be expressed in consistent terms and units with a clear explanation of unusual technical terms. d) When it is foreseen that a machine will be put to non-professional use, the instructions should be written in a form that is readily understood by the non-professional user. If personal protective equipment is required for the safe use of the machine, clear advice should be given, for example, on the packaging as well as on the machine, so that this information is prominently displayed at the point of sale. e) Durability and availability of the documents: documents giving instructions for use should be produced in durable form (i.e. they should be able to survive frequent handling by the user). It can be useful to mark them "keep for future reference". Where information for use is kept in electronic form (CD, DVD, tape, hard disk, etc.), information on safety-related issues that need immediate action shall always be backed up with a hard copy that is readily available.	P	
7 Documentation of risk assessment and risk reduction			
	The documentation shall demonstrate the procedure that has been followed and the results that have been achieved. This includes, when relevant, documentation of a) the machinery for which the risk assessment has been made (for example, specifications, limits, intended use); b) any relevant assumptions that have been made (loads, strengths, safety factors, etc.); c) the hazards and hazardous situations identified and the hazardous events considered in the risk assessment; d) the information on which risk assessment was based (see 5.2): 1) the data used and the sources (accident histories, experience gained from risk reduction applied to similar machinery, etc.); 2) the uncertainty associated with the data used and its impact on the risk assessment; e) the risk reduction objectives to be achieved by protective measures; f) the protective measures implemented to eliminate identified hazards or to reduce risk; g) residual risks associated with the machinery; h) the result of the risk assessment (see Figure 1); i) any forms completed during the risk assessment. Standards or other specifications used to select protective measures referred to in f) above should be referenced. NOTE No requirement is given in this International Standard to deliver the risk assessment documentation together with the machine. See ISO/TR 14121-2 for information on	P	

	documentation.		
EN 60204-1			
4.1	**General**		
	This part of IEC 60204 is intended to apply to electrical equipment used with a wide variety of machines and with a group of machines working together in a co-coordinated manner. 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. This will determine the adequate risk reduction and the necessary protective measures for persons who can be exposed to those hazards, while still maintaining an acceptable level of performance of the machine and its equipment.	P	
4.2 Selection of equipment			
4.2.1	**General**		
	Electrical components and devices shall: —be suitable for their intended use; and —conform to relevant IEC standards where such exist; and —be applied in accordance with the supplier's instructions risk assessment of the machine.	P	
4.2.2	**Electrical equipment in compliance with the EN 60439 series**		
	Depending upon the machine, its intended use and its electrical equipment, the designer may select parts of the electrical equipment of the machine that are in compliance with EN 60439-1 and, as necessary, other relevant parts of the EN 60439 series (see also Annex F).	P	
4.3 Electrical supply			
4.3.1	**General**		
	The electrical equipment shall be designed to operate correctly with the conditions of the supply: —as specified in 4.3.2 or 4.3.3, or —as otherwise specified by the user (see Annex B), or as specified by the supplier in the case of a special source of supply such as an on-board generator.	P	
4.3.2	**AC supplies**		
	Voltage: Steady state voltage: 0,9 to 1,1 of nominal voltage. Frequency: 0,99 to 1,01 of nominal frequency continuously; 0,98 to 1,02 short time. Harmonics: Harmonic distortion not exceeding 10 % of the total r.m.s. voltage between live conductors for the sum of the 2nd through to the 5th harmonic. An additional 2 % of the total r.m.s. voltage between live conductors for the sum of the 6th through to the 30th harmonic is permissible. Voltage unbalance: Neither the voltage of the negative sequence component nor the voltage of the zero sequence components in three-phase supplies exceeding 2 % of the positive sequence component. Voltage interruption: Supply interrupted or at zero voltage for not more than 3 ms at any random time in the supply cycle with more than 1 s between successive interruptions. Voltage dips:	P	**AC: 380V** $Sum_{2nd\text{-}5th\ harmonic}$<=10% $Sum_{6nd\text{-}30th\ harmonic}$<=2% **50Hz** Voltage unbalance<=2% Voltage interruption <=3ms Rms* 0.707 Voltage dips<=20%

	Voltage dips not exceeding 20 % of the peak voltage of the supply for more than one cycle with more than 1 s between successive dips.		
4.3.3	**DC supplies**		
	From batteries, Voltage 0,85 to 1,15 of nominal voltage 0,7 to 1,2 of nominal voltage in the case of battery-operated vehicles. Voltage interruption: Not exceeding 5 ms From converting equipment. Voltage: 0,9 to 1,1 of nominal voltage. Voltage interruption: Not exceeding 20 ms with more than 1 s between successive interruptions. Ripple (peak-to-peak): Not exceeding 0,15 of nominal voltage.	N	
4.3.4	**Special supply systems**		
	For special supply systems such as on-board generators, the limits given in 4.3.2 and 4.3.3 may be exceeded provided that the equipment is designed to operate correctly with those conditions.	P	
4.4 Physical environment and operating conditions			
4.4.1	**General**		
	The electrical equipment shall be suitable for the physical environment and operating conditions of its intended use. The requirements of 4.4.2 to 4.4.8 cover the physical environment and operating conditions of the majority of machines covered by this part of EN 60204. When special conditions apply or the limits specified are exceeded, an agreement between user and supplier (see 4.1) is recommended (see Annex B).	P	
4.4.3	**Ambient air temperature**		
	Electrical equipment shall be capable of operating correctly in the intended ambient air temperature. The minimum requirement for all electrical equipment is correct operation between air temperatures of +5 °C and +40 °C. For very hot environments (for example hot climates, steel mills, paper mills) and for cold environments, additional measures are recommended (see Annex B).	P	35%~85% **Safety instruction**
4.4.4	**Humidity**		
	The electrical equipment shall be capable of operating correctly when the relative humidity does not exceed 50 % at a maximum temperature of +40 °C. Higher relative humilities are permitted at lower temperatures (for example 90 % at 20 °C). Harmful effects of occasional condensation shall be avoided by design of the equipment or where necessary, by additional measures (for example built-in heaters, air conditioners, drain holes).	P	Safety instruction
4.4.5	**Altitude**		
	Electrical equipment shall be capable of operating correctly at altitudes up to 1000 m above mean sea level.	P	up to 1000 m above m.s.l.
4.4.6	**Contaminants**		
	Electrical equipment shall be adequately protected against the ingress of solids and liquids The electrical equipment shall be adequately protected against contaminants (for example dust, acids, corrosive gases, salts) that can be present in the physical environment in which the electrical equipment is to be installed (see Annex B).	P	Safety instruction
4.4.7	**Ionizing and non-ionizing radiation**		

	When equipment is subject to radiation (for example microwave, ultraviolet, lasers, X-rays), additional measures shall be taken to avoid malfunctioning of the equipment and accelerated deterioration of the insulation. A special agreement is recommended between the supplier and the user (see Annex B).	P	Safety instruction
4.4.8	**Vibration, shock, and bump**		
	Undesirable effects of vibration, shock and bump (including those generated by the machine and its associated equipment and those created by the physical environment) shall be avoided by the selection of suitable equipment, by mounting it away from the machine, or by provision of anti-vibration mountings. A special agreement is recommended between the supplier and the user (see Annex B).	P	Safety instruction
4.5	**Transportation and storage**		
	Electrical equipment shall be designed to withstand, or suitable precautions shall be taken to protect against, the effects of transportation and storage temperatures within a range of –25 °C to +55 °C and for short periods not exceeding 24 h at up to +70 °C. Suitable means shall be provided to prevent damage from humidity, vibration, and shock. A special agreement can be necessary between the supplier and the user (see Annex B).	P	Safety instruction
4.6	**Provisions for handling**		
	Heavy and bulky electrical equipment that has to be removed from the machine for transport or that is independent of the machine, shall be provided with suitable means for handling by cranes or similar equipment.	P	Safety instruction
4.7	**Installation**		
	Electrical equipment shall be installed in accordance with the electrical equipment supplier's Instructions.	P	Safety instruction
5 Incoming supply conductor terminations and devices for disconnecting and switching off			
5.1	**Incoming supply conductor terminations**		
	It is recommended that, where practicable, the electrical equipment of a machine is connected to a single incoming supply. Where another supply is necessary for certain parts of the equipment (for example, electronic equipment that operates at a different voltage), that supply should be derived, as far as is practicable, from devices (for example, transformers, converters) forming part of the electrical equipment of the machine. For large complex machinery comprising a number of widely-spaced machines working together in a coordinated manner, there can be a need for more than one incoming supply depending upon the site supply arrangements (see 5.3.1) Unless a plug is provided with the machine for the connection to the supply (see 5.3.2 e), it is recommended that the supply conductors are terminated at the supply disconnecting device. Where a neutral conductor is used it shall be clearly indicated in the technical documentation of the machine, such as in the installation diagram and in the circuit diagram, and a separate insulated terminal, labeled N in accordance with 16.1, shall be provided for the neutral conductor (see also Annex B). There shall be no connection between the neutral conductor and the protective bonding circuit inside the electrical equipment nor shall a combined PEN terminal be provided. Exception: a connection may be made between the neutral terminal and the PE terminal at the point of the connection of the power supply to the machine for TN-C systems. All terminals for the incoming supply connection shall be clearly identified in accordance with IEC	P	

	60445 and 16.1. For the identification of the external protective conductor terminal, see 5.2. See 17.8 for the provision of instructions for maintenance.		
5.2	**Terminal for connection to the external protective earthing system**		
	For each incoming supply, a terminal shall be provided in the vicinity of the associated phase conductor terminals for connection of the machine to the external protective earthing system or to the external protective conductor, depending upon the supply distribution system. The terminal shall be of such a size as to enable the connection of an external protective copper conductor with a cross-sectional area in accordance with Table 1.	P	Earth Resistance 2.5Ω, Connected with copper wire S=25mm2
5.3 Supply disconnecting (isolating) device			
5.3.1	**General**		
	A supply disconnecting device shall be provided: —for each incoming source of supply to a machine(s); —for each on-board power supply. The supply disconnecting device shall disconnect (isolate) the electrical equipment of the machine from the supply when required (for example for work on the machine, including the electrical equipment). When two or more supply disconnecting devices are provided, protective interlocks for their correct operation shall also be provided in order to prevent a hazardous situation, including damage to the machine or to the work in progress.	P	A supply disconnecting device has been provided
5.3.2	**Type**		
	The supply disconnecting device shall be one of the following types: a) switch-disconnect or, with or without fuses, in accordance with IEC 60947-3, utilization category AC-23B or DC-23B; b) disconnect or, with or without fuses, in accordance with IEC 60947-3, that has an auxiliary contact that in all cases causes switching devices to break the load circuit before the opening of the main contacts of the disconnector; c) a circuit-breaker suitable for isolation in accordance with IEC 60947-2; d) any other switching device in accordance with an IEC product standard for that device and which meets the isolation requirements of IEC 60947-1 as well as a utilization category defined in the product standard as appropriate for on-load switching of motors or other inductive loads; e) a plug/socket combination for a flexible cable supply.	P	
5.3.3	**Requirements**		
	When the supply disconnecting device is one of the types specified in 5.3.2 a) to d) it shall fulfill all of the following requirements: —isolate the electrical equipment from the supply and have one OFF (isolated) and one ON position marked with "O" and "I" (symbols IEC 60417-5008 (DB:2002-10) and IEC 60417-5007 (DB:2002-10), see 10.2.2); —have a visible contact gap or a position indicator which cannot indicate OFF (isolated) until all contacts are actually open and the requirements for the isolating function have been satisfied; —have an external operating means (for example handle), (exception: power-operated switchgear need not be operable from outside the enclosure where there are other means to open it). Where the external operating means is not intended for emergency operations, it is	P	isolate the electrical equipment from the supply and have one OFF (isolated) and one ON position

	recommended that it be colored BLACK or GREY (see 10.7.4 and 10.8.4); —be provided with a means permitting it to be locked in the OFF (isolated) position (for example by padlocks). When so locked, remote as well as local closing shall be prevented; —disconnect all live conductors of its power supply circuit. However, for TN supply systems, the neutral conductor may or may not be disconnected except in countries where disconnection of the neutral conductor (when used) is compulsory; —have a breaking capacity sufficient to interrupt the current of the largest motor when stalled together with the sum of the normal running currents of all other motors and/or loads. The calculated breaking capacity may be reduced by the use of a proven diversity factor. When the supply disconnecting device is a plug/socket combination, it shall fulfill the following requirements: have the switching capability, or be interlocked with a switching device that has a breaking capacity, sufficient to interrupt the current of the largest motor when stalled together with the sum of the normal running currents of all other motors and/or loads. The calculated breaking capacity may be reduced by the use of a proven diversity factor. When the interlocked switching device is electrically operated (for example a contactor) it —shall have an appropriate utilization category. Where the supply disconnecting device is a plug/socket combination, a switching device with an appropriate utilization category shall be provided for switching the machine on and off. This can be achieved by the use of the interlocked switching device described above.		
5.3.4	**Operating means**		
	The operating means (for example, a handle) of the supply disconnecting device shall be easily accessible and located between 0,6 m and 1,9 m above the servicing level. An upper limit of 1,7 m is recommended.	P	1,7 m
5.3.5	**Excepted circuits**		
	The following circuits need not be disconnected by the supply disconnecting device: —lighting circuits for lighting needed during maintenance or repair; —plug and socket outlets for the exclusive connection of repair or maintenance tools and equipment (for example hand drills, test equipment); —under voltage protection circuits that are only provided for automatic tripping in the event of supply failure; —circuits supplying equipment that should normally remain energized for correct operation (for example temperature controlled measuring devices, product (work in progress) heaters, program storage devices); —control circuits for interlocking. It is recommended, however, that such circuits be provided with their own disconnecting device. Where such a circuit is not disconnected by the supply disconnecting device: —permanent warning label(s) in accordance with 16.1 shall be appropriately placed in proximity to the supply disconnecting device; —a corresponding statement shall be included in the maintenance manual, and one or more of the following shall apply; —a permanent warning label in accordance with 16.1 is affixed in proximity to each excepted circuit, or	P	

	—the excepted circuit is separated from other circuits, or —the conductors are identified by colour taking into account the recommendation of 13.2.4.		
5.4	**Devices for switching off for prevention of unexpected start-up**		
	Devices for switching off for the prevention of unexpected start-up shall be provided (for example where, during maintenance, a start-up of the machine or part of the machine can create a hazard). Such devices shall be appropriate and convenient for the intended use, shall be suitably placed, and readily identifiable as to their function and purpose (for example by a durable marking in accordance with 16.1 where necessary).	P	Tow buttons have to be pressed at a same time less than 0.5S discrepancy.
5.5	**Devices for disconnecting electrical equipment**		
	Devices shall be provided for disconnecting (isolating) electrical equipment to enable work to be carried out when it is de-energized and isolated. Such devices shall be: —appropriate and convenient for the intended use; —suitably placed; —readily identifiable as to which part(s) or circuit(s) of the equipment is served (for example by durable marking in accordance with 16.1 where necessary). Means shall be provided to prevent inadvertent and/or mistaken closure of these devices either at the controller or from other locations (see also 5.6). The supply disconnecting device (see 5.3) may, in some cases, fulfil that function. However where it is necessary to work on individual parts of the electrical equipment of a machine, or on one of a number of machines fed by a common conductor bar, conductor wire or inductive power supply system, a disconnecting device shall be provided for each part, or for each machine, requiring separate isolation. In addition to the supply disconnecting device, the following devices that fulfil the isolation function may be provided for this purpose: —devices described in 5.3.2; —disconnectors, withdrawable fuse links and withdrawable links only if located in an electrical operating area (see 3.15) and relevant information is provided with the electrical equipment (see 17.2 b)9) and b)12)).	P	
5.6	**Protection against unauthorized, inadvertent and/or mistaken connection**		
	The devices described in 5.4 and 5.5 that are located outside an enclosed electrical operating area shall be equipped with means to secure them in the OFF position (disconnected state), (for example by provisions for padlocking, trapped key interlocking). When so secured, remote as well as local reconnection shall be prevented. Where a non-lockable disconnecting device (for example withdrawable fuse-links withdrawable links) other means of protection against reconnection (for example warning labels in accordance with 16.1) may be provided. However, when a plug/socket combination according to 5.3.2 e) is so□positioned that it can be kept under the immediate supervision of the person carrying out the work, means for securing in the disconnected state need not be provided.	P	Using system of safety for electro-sensitivity
6 Protection against electric shock			
6.1	**General**		
	The electrical equipment shall provide protection of persons against electric shock from: – direct contact (see 6.2 and 6.4);	P	

	– indirect contact (see 6.3 and 6.4). The measures for this protection given in 6.2, 6.3, and, for PELV, in 6.4, are a recommended selection from IEC 60364-4-41. Where those recommended measures are not practicable, for example due to the physical or operational conditions, other measures from IEC 60364-4-41 may be used.		
6.2	**Protection against direct contact**		
6.2.1	**General**		
	For each circuit or part of the electrical equipment, the measures of either 6.2.2 or 6.2.3 and where applicable, 6.2.4 shall be applied. Exception: where those measures are not appropriate, other measures for protection against direct contact (for example by using barriers, by placing out of reach, using obstacles, using construction or installation techniques that prevent access) as defined in IEC 60364-4-41 may be applied (see 6.2.5 and 6.2.6). When the equipment is located in places open to all persons, which can include children measures of either 6.2.2 with a minimum degree of protection against direct contact corresponding to IP4X or IPXXD (see IEC 60529), or 6.2.3 shall be applied.	P	IP4X
6.2.2	**Protection by enclosures**		
	Live parts shall be located inside enclosures that conform to the relevant requirements of Clauses 4, 11, and 14 and that provide protection against direct contact of at least IP2X or IPXXB (see IEC 60529). Where the top surfaces of the enclosure are readily accessible, the minimum degree of protection against direct contact provided by the top surfaces shall be IP4X or IPXXD Opening an enclosure (i.e. opening doors, lids, covers, and the like) shall be possible only under one of the following conditions: a: b: c:	P	IP45
6.2.3	**Protection by insulation of live parts**		
	Live parts protected by insulation shall be completely covered with insulation that can only be removed by destruction. Such insulation shall be capable of withstanding the mechanical, chemical, electrical, and thermal stresses to which it can be subjected under normal operating conditions.	P	IP42
6.2.4	**Protection against residual voltages**		
	Live parts having a residual voltage greater than 60 V after the supply has been disconnected shall be discharged to 60 V or less within a time period of 5 s after disconnection of the supply voltage provided that this rate of discharge does not interfere with the proper functioning of the equipment. Exempted from this requirement are components having a stored charge of 60 µC or less. Where this specified rate of discharge would interfere with the proper functioning of the equipment, a durable warning notice drawing attention to the hazard and stating the delay required before the enclosure may be opened shall be displayed at an easily visible location on or immediately adjacent to the enclosure containing the capacitances. In the case of plugs or similar devices, the withdrawal of which results in the exposure of conductors (for example pins), the discharge time shall not exceed 1 s, otherwise such	P	IP12 IP22 IP22

	conductors shall be protected against direct contact to at least IP2X or IPXXB. If neither a discharge time of 1 s nor a protection of at least IP2X or IPXXB can be achieved (for example in the case of removable collectors on conductor wires, conductor bars, or slip-ring assemblies, see 12.7.4), additional switching devices or an appropriate warning device (for example a warning notice in accordance with 16.1) shall be applied.		
6.2.5	**Protection by barriers**		
	For protection by barriers, 412.2 of IEC 60364-4-41 shall apply.	P	
6.2.6	**Protection by placing out of reach or protection by obstacles**		
	For protection by placing out of reach, 412.4 of IEC 60364-4-41 shall apply. For protection by obstacles, 412.3 of IEC 60364-4-41 shall apply. For conductor wire systems or conductor bar systems with a degree of protection less than IP2X, see 12.7.1.	P	IP22
6.3 Protection against indirect contact			
6.3.1	**General**		
	Protection against indirect contact (3.29) is intended to prevent hazardous situations due to an insulation fault between live parts and exposed conductive parts. For each circuit or part of the electrical equipment, at least one of the measures in accordance with 6.3.2 to 6.3.3 shall be applied: – measures to prevent the occurrence of a touch voltage (6.3.2); or – automatic disconnection of the supply before the time of contact with a touch voltage can become hazardous (6.3.3).	P	
6.3.2 Prevention of the occurrence of a touch voltage			
6.3.2.1	**General**		
	Measures to prevent the occurrence of a touch voltage include the following: —provision of class II equipment or by equivalent insulation; —electrical separation.	P	
6.3.2.2	**Protection by provision of class II equipment or by equivalent insulation**		
	This measure is intended to prevent the occurrence of touch voltages on the accessible parts through a fault in the basic insulation. This protection is provided by one or more of the following: —class II electrical devices or apparatus (double insulation, reinforced insulation or by equivalent insulation in accordance with IEC 61140); —switchgear and control gear assemblies having total insulation in accordance with IEC 60439-1; —supplementary or reinforced insulation in accordance with 413.2 of IEC 60364-4-41.	P	
6.3.2.3	**Protection by electrical separation**		
	Electrical separation of an individual circuit is intended to prevent a touch voltage through contact with exposed conductive parts that can be energized by a fault in the basic insulation of the live parts of that circuit. For this type of protection, the requirements of 413.5 of IEC 60364-4-41 apply.	P	
6.3.3	**Protection by automatic disconnection of supply**		
	This measure consists of the interruption of one or more of the line conductors by the automatic operation of a protective device in case of a fault. This interruption shall occur within a sufficiently short time to limit the duration of a touch voltage to a time within which the touch voltage is not	P	

	hazardous. Interruption times are given in Annex A.		
6.4 Protection by the use of PELV			
6.4.1	**General requirements**		
	The use of PELV (Protective Extra-Low Voltage) is to protect persons against electric shock from indirect contact and limited area direct contact (see 8.2.5). PELV circuits shall satisfy all of the conditions.	P	
6.4.2	**Sources for PELV**		
	The source for PELV shall be one of the following: —a safety isolating transformer in accordance with IEC 61558-1 and IEC 61558-2-6; —a source of current providing a degree of safety equivalent to that of the safety isolating transformer (for example a motor generator with winding providing equivalent isolation); —an electrochemical source (for example a battery) or another source independent of a higher voltage circuit (for example a diesel-driven generator); —an electronic power supply conforming to appropriate standards specifying measures to be –taken to ensure that, even in the case of an internal fault, the voltage at the outgoing terminals cannot exceed the values specified in 6.4.1.	P	
7 Protection of equipment			
7.1	**General**		
	This Clause details the measures to be taken to protect equipment against the effects of: —overcurrent arising from a short circuit; —overload and/or loss of cooling of motors; —abnormal temperature; —loss of or reduction in the supply voltage; —overspeed of machines/machine elements; —earth fault/residual current; —incorrect phase sequence; —overvoltage due to lightning and switching surges.	P	
7.2 Overcurrent protection			
7.2.1	**General**		
	Overcurrent protection shall be provided where the current in a machine circuit can exceed either the rating of any component or the current carrying capacity of the conductors whichever is the lesser value. The ratings or settings to be selected are detailed in 7.2.10.	P	
7.2.2	**Supply conductors**		
	Unless otherwise specified by the user, the supplier of the electrical equipment is not responsible for providing the overcurrent protective device for the supply conductors to the electrical equipment (see Annex B). The supplier of the electrical equipment shall state on the installation diagram the data necessary for selecting the overcurrent protective device (see 7.2.10 and 17.4).	P	
7.2.3	**Power circuits**		
	Devices for detection and interruption of overcurrent, selected in accordance with 7.2.10 shall be applied to each live conductor. The following conductors, as applicable, shall not be disconnected without disconnecting all associated live conductors:	P	

	—the neutral conductor of a.c. power circuits; —the earthed conductor of d.c. power circuits; —d.c. power conductors bonded to exposed conductive parts of mobile machines. Where the cross-sectional area of the neutral conductor is at least equal to or equivalent to that of the phase conductors, it is not necessary to provide over current detection for the neutral conductor nor a disconnecting device for that conductor. For a neutral conductor with a cross-sectional area smaller than that of the associated phase conductors, the measures detailed in 524 of IEC 60364-5-52 shall apply. In IT systems, it is recommended that the neutral conductor is not used. However, where a neutral conductor is used, the measures detailed in 431.2.2 of IEC 60364-4-43 shall apply.		
7.2.4	**Control circuits**		
	Conductors of control circuits directly connected to the supply voltage and of circuits supplying control circuit transformers shall be protected against over current in accordance with 7.2.3. Conductors of control circuits supplied by a control circuit transformer or d.c. supply shall be protected against over current (see also 9.4.3.1): —in control circuits connected to the protective bonding circuit, by inserting an over current protective device into the switched conductor; —in control circuits not connected to the protective bonding circuit; —where the same cross sectional area conductors are used in all control circuits, by inserting an over current protective device into the switched conductor, and; —where different cross sectional areas conductors are used in different sub-circuits, by inserting an overcurrent protective device into both switched and common conductors of each sub-circuit.	P	
7.2.5	**Socket outlets and their associated conductors**		
	Overcurrent protection shall be provided for the circuits feeding the general purpose socket outlets intended primarily for supplying power to maintenance equipment. Overcurrent protective devices shall be provided in the unearthed live conductors of each circuit feeding such socket outlets.	P	
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 over current devices separate from those protecting other circuits.	P	
7.2.7	**Transformers**		
	Transformers shall be protected against over current in accordance with the manufacturer's instructions. Such protection shall (see also 7.2.10): —avoid nuisance tripping due to transformer magnetizing inrush currents; —avoid a winding temperature rise in excess of the permitted value for the insulation class of transformer when it is subjected to the effects of a short circuit at its secondary terminals. The type and setting of the over current protective device should be in accordance with the recommendations of the transformer supplier.	P	
7.2.8	**Location of over current protective devices**		
	An over current protective device shall be located at the point where a reduction in the cross-sectional area of the conductors or another change reduces the current-carrying capacity of the conductors, except where all the following conditions are satisfied: – the current carrying capacity of the conductors is at least equal to that of the load;	P	

	– the part of the conductor between the point of reduction of current-carrying capacity and the position of the overcurrent protective device is no longer than 3 m; – the conductor is installed in such a manner as to reduce the possibility of a short-circuit, for example, protected by an enclosure or duct.		
7.2.9	**Overcurrent protective devices**		
	The rated short-circuit breaking capacity shall be at least equal to the prospective fault current at the point of installation. Where the short-circuit current to an over current protective device can include additional currents other than from the supply (for example from motors from power factor correction capacitors), those currents shall be taken into consideration. A lower breaking capacity is permitted where another protective device (for example the over current protective device for the supply conductors (see 7.2.2) having the necessary breaking capacity is installed on the supply side. In that case, the characteristics of the two devices shall be co-coordinated so that the let-through energy (I^2t) of the two devices in series does not exceed that which can be withstood without damage to the over current protective device on the load side and to the conductors protected by that device (see Annex A of IEC 60947-2). Where fuses are provided as over current protective devices, a type readily available in the country of use shall be selected, or arrangements shall be made for the supply of spare parts.	P	Using fuses wire as protective device
7.2.10	**Rating and setting of overcurrent protective devices**		
	The rated current of fuses or the setting current of other over current protective devices shall be selected as low as possible but adequate for the anticipated over currents (for example during starting of motors or energizing of transformers). When selecting those protective devices, consideration shall be given to the protection of switching devices against damage due to over currents (for example welding of the switching device contacts). The rated current or setting of an over current protective device is determined by the current carrying capacity of the conductors to be protected in accordance with 12.4, D.2 and the maximum allowable interrupting time t in accordance with Clause D.3, taking into account the needs of co-ordination with other electrical devices in the protected circuit.	P	
7.3 Protection of motors against overheating			
7.3.1	**General**		
	Protection of motors against overheating shall be provided for each motor rated at more than0,5 kW. Exceptions: In applications where an automatic interruption of the motor operation is unacceptable (for example fire pumps), the means of detection shall give a warning signal to which the operator can respond. Protection of motors against overheating can be achieved by: —overload protection (7.3.2), —over-temperature protection (7.3.3),or —current-limiting protection (7.3.4). Automatic restarting of any motor after the operation of protection against overheating shall be prevented where this can cause a hazardous situation or damage to the machine or to the work in progress.	P	
7.3.2	**Overload protection**		
	Where overload protection is provided, detection of overload(s) shall be provided in each live	P	

	conductor except for the neutral conductor. However, where the motor overload detection is not used for cable overload protection (see also Clause D.2), the number of overload detection devices may be reduced at the request of the user (see also Annex B). For motors having single-phase or d.c. power supplies, detection in only one unearthed live conductor is permitted. Where overload protection is achieved by switching off, the switching device shall switch off all live conductors. The switching of the neutral conductor is not necessary for overload protection. Where motors with special duty ratings are required to start or to brake frequently (for example, motors for rapid traverse, locking, rapid reversal, sensitive drilling) it can be difficult to provide overload protection with a time constant comparable with that of the winding to be protected. Appropriate protective devices designed to accommodate special duty motors or over-temperature protection (see 7.3.3) can be necessary. For motors that cannot be overloaded (for example torque motors, motion drives that either are protected by mechanical overload protection devices or are adequately dimensioned), overload protection is not required.		
7.3.3	**Over-temperature protection**		
	The provision of motors with over-temperature protection (see IEC 60034-11) is recommended in situations where the cooling can be impaired (for example dusty environments). Depending upon the type of motor, protection under stalled rotor or loss of phase conditions is not always ensured by over-temperature protection, and additional protection should then be provided. Over-temperature protection is also recommended for motors that cannot be overloaded (for example torque motors, motion drives that are either protected by mechanical overload protection devices or are adequately dimensioned), where the possibility of over-temperature exists (for example due to reduced cooling).	P	
7.3.4	**Current limiting protection**		
	Where protection against the effects of overheating in three phase motors is achieved by current limitation, the number of current limitation devices may be reduced from 3 to 2 (see 7.3.2). For motors having single phase a.c or d.c. power supplies, current limitation in only one unearthed live conductor is permitted.	P	
7.4	**Abnormal temperature protection**		
	Resistance heating or other circuits that are capable of attaining or causing abnormal temperatures (for example, due to short-time rating or loss of cooling medium) and therefore can cause a hazardous situation shall be provided with suitable detection to initiate an appropriate control response.	P	
7.5	**Protection against supply interruption or voltage reduction and subsequent restoration**		
	Where a supply interruption or a voltage reduction can cause a hazardous situation, damage to the machine, or to the work in progress, under voltage protection shall be provided by, for example, switching off the machine at a predetermined voltage level. Where the operation of the machine can allow for an interruption or a reduction of the voltage for a short time period, delayed under voltage protection may be provided. The operation of the under voltage device shall not impair the operation of any stopping control of the machine. Upon restoration of the voltage or upon switching on the incoming supply, automatic or unexpected restarting of the machine shall be prevented where such a restart can cause a hazardous situation. Where only a part of the machine or of the group of machines working together in a coordinated	P	

	manner is affected by the voltage reduction or supply interruption, the under voltage protection shall initiate appropriate control responses to ensure co-ordination.		
7.6	**Motor overspeed protection**		
	Overspeed protection shall be provided where overspeeding can occur and could possibly cause a hazardous situation taking into account measures in accordance with 9.3.2. Overspeed protection shall initiate appropriate control responses and shall prevent automatic restarting. The overspeed protection should operate in such a manner that the mechanical speed limit of the motor or its load is not exceeded.	P	
7.7	**Earth fault/residual current protection**		
	In addition to providing over current protection for automatic disconnection as described in 6.3, earth fault/residual current protection can be provided to reduce damage to equipment due to earth fault currents less than the detection level of the over current protection. The setting of the devices shall be as low as possible consistent with correct operation of the equipment.	P	Using copper wire connect to the earth system.
7.8	**Phase sequence protection**		
	Where an incorrect phase sequence of the supply voltage can cause a hazardous situation or damage to the machine, protection shall be provided.	P	L1 L2 L3
7.9	**Protection against over voltages due to lightning and to switching surges**		
	Protective devices can be provided to protect against the effects of overvoltage due to lightning or to switching surges. Where provided: —devices for the suppression of over voltages due to lightning shall be connected to the incoming terminals of the supply disconnecting device. —devices for the suppression of over voltages due to switching surges shall be connected across the terminals of all equipment requiring such protection.	P	
8 Equipment potential bonding			
8.1	**General**		
	This Clause provides requirements for both protective bonding and functional bonding.	P	
8.2 Protective bonding circuit			
8.2.1	**General**		
	The protective bonding circuit consists of: – PE terminal(s) (see 5.2); – the protective conductors in the equipment of the machine including sliding contacts where they are part of the circuit; – the exposed conductive parts and conductive structural parts of the electrical equipment; – those extraneous conductive parts which form the structure of the machine. All parts of the protective bonding circuit shall be so designed that they are capable of withstanding the highest thermal and mechanical stresses that can be caused by earth-fault currents that could flow in that part of the protective bonding circuit.	P	
8.2.2	**Protective conductors**		
	Protective conductors shall be identified in accordance with 13.2.2. Copper conductors are preferred. Where a conductor material other than copper is used, its	P	20 mm^2

	electrical resistance per unit length shall not exceed that of the allowable copper conductor and such conductors shall be not less than 16 mm^2 in cross-sectional area. The cross-sectional area of protective conductors shall be determined in accordance with the requirements of: —543 of IEC 60364-5-54; or —7.4.3.1.7 of IEC 60439-1, as appropriate. This requirement is met in most cases where the relationship between the cross-sectional area of the phase conductors associated with that part of the equipment and the cross-sectional area of the associated protective conductor is in accordance with Table 1 (see 5.2) See also 8.2.8.		
8.2.3	**Continuity of the protective bonding circuit**		
	All exposed conductive parts shall be connected to the protective bonding circuit in accordance with 8.2.1. Exception: see 8.2.5. Where a part is removed for any reason (for example routine maintenance), the protective bonding circuit for the remaining parts shall not be interrupted. Connection and bonding points shall be so designed that their current-carrying capacity is not impaired by mechanical, chemical, or electrochemical influences. Where enclosures and conductors of aluminium or aluminium alloys are used, particular consideration should be given to the possibility of electrolytic corrosion. Metal ducts of flexible or rigid construction and metallic cable sheaths shall not be used as protective conductors. Nevertheless, such metal ducts and the metal sheathing of all connecting cables (for example cable armouring, lead sheath) shall be connected to the protective bonding circuit. Where the electrical equipment is mounted on lids, doors, or cover plates, continuity of the protective bonding circuit shall be ensured and a protective conductor (see 8.2.2) is recommended. Otherwise fastenings, hinges or sliding contacts designed to have a low resistance shall be used (see 18.2.2, Test 1). The continuity of the protective conductor in cables that are exposed to damage (for example flexible trailing cables) shall be ensured by appropriate measures (for example monitoring). For requirements for the continuity of the protective conductor using conductor wires, conductor bars and slip-ring assemblies, see 12.7.2.	P	
8.2.4	**Exclusion of switching devices from the protective bonding circuit**		
	The protective bonding circuit shall not incorporate a switching device or an overcurrent protective device (for example switch, fuse). No means of interruption of the protective bonding conductor shall be provided. Exception: links for test or measurement purposes that cannot be opened without the use of a tool and that are located in an enclosed electrical operating area. Where the continuity of the protective bonding circuit can be interrupted by means of removable current collectors or plug/socket combinations, the protective bonding circuit shall be interrupted by a first make last break contact. This also applies to removable or withdrawable plug-in units (see also 13.4.5).	P	
8.2.5	**Parts that need not be connected to the protective bonding circuit**		
	It is not necessary to connect exposed conductive parts to the protective bonding circuit where those parts are mounted so that they do not constitute a hazard because:	P	

	– they cannot be touched on large surfaces or grasped with the hand and they are small in size (less than approximately 50 mm × 50 mm); or – they are located so that either contact with live parts, or an insulation failure, is unlikely. This applies to small parts such as screws, rivets, and nameplates and to parts inside an enclosure, irrespective of their size (for example electromagnets of contactors or relays and mechanical parts of devices) (see also 410.3.3.5 of IEC 60364-4-41).		
8.2.6	**Protective conductor connecting points**		
	All protective conductors shall be terminated in accordance with 13.1.1. The protective conductor connecting points shall have no other function and are not intended, for example to attach or connect appliances or parts. Each protective conductor connecting point shall be marked or labelled as such using the symbol IEC 60417-5019 or with the letters PE, the graphical symbol being preferred, or by use of the bicolour combination GREEN-AND-YELLOW, or by any combination of these.	P	
8.2.7	**Mobile machines**		
	On mobile machines with on-board power supplies, the protective conductors, the conductive structural parts of the electrical equipment, and those extraneous conductive parts which form the structure of the machine shall all be connected to a protective bonding terminal to provide protection against electric shock. Where a mobile machine is also capable of being connected to an external incoming power supply, this protective bonding terminal shall be the connection point for the external protective conductor.	P	
8.2.8	**Additional protective bonding requirements for electrical equipment having earth leakage currents higher than 10mA a.c. or d.c.**		
	Where electrical equipment has an earth leakage current (for example adjustable speed electrical power drive systems and information technology equipment) that is greater than 10 mA a.c. or d.c. in any incoming supply, one or more of the following conditions for the associated protective bonding circuit shall be satisfied: a) the protective conductor shall have a cross-sectional area of at least 10 mm^2 Cu or 16 mm^2 Al, through its total run; b) where the protective conductor has a cross-sectional area of less than 10 mm^2 Cu or 16 mm^2 Al, a second protective conductor of at least the same cross-sectional area shall be provided up to a point where the protective conductor has a cross-sectional area not less than 10 mm^2 Cu or 16 mm^2 Al. c) automatic disconnection of the supply in case of loss of continuity of the protective conductor. To prevent difficulties associated with electromagnetic disturbances, the requirements of 4.4.2 also apply to the installation of duplicate protective conductors. In addition, a warning label shall be provided adjacent to the PE terminal, and where necessary on the nameplate of the electrical equipment. The information provided under 17.2 b)1) shall include information about the leakage current and the minimum cross-sectional area of the external protective conductor.	P	12 mm^2 Copper wire
8.3	**Functional bonding**		
	Protection against maloperation as a result of insulation failures can be achieved by connecting to a common conductor in accordance with 9.4.3.1. For recommendations regarding functional bonding to avoid maloperation due to electromagnetic disturbances, see 4.4.2.	P	
8.4	**Measures to limit the effects of high leakage current**		

	The effects of high leakage current can be restricted to the equipment having high leakage current by connection of that equipment to a dedicated supply transformer having separate windings. The protective bonding circuit shall be connected to exposed conductive parts of the equipment and, in addition, to the secondary winding of the transformer. The protective conductor(s) between the equipment and the secondary winding of the transformer shall comply with one or more of the arrangements described in 8.2.8.	P	＜10 μmA
9 Control circuits and control functions			
9.1 Control circuits			
9.1.1	**Control circuit supply**		
	Where control circuits are supplied from an a.c. source, control transformers shall be used for supplying the control circuits. Such transformers shall have separate windings. Where several transformers are used, it is recommended that the windings of those transformers be connected in such a manner that the secondary voltages are in phase. Where d.c. control circuits derived from an a.c. supply are connected to the protective bonding circuit (see 8.2.1), they shall be supplied from a separate winding of the a.c. control circuit transformer or by another control circuit transformer. Transformers are not mandatory for machines with a single motor starter and/or a maximum of two control devices (for example interlock device, start/stop control station).	P	
9.1.2	**Control circuit voltages**		
	The nominal value of the control voltage shall be consistent with the correct operation of the control circuit. The nominal voltage shall not exceed 277 V when supplied from a transformer.	P	**380V**
9.1.3	**Protection**		
	Control circuits shall be provided with over current protection in accordance with 7.2.4 and 7.2.10.	P	
9.2 Control functions			
9.2.1	**Start functions**		
	Start functions shall operate by energizing the relevant circuit (see 9.2.5.2).	P	
9.2.2	**Stop functions**		
	There are three categories of stop functions as follows: —stop category 0: stopping by immediate removal of power to the machine actuators (i.e. an uncontrolled stop – see 3.56); —stop category 1: a controlled stop (see 3.11) with power available to the machine actuators to achieve the stop and then removal of power when the stop is achieved; —stop category 2: a controlled stop with power left available to the machine actuators.	P	Category 0
9.2.3	**Operating modes**		
	Each machine can have one or more operating modes determined by the type of machine and its application. When a hazardous situation can result from a mode selection unauthorized and/or inadvertent selection shall be prevented by suitable means (for example key operated switch, access code). Mode selection by itself shall not initiate machine operation. A separate actuation of the start control shall be required. For each specific operating mode, the relevant safety functions and/or protective measures shall be implemented. Indication of the selected operating mode shall be provided (for example the position of a mode	P	

	selector, the provision of an indicating light, a visual display indication).		
9.2.4	**Suspension of safety functions and/or protective measures**		
	Where it is necessary to suspend safety functions and/or protective measures (for example for setting or maintenance purposes), protection shall be ensured by: —disabling all other operating (control) modes	P	
9.2.5 Operation			
9.2.5.1	**General**		
	The necessary safety functions and/or protective measures (for example interlocks (see 9.3) shall be provided for safe operation. Measures shall be taken to prevent movement of the machine in an unintended or unexpected manner after any stopping of the machine (for example due to locked-off condition, power supply fault, battery replacement, lost signal condition with cableless control). Where a machine has more than one control station, measures shall be provided to ensure that initiation of commands from different control stations do not lead to a hazardous situation.	P	
9.2.5.2	**Start**		
	The start of an operation shall be possible only when all of the relevant safety functions and/or protective measures are in place and are operational except for conditions as described in 9.2.4. On those machines (for example mobile machines) where safety functions and/or protective measures cannot be applied for certain operations, manual control of such operations shall be by hold-to-run controls, together with enabling devices, as appropriate. Suitable interlocks shall be provided to secure correct sequential starting. In the case of machines requiring the use of more than one control station to initiate a start, each of these control stations shall have a separate manually actuated start control device. The conditions to initiate a start shall be: – all required conditions for machine operation shall be met, and – all start control devices shall be in the released (off) position, then – all start control devices shall be actuated concurrently (see 3.6).	P	
9.2.5.3	**Stop**		
	Stop category 0 and/or stop category 1 and/or stop category 2 stop functions shall be provided as indicated by the risk assessment and the functional requirements of the machine. Stop functions shall override related start functions (see 9.2.5.2). Where required, facilities to connect protective devices and interlocks shall be provided. If such a protective device or interlock causes a stop of the machine, it may be necessary for that condition to be signaled to the logic of the control system. The reset of the stop function shall not initiate any hazardous situation. Where more than one control station is provided, stop commands from any control station shall be effective when required by the risk assessment of the machine.	P	
9.2.5.4 Emergency operations (emergency stop, emergency switching off)			
9.2.5.4.1	**General**		
	The emergency stop and the emergency switching off functions of the emergency operations listed in Annex E, both of which are, in this part of IEC 60204, initiated by a single human action. Once active operation of an emergency stop (see 10.7) or emergency switching off (see 10.8) actuator has ceased following a command, the effect of this command shall be sustained until it is reset. This reset shall be possible only by a manual action at that location where the command	P	

	has been initiated. The reset of the command shall not restart the machinery but only permit restarting. It shall not be possible to restart the machinery until all emergency stop commands have been reset. It shall not be possible to reenergize the machinery until all emergency switching off commands have been reset.		
9.2.5.4.2	**Emergency stop**		
	Given in ISO 13850. The emergency stop shall function either as a stop category 0 or as a stop category 1 (see 9.2.2). The choice of the stop category of the emergency stop depends on the results of a risk assessment of the machine. In addition to the requirements for stop (see 9.2.5.3), the emergency stop function has the following requirements: —it shall override all other functions and operations in all modes; —power to the machine actuators that can cause a hazardous situation(s) shall be either removed immediately (stop category 0) or shall be controlled in such a way to stop the hazardous motion as quickly as possible (stop category 1) without creating other hazards; —reset shall not initiate a restart.	P	Category 0
9.2.5.4.3	**Emergency switching off**		
	The functional aspects of emergency switching off are given in 536.4 of IEC 60364-5-53. Emergency switching off should be provided where: —protection against direct contact (for example with conductor wires, conductor bars, slip ring assemblies, control gear in electrical operating areas) is achieved only by placing out of reach or by obstacles (see 6.2.6); or —there is the possibility of other hazards or damage caused by electricity. Emergency switching off is accomplished by switching off the relevant incoming supply by electromechanical switching devices, effecting a stop category 0 of machine actuators connected to this incoming supply. When a machine cannot tolerate this stop category 0 stop, it may be necessary to provide other measures, for example protection against direct contact so that emergency switching off is not necessary.	P	Category 0
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 situation shall be monitored by providing, for example, over travel limiters, motor overspeed detection, mechanical overload detection or anti-collision devices.	P	
9.2.6 Other control functions			
9.2.6.1	**Hold-to-run controls**		
	Hold-to-run controls shall require continuous actuation of the control device(s) to achieve operation.	P	
9.2.6.2	**Two-hand control**		
	Three types of two-hand control are defined in ISO 13851, the selection of which is determined by the risk assessment. These shall have the following features: Type I: this type requires: – the provision of two control devices and their concurrent actuation by both hands; – continuous concurrent actuation during the hazardous situation;	N	

	– machine operation shall cease upon the release of either one or both of the control devices when hazardous situations are still present. A Type I two-hand control device is not considered to be suitable for the initiation of hazardous operation. Type II: a type I control requiring the release of both control devices before machine operation can be reinitiated. Type III: a type II control requiring concurrent actuation of the control devices as follows: – it shall be necessary to actuate the control devices within a certain time limit of each other, not exceeding 0,5 s; – where this time limit is exceeded, both control devices shall be released before machine operation can be initiated.		
9.2.6.3	**Enabling control**		
	Enabling control (see also 10.9) is a manually activated control function interlock that: a) when activated allows a machine operation to be initiated by a separate start control and b) when de-activated —initiates a stop function in accordance with 9.2.5.3, and —prevents initiation of machine operation. Enabling control shall be so arranged as to minimize the possibility of defeating, for example by requiring the de-activation of the enabling control device before machine operation may be reinitiated. It should not be possible to defeat the enabling function by simple means.	P	
9.2.6.4	**Combined start and stop controls**		
	Push-buttons and similar control devices that, when operated, alternately initiate and stop motion shall only be provided for functions which cannot result in a hazardous situation.	P	
9.2.7 Cableless control			
9.2.7.1	**General**		
	This sub clause deals with the functional requirements of control systems employing cableless (for example radio, infra-red) techniques for transmitting commands and signals between a machine control system and operator control station(s). Means shall be provided to readily remove or disconnect the power supply of the operator control station (see also 9.2.7.3). Means (for example key operated switch, access code) shall be provided, as necessary, to prevent unauthorized use of the operator control station. Each operator control station shall carry an unambiguous indication of which machine(s) is (are) intended to be controlled by that operator control station.	P	
9.2.7.2	**Control limitation**		
	Measures shall be taken to ensure that control commands: —affect only the intended machine; —affect only the intended functions. Measures shall be taken to prevent the machine from responding to signals other than those from the intended operator control station(s). Where necessary, means shall be provided so that the machine can only be controlled from operator control stations in one or more predetermined zones or locations.	P	
9.2.7.3	**Stop**		
	Cableless control stations shall include a separate and clearly identifiable means to initiate the	P	

	stop function of the machine or of all the operations that can cause a hazardous situation. The actuating means to initiate this stop function shall not be marked or labelled as an emergency stop device (see10.7). 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, in the following situations: – when a stop signal is received; – when a fault is detected in the cableless control system; – when a valid signal (which includes a signal that communication is established and maintained) has not been detected within a specified period of time (see Annex B), except when a machine is executing a pre-programmed task taking it outside the range of the cableless control where no hazardous situation can occur.		
9.2.7.4	**Use of more than one operator control station**		
	Where a machine has more than one operator control station, including one or morecableless control stations, measures shall be provided to ensure that only one of the control stations can be enabled at a given time. 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. Exception: a stop command from any one of the control stations shall be effective when required by the risk assessment of the machine.	P	
9.2.7.5	**Battery-powered operator control stations**		
	A variation in the battery voltage shall not cause a hazardous situation. If one or more potentially hazardous motions are controlled using a battery-powered cableless operator control station, a clear warning shall be given to the operator when a variation in battery voltage exceeds specified limits. Under those circumstances, the cableless operator control station shall remain functional long enough for the operator to put the machine into a nonhazardous situation.	P	
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 hazardous machine operation.	P	
9.3.2	**Exceeding operating limits**		
	Where an operating limits (for example speed, pressure, position) can be exceeded leading to a hazardous situation, means shall be provided to detect when a predetermined limit(s) is exceeded and initiate an appropriate control action.	P	
9.3.3	**Operation of auxiliary functions**		
	The correct operation of auxiliary functions shall be checked by appropriate devices (for example pressure sensors). Where the non-operation of a motor or device for an auxiliary function (for example lubrication, supply of coolant, swarf removal) can cause a hazardous situation, or cause damage to the machine or to the work in progress, appropriate interlocking shall be provided.	P	
9.3.4	**Interlocks between different operations and for contrary motions**		
	All contactors, relays, and other control devices that control elements of the machine and that can cause a hazardous situation when actuated at the same time (for example those which initiate contrary motion), shall be interlocked against incorrect operation.	P	

	Reversing contactors (for example those controlling the direction of rotation of a motor) shall be interlocked in such a way that in normal service no short circuit can occur when switching. Where, for safety or for continuous operation, certain functions on the machine are required to be interrelated, proper co-ordination shall be ensured by suitable interlocks. For a group of machines working together in a co-ordinated manner and having more than one controller, provision shall be made to co-ordinate the operations of the controllers as necessary. Where a failure of a mechanical brake actuator can result in the brake being applied when the associated machine actuator is energized and a hazardous situation can result, interlocks shall be provided to switch off the machine actuator.		
9.3.5	**Reverse current braking**		
	Where braking of a motor is accomplished by current reversal, measures shall be provided to prevent the motor starting in the opposite direction at the end of braking where that reversal can cause a hazardous situation or damage to the machine or to the work in progress. For this purpose, a device operating exclusively as a function of time is not permitted. Control circuits shall be so arranged that rotation of a motor shaft, for example manually shall not result in a hazardous situation.	P	
9.4 Control functions in the event of failure			
9.4.1	**General requirements**		
	Where failures or disturbances in the electrical equipment can cause a hazardous situation or damage to the machine or to the work in progress, appropriate measures shall be taken to minimize the probability of the occurrence of such failures or disturbances. The required measures and the extent to which they are implemented, either individually or in combination, depend on the level of risk associated with the respective application (see 4.1).	P	
9.4.2 Measures to minimize risk in the event of failure			
9.4.2.1	**Use of proven circuit techniques and components**		
	These measures include but are not limited to: —bonding of control circuits to the protective bonding circuit for functional purposes (see 9.4.3.1 and Figure 2); —connection of control devices in accordance with 9.4.3.1; —stopping by de-energizing (see 9.2.2); —the switching of all control circuit conductors to the device being controlled (see 9.4.3.1); —switching devices having direct opening action (see IEC 60947-5-1); —circuit design to reduce the possibility of failures causing undesirable operations.	P	
9.4.2.2	**Provisions of partial or complete redundancy**		
	By providing partial or complete redundancy, it is possible to minimize the probability that one single failure in the electrical circuit can result in a hazardous situation. Redundancy can be effective in normal operation (on-line redundancy) or designed as special circuits that take over the protective function (off-line redundancy) only where the operating function fails. Where off-line redundancy which is not active during normal operation is provided, suitable measures shall be taken to ensure that those control circuits are available when required.	P	
9.4.2.3	**Provision of diversity**		
	The use of control circuits having different principles of operation, or using different types of components or devices can reduce the probability of hazards resulting from faults and/or failures. Examples include:	P	Directly using diversity

	—the combination of normally open and normally closed contacts operated by interlocking guards; —the use of different types of control circuit components in the circuit; —the combination of electromechanical and electronic equipment in redundant configurations. The combination of electrical and non-electrical systems (for example mechanical, hydraulic, pneumatic) may perform the redundant function and provide the diversity.		
9.4.2.4	**Provision for functional tests**		
	Functional tests may be carried out automatically by the control system, or manually by inspection or tests at start-up and at predetermined intervals or a combination as appropriate (see also 17.2 and 18.6).	P	
9.4.3 Protection against maloperation due to earth faults, voltage interruptions and loss of circuit continuity			
9.4.3.1	**Earth faults**		
	Earth faults on any control circuit shall not cause unintentional starting, potentially hazardous motions, or prevent stopping of the machine. Methods to meet these requirements include but are not limited to the following: Method a) Method b) Method c)	P	Method a
9.4.3.2	**Voltage interruptions**		
	The requirements detailed in 7.5 shall apply. Where the control system uses a memory device(s), proper functioning in the event of power failure shall be ensured (for example by using a non-volatile memory) to prevent any loss of memory that can result in a hazardous situation.	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 situation, appropriate measures shall be taken (for example by duplication of the sliding contacts).	P	
10 Operator interface and machine-mounted control devices			
10.1 General			
10.1.1	**General device requirements**		
	This Clause contains requirements for devices mounted outside or partially outside control enclosures. As far as is practicable, those devices shall be selected, mounted, and identified or coded in accordance with relevant parts of IEC 61310. The possibility of inadvertent operation shall be minimized by, for example, positioning of devices, suitable design, provision of additional protective measures. Particular consideration shall be given to the selection, arrangement, programming and use of operator input devices such as touchscreens, keypads and keyboards, for the control of hazardous machine operations. See IEC 60447.	P	
10.1.2	**Location and mounting**		
	As far as is practicable, machine-mounted control devices shall be: —readily accessible for service and maintenance; —mounted in such a manner as to minimize the possibility of damage from activities such as	P	0,8M

	material handling. The actuators of hand-operated control devices shall be selected and installed so that: —they are not less than 0,6 m above the servicing level and are within easy reach of the normal working position of the operator; —the operator is not placed in a hazardous situation when operating them. The actuators of foot-operated control devices shall be selected and installed so that: —they are within easy reach of the normal working position of the operator; —the operator is not placed in a hazardous situation when operating them.		
10.1.3	**Protection**		
	The degree of protection (see IEC 60529) together with other appropriate measures shall afford protection against: —the effects of aggressive liquids, vapours, or gases found in the physical environment or used on the machine; —the ingress of contaminants (for example swarf, dust, particulate matter). In addition, the operator interface control devices shall have a minimum degree of protection against direct contact of IPXXD (see IEC 60529).	P	
10.1.4	**Position sensors**		
	Position sensors (for example position switches, proximity switches) shall be so arranged that they will not be damaged in the event of over travel. Position sensors in circuits with safety-related control functions shall have direct opening action (see IEC 60947-5-1) or shall provide similar reliability (see 9.4.2).	P	
10.1.5	**Portable and pendant control stations**		
	Portable and pendant operator 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 (for example if the operator control station is dropped or strikes an obstruction) (see also 4.4.8).	P	
10.2 Push-buttons			
10.2.1	**Colors**		
	Push-button actuators shall be colour-coded in accordance with Table 2 (see also 9.2 and Annex B). The colours for START/ON actuators should be WHITE, GREY, BLACK or GREEN with a preference for WHITE. RED shall not be used. The colour RED shall be used for emergency stop and emergency switching off actuators. The colours for STOP/OFF actuators should be BLACK, GREY, or WHITE with a preference for BLACK. GREEN shall not be used. RED is permitted, but it is recommended that RED is not used near an emergency operation device. WHITE, GREY, or BLACK are the preferred colours for push-button actuators that alternately act as START/ON and STOP/OFF push-buttons. The colours RED, YELLOW, or GREEN shall not be used (see also 9.2.6). WHITE, GREY, or BLACK are the preferred colours for push-button actuators that cause operation while they are actuated and cease the operation when they are released (for example hold-to-run). The colours RED, YELLOW, or GREEN shall not be used. Reset push-buttons shall be BLUE, WHITE, GREY, or BLACK. Where they also act as a STOP/OFF button, the colours WHITE, GREY, or BLACK are preferred with the main preference	P	Red: emergency stop Yellow: Green: start White: no use Black: stop

	being for BLACK. GREEN shall not be used. Where the same colour WHITE, GREY, or BLACK is used for various functions (for example WHITE for START/ON and for STOP/OFF actuators) a supplementary means of coding (for example shape, position, symbol) shall be used for the identification of push-button actuators.		
10.2.2	**Markings**		
	In addition to the functional identification as described in 16.3, it is recommended that pushbuttons be marked, near to or preferably directly on the actuators, with the symbols given in Table 3.	P	
10.3 Indicator lights and displays			
10.3.1	**General**		
	Indicator lights and displays serve to give the following types of information: —Indication: to attract the operator's attention or to indicate that a certain task should be performed. The colors RED, YELLOW, BLUE, and GREEN are normally used in this mode; for flashing indicator lights and displays, see 10.3.3. —confirmation: to confirm a command, or a condition, or to confirm the termination of a change or transition period. The colors BLUE and WHITE are normally used in this mode and GREEN may be used in some cases. Indicator lights and displays shall be selected and installed in such a manner as to be visible from the normal position of the operator. Indicator light circuits used for warning lights shall be fitted with facilities to check the operability of these lights.	P	Red light: emergency Green: normal
10.3.2	**Colors**		
	Unless otherwise agreed between the supplier and the user (see Annex B), indicator lights shall be colour-coded with respect to the condition (status) of the machine in accordance with Table 4. Indicating towers on machines should have the applicable colors in the following order from the top down; RED, YELLOW, BLUE, GREEN and WHITE.	P	
10.3.3	**Flashing lights and displays**		
	For further distinction or information and especially to give additional emphasis, flashing lights and displays can be provided for the following purposes: – to attract attention; – to request immediate action; – to indicate a discrepancy between the command and actual state; – to indicate a change in process (flashing during transition). It is recommended that higher frequency flashing lights or display be used for higher priority information (see IEC 60073 for recommended flashing rates and pulse/pause ratios). Where flashing lights or displays are used to provide higher priority information, audible warning devices should also be provided.	P	
10.4	**Illuminated push-buttons**		
	Illuminated push-button actuators shall be colour-coded in accordance with Tables 2 and 4. Where there is difficulty in assigning an appropriate colour, WHITE shall be used. The colour RED for the emergency stop actuator shall not depend on the illumination of its light.	P	
10.5	**Rotary control devices**		
	Devices having a rotational member, such as potentiometers and selector switches, shall have means of prevention of rotation of the stationary member.	P	

	Friction alone shall not be considered sufficient.		
10.6	**Start devices**		
	Actuators used to initiate a start function or the movement of machine elements (for example slides, spindles, carriers) shall be constructed and mounted so as to minimize inadvertent operation. However, mushroom-type actuators may be used for two-hand control (see also ISO 13851).	P	
10.7 Emergency stop devices			
10.7.1	**Location of emergency stop devices**		
	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 (exception: see 9.2.7.3). There can be circumstances where confusion can occur between active and inactive emergency stop devices caused by disabling the operator control station. In such cases means (for example, information for use) shall be provided to minimize confusion.	P	In front of the operating table
10.7.2	**Types of emergency stop device**		
	The types of device for emergency stop include: – a push-button operated switch with a palm or mushroom head type; – a pull-cord operated switch; – a pedal-operated switch without a mechanical guard. The devices shall have direct opening operation (see IEC 60947-5-1, Annex K).	P	push-button back in manual operation
10.7.3	**Color of actuators**		
	Actuators of emergency stop devices shall be colored RED. If a background exists immediately around the actuator, then this background shall be colored YELLOW. See also ISO 13850.	P	Red in a background of yellow
10.7.4	**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: —it is readily accessible to the operator; and —it is of the type described in 5.3.2 a), b), c), or d). When also intended for such use, the supply disconnecting device shall meet the colour requirements of 10.7.3.	P	
10.8 Emergency switching off devices			
10.8.1	**Location of emergency switching off devices**		
	Emergency switching off devices shall be located as necessary for the given application. Normally, those devices will be located separate from operator control stations. Where it is necessary to provide a control station with an emergency stop device and an emergency switching off device, means shall be provided to avoid confusion between these devices.	P	Push-Button
10.8.2	**Types of emergency switching off device**		
	The types of device for emergency switching off include: —a push-button operated switch with a palm or mushroom head type of actuator; —a pull-cord operated switch. The devices shall have direct opening action (see IEC 60947-5-1, Annex K). The push-button operated switch may be in a break-glass enclosure.	P	back in manual operation
10.8.3	**Color of actuators**		

	Actuators of emergency switching off devices shall be coloured RED. If a background exists immediately around the actuator, then this background shall be coloured YELLOW. Where confusion can occur between emergency stop and emergency switching off devices, means shall be provided to minimise confusion.	P	Red in a background of yellow
10.8.4	**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 color requirements of 10.8.3.	P	
10.9	**Enabling control device**		
	When an enabling control device is provided as a part of a system, it shall signal the enabling control to allow operation when actuated in one position only. In any other position, operation shall be stopped or prevented. Enabling control devices shall be selected and arranged so as to minimize the possibility of defeating. Enabling control devices shall be selected that have the following features: —designed in accordance with ergonomic principles; —for a two-position type: —position 1: off-function of the switch (actuator is not operated); —position 2: enabling function (actuator is operated). —for a three-position type: —position 1: off-function of the switch (actuator is not operated); —position 2: enabling function (actuator is operated in its mid position); —position 3: off-function (actuator is operated past its mid position); —when returning from position 3 to position 2, the enabling function is not activated.	P	Obvious to operator
11 Control gear: location, mounting, and enclosures			
11.1	**General requirements**		
	All control gear shall be located and mounted so as to facilitate: —its accessibility and maintenance; —its protection against the external influences or conditions under which it is intended to operate; —operation and maintenance of the machine and its associated equipment.	P	
11.2 Location and mounting			
11.2.1	**Accessibility and maintenance**		
	All items of control gear shall be placed and oriented so that they can be identified without moving them or the wiring. For items that require checking for correct operation or that are liable to need replacement, those actions should be possible without dismantling other equipment or parts of the machine (except opening doors or removing covers, barriers or obstacles). Terminals not part of control gear components or devices shall also conform to these requirements. All control gear shall be mounted so as to facilitate its operation and maintenance from the front. Where a special tool is necessary to adjust, maintain, or remove a device, such a tool shall be supplied. Where access is required for regular maintenance or adjustment, the relevant devices shall be located between 0,4 m and 2,0 m above the servicing level. It is recommended that terminals be at least 0,2 m above the servicing level and be so placed that conductors and cables can be easily connected to them. No devices except devices for operating, indicating, measuring, and cooling shall be mounted on doors or on normally removable access covers of	P	Input/output indicator

	enclosures. Where control devices are connected through plug-in arrangements, their association shall be made clear by type (shape), marking or reference designation, singly or in combination (see 13.4.5). Plug-in devices that are handled during normal operation shall be provided with no interchangeable features where the lack of such a facility can result in malfunctioning. Plug/socket combinations that are handled during normal operation shall be located and mounted so as to provide unobstructed access. Test points for connection of test equipment, where provided, shall be: —mounted so as to provide unobstructed access; —clearly identified to correspond with the documentation (see 17.3); —adequately insulated; —Sufficiently spaced.		
11.2.2	**Physical separation or grouping**		
	Non-electrical parts and devices, not directly associated with the electrical equipment, shall not be located within enclosures containing control gear. Devices such as solenoid valves should be separated from the other electrical equipment (for example in a separate compartment). 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. Terminals shall be separated into groups for: —power circuits; —associated control circuits; —other control circuits, fed from external sources (for example for interlocking). The groups may be mounted adjacently, provided that each group can be readily identified (for example by markings, by use of different sizes, by use of barriers or by colors). When arranging the location of devices (including interconnections), the clearances and creep age distances specified for them by the supplier shall be maintained, taking into account the external influences or conditions of the physical environment.	P	
11.2.3	**Heating effects**		
	Heat generating components (for example heat sinks, power resistors) shall be so located that the temperature of each component in the vicinity remains within the permitted limit.	P	
11.3	**Degrees of protection**		
	The protection of control gear against ingress of solid foreign objects and of liquids shall be adequate taking into account the external influences under which the machine is intended to operate (i.e. the location and the physical environmental conditions) and shall be sufficient against dust, coolants, and swarf. Enclosures of control gear shall provide a degree of protection of at least IP22 (see IEC 60529). Exceptions: a) Where an electrical operating area is used as a protective enclosure for an appropriate degree of protection against the ingress of solid bodies and liquids. b) Where removable collectors on conductor wire or conductor bar systems are used and IP22 is not achieved, but the measures of 6.2.5 are applied.	P	Degrees of protection: IP45
11.4 Enclosures, doors and openings		P	
12 Conductors and cables			

Standard: EN 60204-1:2018, EN ISO 12100:2010, EN 13985:2003+A1:2009			
Clause	**Requirement-Test**	**Result**	**Verdict**
12.1	**General requirements**		
	Conductors and cables shall be selected so as to be suitable for the operating conditions (for example voltage, current, protection against electric shock, grouping of cables) and external influences (for example ambient temperature, presence of water or corrosive substances mechanical stresses (including stresses during installation), fire hazards) that can exist.	P	
12.2	**Conductors**		
	In general, conductors shall be of copper. Where aluminum conductors are used, the cross-sectional area shall be at least 16 mm^2. To ensure adequate mechanical strength, the cross-sectional area of conductors should not be less than as shown in Table 5. However, conductors with smaller cross-sectional areas or other constructions than shown in Table 5 may be used in equipment provided adequate mechanical strength is achieved by other means and proper functioning is not impaired.	P	20mm^2
12.3	**Insulation**		
	The types of insulation include (but are not limited to): —polyvinyl chloride (PVC); —rubber, natural and synthetic; —silicone rubber (SiR); —mineral; —cross-linked polyethylene (XLPE); —ethylene propylene compound (EPR). Where the insulation of conductors and cables (for example PVC) can constitute hazards due to the propagation of a fire or the emission of toxic or corrosive fumes, guidance from the cable supplier should be sought. It is important to give special attention to the integrity of a circuit having a safety-related function. The insulation of cables and conductors used, shall be suitable for a test voltage: —not less than 2 000 V a.c. for a duration of 5 min for operation at voltages higher than 50 V a.c. or 120 V d.c, or —not less than 500 V a.c. for a duration of 5 min for PELV circuits (see IEC 60364-4-41 class III equipment). The mechanical strength and thickness of the insulation shall be such that the insulation cannot be damaged in operation or during laying, especially for cables pulled into ducts.	P	Protection degree of electrical operation box: IP54 1000V ac for 5min
12.4	**Current-carrying capacity in normal service**		
	The current-carrying capacity depends on several factors, for example insulation material number of conductors in a cable, design (sheath), methods of installation, grouping and ambient temperature. One typical example of the current-carrying capacities for PVC insulated wiring between enclosures and individual items of equipment under steady-state conditions is given in Table 6.	P	Protection degree of electrical operation box: IP54
12.5	**Conductor and cable voltage drop**		
	The voltage drop from the point of supply to the load shall not exceed 5 % of the nominal voltage under normal operating conditions. In order to conform to this requirement, it can be necessary to use conductors having a larger cross-sectional area than that derived from Table 6.	P	
12.6 Flexible cables			
12.6.1	**General**		
	Flexible cables shall have Class 5 or Class 6 conductors.	P	Class 5

12.6.2	**Mechanical rating**		
	The cable handling system of the machine shall be so designed to keep the tensile stress of the conductors as low as is practicable during machine operations. Where copper conductors are used, the tensile stress applied to the conductors shall not exceed 15 N/mm2 of the copper cross-sectional area. Where 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 maximal tensile stress should be agreed with the cable manufacturer. The maximum stress applied to the conductors of flexible cables with material other than copper shall be within the cable manufacturer's specification.	P	Flexible cables: CE certificate provided. 2000V/5min
12.6.3	**Current-carrying 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 maximum allowable conductor temperature is not exceeded. For cables of circular cross-sectional area installed on drums, the maximum current-carrying capacity in free air should be derated in accordance with Table 7 (see also Clause 44 of IEC 60621-3).	P	
12.7 Conductor wires, conductor bars and slip-ring assemblies			
12.7.1	**Protection against direct contact**		
	Conductor wires, conductor bars and slip-ring assemblies shall be installed or enclosed in such a way that, during normal access to the machine, protection against direct contact is achieved by the application of one of the following protective measures: – protection by partial insulation of live parts, or where this is not practicable; – protection by enclosures or barriers of at least IP2X (see 412.2 of IEC 60364-4-41). Horizontal top surfaces of barriers or enclosures that are readily accessible shall provide a degree of protection of at least IP4X (see 412.2.2 of IEC 60364-4-41). Where the required degree of protection is not achieved, protection by placing live parts out of reach in combination with emergency switching off in accordance with 9.2.5.4.3 shall be applied. Conductor wires and conductor bars shall be so placed and/or protected as to: – prevent contact, especially for unprotected conductor wires and conductor bars, with conductive items such as the cords of pull-cord switches, strain-relief devices and drive chains; – prevent damage from a swinging load.	P	
12.7.2	**Protective conductor circuit**		
	Where conductor wires, conductor bars and slip-ring assemblies are installed as part of the protective bonding circuit, they shall not carry current in normal operation. Therefore, the protective conductor (PE) and the neutral conductor (N) shall each use a separate conductor wire, conductor bar or slip-ring. The continuity of the protective conductor circuit using sliding contacts shall be ensured by taking appropriate measures (for example, duplication of the current collector continuity monitoring).	P	
12.7.3	**Protective conductor current collectors**		
	Protective conductor current collectors shall have a shape or construction so that they are not interchangeable with the other current collectors. Such current collectors shall be of the sliding contact type.	P	
12.7.4	**Removable current collectors with a disconnector function**		

	Removable current collectors having 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 (see also 8.2.4).	P	
12.7.5	**Clearances in air**		
	Clearances between the respective conductors and between adjacent systems, of conductor wires, conductor bars, slip-ring assemblies and their current collectors shall be suitable for at least a rated impulse voltage of an overvoltage category III in accordance with IEC 60664-1.	P	
12.7.6	**Creepage distances**		
	Creepage distances between the respective conductors, between adjacent systems of conductor wires, conductor bars and slip-ring assemblies, and their current collectors shall be suitable for operation in the intended environment, for example open air (IEC 60664-1), inside buildings, protected by enclosures. In abnormally dusty, moist or corrosive environments, the following creepage distance requirements apply: – unprotected conductor wires, conductor bars, and slip-ring assemblies shall be equipped with insulators with a minimum creepage distance of 60 mm; – enclosed conductor wires, insulated multipole conductor bars and insulated individual conductor bars shall have a minimum creepage distance of 30 mm. The manufacturer's recommendations shall be followed regarding special measures to prevent a gradual reduction in the insulation values due to unfavourable ambient conditions (for example deposits of conductive dust, chemical attack).	P	
12.7.7	**Conductor system sectioning**		
	Where conductor wires or conductor bars are arranged so that they can be divided into isolated sections, suitable design measures shall be employed to prevent the energization of adjacent sections by the current collectors themselves.	P	
12.7.8	**Construction and installation of conductor wire, conductor bar systems and slip-ring assemblies**		
	Conductor wires, conductor bars and slip-ring assemblies in power circuits shall be grouped separately from those in control circuits. Conductor wires, conductor bars and slip-ring assemblies shall be capable of withstanding without damage, the mechanical forces and thermal effects of short-circuit currents. Removable covers for conductor wire and conductor bar systems laid underground or under floor shall be so designed that they cannot be opened by one person without the aid of a tool. Where conductor bars are installed in a common metal enclosure, the individual sections of the enclosure shall be bonded together and connected to a protective bonding conductor at several points depending upon their length. Metal covers of conductor bars laid underground or under floor shall also be bonded together and connected to a protective bonding conductor. The protective bonding circuit shall include the covers or cover plates of metal enclosures or under floor ducts. Where metal hinges form a part of the bonding circuit, their continuity shall be verified (see Clause 18). Underground and under floor conductor bar ducts shall have drainage facilities.	P	
13 Wiring practices			
13.1 Connections and routing			

13.1.1	**General requirements**		
	All connections, especially those of the protective bonding circuit, shall be secured against accidental loosening.	P	
13.1.2	**Conductor and cable runs**		
	Conductors and cables shall be run from terminal to terminal without splices or joints. Connections using plug/socket combinations with suitable protection against accidental disconnection are not considered to be joints for the purpose of this Sub clause. Exception: Where it is impracticable to provide terminals in a junction box (for example on mobile machines, on machines having long flexible cables; cable connections exceeding a length which is not practical to be supplied by the cable manufacturer on one cable drum; repair of cable due to mechanical stresses during installation and operation), splices or joints may be used. Where it is necessary to connect and disconnect cables and cable assemblies, a sufficient extra length shall be provided for that purpose. The terminations of cables shall be adequately supported to prevent mechanical stresses at the terminations of the conductors. Wherever practicable, the protective conductor shall be placed close to the associated live conductors in order to decrease the impedance of the loop.	P	
13.1.3	**Conductors of different circuits**		
	Conductors of different circuits may be laid side by side, may occupy the same duct (for example conduit, cable trunking system), or may be in the same multiconductor cable provided that the arrangement does not impair the proper functioning of the respective circuits. Where those circuits operate at different voltages, the conductors shall be separated by suitable barriers or shall be insulated for the highest voltage to which any conductor within the same duct can be subjected, for example line to line voltage for unearthed systems and phase to earth voltage for earthed systems.	P	
13.1.4	**Connection between pick-up and pick-up converter of an inductive power supply system**		
	The cable between the pick-up and the pick-up converter as specified by the manufacturer of the inductive power supply shall be: —as short as practicable; —adequately protected against mechanical damage.	P	
13.2 Identification of conductors			
13.2.1	**General requirements**		
	Each conductor shall be identifiable at each termination in accordance with the technical documentation (see Clause 17). It is recommended (for example to facilitate maintenance) that conductors be identified by number, alphanumeric, color (either solid or with one or more stripes), or a combination of color and numbers or alphanumeric. When numbers are used, they shall be Arabic; lettersbvshall be Roman (either upper or lower case).	P	
13.2.2	**Identification of the protective conductor**		
	The protective conductor shall be readily distinguishable by shape, location, marking, or color. When identification is by color alone, the bicolor combination GREEN-ANDYELLOW shall be used throughout the length of the conductor. This colour identification is strictly reserved for the protective conductor. For insulated conductors, the bicolor combination GREEN-AND-YELLOW shall be such that on	P	

	any 15 mm length, one of the colors covers at least 30 % and not more than 70 % of the surface of the conductor, the other color covering the remainder of the surface. Where the protective conductor can be easily identified by its shape, position, or construction (for example a braided conductor, uninsulated stranded conductor), or where the insulated conductor is not readily accessible, color coding throughout its length is not necessary but the ends or accessible locations shall be clearly identified by the graphical symbol IEC 60417-5019 (DB: 2002-10) or by the bicolor combination GREEN-AND-YELLOW.		
13.2.3	**Identification of the neutral conductor**		
	Where a circuit includes a neutral conductor that is identified by color alone, the color used for this conductor shall be BLUE. In order to avoid confusion with other colors, it is recommended that an unsaturated blue be used, called here “light blue” (see 3.2.2 of IEC 60446). Where the selected color is the sole identification of the neutral conductor, that color shall not be used for identifying any other conductor where confusion is possible. Where identification by color is used, bare conductors used as neutral conductors shall be either colored by a stripe, 15 mm to 100 mm wide in each compartment or unit and at each accessible location, or colored throughout their length.	P	
13.2.4	**Identification by color**		
	Where color-coding is used for identification of conductors (other than the protective conductor (see 13.2.2) and the neutral conductor (see 13.2.3)), the following colors may be used: BLACK, BROWN, RED, ORANGE, YELLOW, GREEN, BLUE (including LIGHT BLUE), VIOLET, GREY, WHITE, PINK, TURQUOISE.	P	
13.3	**Wiring inside enclosures**		
	Conductors inside enclosures shall be supported where necessary to keep them in place. Non-metallic ducts shall be permitted only when they are made with a flame-retardant insulating material (see the IEC 60332 series). It is recommended that electrical equipment mounted inside enclosures be designed and constructed in such a way as to permit modification of the wiring from the front of the enclosure (see also 11.2.1). Where that is not practicable and control devices are connected from the rear of the enclosure, access doors or swing out panels shall be provided.	P	
13.4 Wiring outside enclosures			
13.4.1	**General requirements**		
	The means of introduction of cables or ducts with their individual glands, bushings, etc, into an enclosure shall ensure that the degree of protection is not reduced (see 11.3).	P	
13.4.2	**External ducts**		
	Conductors and their connections external to the electrical equipment enclosure(s) shall be enclosed in suitable ducts (i.e. conduit or cable trunking systems) as described in 13.5except for suitably protected cables that may be installed without ducts and with or without the use of open cable trays or cable support means. Where devices such as position switches or proximity switches are supplied with a dedicated cable, their cable need not be enclosed in a duct when the cable is suitable for the purpose, sufficiently short, and so located or protected, that the risk of damage is minimized. Fittings used with ducts or multiconductor cable shall be suitable for the physical environment.	P	
13.4.3	**Connection to moving elements of the machine**		
	Connections to frequently moving parts shall be made using conductors in accordance with 12.2	P	

	and 12.6. Flexible cable and flexible conduit shall be so installed as to avoid excessive flexing and straining, particularly at the fittings.		
13.4.4	**Interconnection of devices on the machine**		
	Where several machine-mounted switching devices (for example position sensors, pushbuttons) are connected in series or in parallel, it is recommended that the connections between those devices be made through terminals forming intermediate test points. Such terminals shall be conveniently placed, adequately protected, and shown on the relevant diagrams.	P	
13.4.5	**Plug/socket combinations**		
	Where plug/socket combinations are provided, they shall fulfill one or more of the following requirements as applicable: Exception: The following requirements do not apply to components or devices inside an enclosure, terminated by fixed plug/socket combinations (no flexible cable), or components connected to a bus system by a plug/socket combination. a)/b)/c)/d)/e)/f)/g)/ h)/i)/j)/k) Exception: The requirements of item k) do not apply to control functions using high frequency signals on the power supply.	P	
13.4.6	**Dismantling for shipment**		
	Where it is necessary that wiring be disconnected for shipment, terminals or plug/socket combinations shall be provided at the sectional points. Such terminals shall be suitably enclosed and plug/socket combinations shall be protected from the physical environment during transportation and storage.	P	
13.4.7	**Additional conductors**		
	Consideration should be given to providing additional conductors for maintenance or repair. When spare conductors are provided, they shall be connected to spare terminals or isolated in such a manner as to prevent contact with live parts.	P	
13.5 Ducts, connection boxes and other boxes			
13.5.1	**General requirements**		
	Ducts shall provide a degree of protection suitable for the application (see IEC 60529). All sharp edges, flash, burrs, rough surfaces, or threads with which the insulation of the conductors can come in contact shall be removed from ducts and fittings. Where necessary, additional protection consisting of a flame-retardant, oil-resistant insulating material shall be provided to protect conductor insulation. Drain holes of 6 mm diameter are permitted in cable trunking systems, connection boxes, and other boxes used for wiring purposes that can be subject to accumulations of oil or moisture.	P	
13.5.2	**Percentage fill of ducts**		
	Consideration of the percentage fill of ducts should be based on the straightness and length of the duct and the flexibility of the conductors. It is recommended that the dimensions and arrangement of the ducts be such as to facilitate the insertion of the conductors and cables.	P	
13.5.3	**Rigid metal conduit and fittings**		
	Rigid metal conduit and fittings shall be of galvanized steel or of a corrosion-resistant material suitable for the conditions. The use of dissimilar metals in contact that can cause galvanic action should be avoided. Conduits shall be securely held in place and supported at each end, Fittings shall be compatible with the conduit and appropriate for the application.	P	

	Fittings shall be threaded unless structural difficulties prevent assembly. Where threadless fittings are used, the conduit shall be securely fastened to the equipment. Conduit bends shall be made in such a manner that the conduit shall not be damaged and the internal diameter of the conduit shall not be effectively reduced.		
13.5.4	**Flexible metal conduit and fittings**		
	A flexible metal conduit shall consist of a flexible metal tubing or woven wire amour. It shall be suitable for the expected physical environment. Fittings shall be compatible with the conduit and appropriate for the application.	P	
13.5.5	**Flexible non-metallic conduit and fittings**		
	Flexible non-metallic conduit shall be resistant to kinking and shall have physical characteristics similar to those of the sheath of multiconductor cables. The conduit shall be suitable for use in the expected physical environment. Fittings shall be compatible with the conduit and appropriate for the application.	P	
13.5.6	**Cable trunking systems**		
	Cable trunking systems external to enclosures shall be rigidly supported and clear of all moving or contaminating portions of the machine. Covers shall be shaped to overlap the sides; gaskets shall be permitted. Covers shall be attached to cable trunking systems by suitable means. On horizontal cable trunking systems, the cover shall not be on the bottom unless specifically designed for such installation. Where the cable trunking system is furnished in sections, the joints between sections shall fit tightly but need not be gasketed. The only openings permitted shall be those required for wiring or for drainage. Cable trunking systems shall not have opened but unused knockouts.	P	
13.5.7	**Machine compartments and cable trunking systems**		
	The use of compartments or cable trunking systems within the column or base of a machine to enclose conductors is permitted provided the compartments or cable trunking systems are isolated from coolant or oil reservoirs and are entirely enclosed. Conductors run in enclosed compartments and cable trunking systems shall be so secured and arranged that they are not subject to damage.	P	
13.5.8	**Connection boxes and other boxes**		
	Connection boxes and other boxes used for wiring purposes shall be accessible for maintenance. Those boxes shall provide protection against the ingress of solid bodies and liquids, taking into account the external influences under which the machine is intended to operate (see 11.3). Those boxes shall not have opened but unused knockouts nor any other openings and shall be so constructed as to exclude materials such as dust, flying, oil, and coolant.	P	IP33
13.5.9	**Motor connection boxes**		
	Motor connection boxes shall enclose only connections to the motor and motor-mounted devices (for example brakes, temperature sensors plugging switches, tachometer generators).	P	IP54
14 Electric motors and associated equipment			
14.1	**General requirements**		
	Electric motors should conform to the relevant parts of IEC 60034 series. The protection requirements for motors and associated equipment are given in 7.2 for over current protection, in 7.3 for overload protection, and in 7.6 for overspeed protection. As many controllers do not switch off the supply to a motor when it is at rest, care shall be taken	P	

	to ensure compliance with the requirements of 5.3, 5.4, 5.5, 7.5, 7.6 and 9.4. Motor control equipment shall be located and mounted in accordance with Clause 11.		
14.2	**Motor enclosures**		
	It is recommended that motor enclosures be chosen from those included in IEC 60034-5. The degree of protection shall be at least IP23 (see IEC 60529) for all motors. More stringent requirements can be needed depending on the application and the physical environment (see 4.4). Motors incorporated as an integral part of the machine shall be so mounted that they are adequately protected from mechanical damage.	P	Protection degree: IP54
14.3	**Motor dimensions**		
	As far as is practicable, the dimensions of motors shall conform to those given in the IEC 60072 series.	P	
14.4	**Motor mounting and compartments**		
	Each motor and its associated couplings, belts, pulleys, or chains, shall be so mounted that they are adequately protected and are easily accessible for inspection, maintenance, adjustment and alignment, lubrication, and replacement. The motor mounting arrangement shall be such that all motor hold-down means can be removed and all terminal boxes are accessible. Motors shall be so mounted that proper cooling is ensured and the temperature rise remains within the limits of the insulation class (see IEC 60034-1). Where practicable, motor compartments should be clean and dry, and when required, shall be ventilated directly to the exterior of the machine. The vents shall be such that ingress of swarf, dust, or water spray is at an acceptable level. There shall be no opening between the motor compartment and any other compartment that does not meet the motor compartment requirements. Where a conduit or pipe is run into the motor compartment from another compartment not meeting the motor compartment requirements, any clearance around the conduit or pipe shall be sealed.	P	
14.5	**Criteria for motor selection**		
	The characteristics of motors and associated equipment shall be selected in accordance with the anticipated service and physical environmental conditions (see 4.4). In this respect, the points that shall be considered include: – type of motor; – type of duty cycle (see IEC 60034-1); – fixed speed or variable speed operation, (and the consequent variable influence of the ventilation); – mechanical vibration; – type of motor control; – influence of the harmonic spectrum of the voltage and/or current feeding the motor (particularly when it is supplied from a static convertor) on the temperature rise; – method of starting and the possible influence of the inrush current on the operation of other users of the same power supply, taking also into account possible special considerations stipulated by the supply authority; – variation of counter-torque load with time and speed; – influence of loads with large inertia; – influence of constant torque or constant power operation; – possible need of inductive reactors between motor and converter.	P	

14.6	**Protective devices for mechanical brakes**		
	Operation of the overload and over current protective devices for mechanical brake actuators shall initiate the simultaneous de-energization (release) of the associated machine actuators.	P	
15 Accessories and lighting			
15.1	**Accessories**		
	Where the machine or its associated equipment is provided with socket-outlets that are intended to be used for accessory equipment (for example hand-held power tools, test equipment), the following apply: —the socket-outlets should conform to IEC 60309-1. Where that is not practicable, they should be clearly marked with the voltage and current ratings; —the continuity of the protective bonding circuit to the socket-outlet shall be ensured except where protection is provided by PELV; —all unearthed conductors connected to the socket-outlet shall be protected against over current and, when required, against overload in accordance with 7.2 and 7.3 separately from the protection of other circuits; —where the power supply to the socket-outlet is not disconnected by the supply disconnecting device for the machine or the section of the machine, the requirements of 5.3.5 apply.	P	
15.2 Local lighting of the machine and equipment			
15.2.1	**General Connections to the protective**		
	The ON/OFF switch shall not be incorporated in the lampholder or in the flexible connecting cords. Stroboscopic effects from lights shall be avoided by the selection of appropriate luminaries. Where fixed lighting is provided in an enclosure, electromagnetic compatibility should be taken into account using the principles outlined in 4.4.2.	P	
15.2.2	**Supply**		
	The nominal voltage of the local lighting circuit shall not exceed 250 V between conductors. A voltage not exceeding 50 V between conductors is recommended.	P	
15.2.3	**Protection**		
	Local lighting circuits shall be protected in accordance with 7.2.6.	P	
15.2.4	**Fittings**		
	Adjustable lighting fittings shall be suitable for the physical environment. The lamp holders shall be: —in accordance with the relevant IEC standard; —constructed with an insulating material protecting the lamp cap so as to prevent unintentional contact. Reflectors shall be supported by a bracket and not by the lamp holder. Exception: where fixed lighting is out of reach of operators during normal operation, the provisions of this Sub clause do not apply.	P	
16 Marking, warning signs and reference designations			
16.1	**General**		
	Warning signs, nameplates, markings, and identification plates shall be of sufficient durability to withstand the physical environment involved.	P	
16.2 Warning signs			
16.2.1	**Electric shock hazard**		

	Enclosures that do not otherwise clearly show that they contain electrical equipment that can give rise to a risk of electric shock shall be marked with the graphical symbol IEC 60417-5036(DB: 2002-10). The warning sign shall be plainly visible on the enclosure door or cover. The warning sign may be omitted (see also 6.2.2 b)) for: —an enclosure equipped with a supply disconnecting device; —an operator-machine interface or control station; —a single device with its own enclosure (for example position sensor).	P	
16.2.2	**Hot surfaces hazard**		
	Where the risk assessment shows the need to warn against the possibility of hazardous surface temperatures of the electrical equipment, the graphical symbol IEC 60417-5041 (DB: 2002-10) shall be used.	P	
16.3	**Functional identification**		
	Control devices, visual indicators, and displays (particularly those related to safety) shall be clearly and durably marked with regard to their functions either on or adjacent to the item. Such markings may be as agreed between the user and the supplier of the equipment (see Annex B). Preference should be given to the use of standard symbols given in IEC 60417- DB: 2002 and ISO 7000.	P	
16.4	**Marking of equipment**		
	Equipment (for example control gear assemblies) shall be legibly and durably marked in a way that is plainly visible after the equipment is installed. A nameplate giving the following information shall be attached to the enclosure adjacent to each incoming supply: —name or trade mark of supplier; —certification mark, when required; —serial number, where applicable; —rated voltage, number of phases and frequency (if a.c.), and full-load current for each supply; —short-circuit rating of the equipment; —main document number (see IEC 62023). The full-load current shown on the nameplate shall be not less than the running currents for all motors and other equipment that can be in operation at the same time under normal conditions. Where only a single motor controller is used, that information may instead be provided on the machine nameplate where it is plainly visible.	P	
16.5	**Reference designations**		
	All enclosures, assemblies, control devices, and components shall be plainly identified with the same reference designation as shown in the technical documentation.	P	
17 Technical documentation			
17.1	**General**		
	The information necessary for installation, operation, and maintenance of the electrical equipment of a machine shall be supplied in the appropriate forms, for example, drawings, diagrams, charts, tables, instructions. The information shall be in an agreed language (see also Annex B). The information provided may vary with the complexity of the electrical equipment. For very simple equipment, the relevant information may be contained in one document, provided that the document shows all the devices of the electrical equipment and enables the connections to the supply network to be made.	P	

17.2	**Information to be provided**		
	The information provided with the electrical equipment shall include: a) A main document (parts list or list of documents); b) Complementary documents	P	
17.3	**Requirements applicable to all documentation**		
	Unless otherwise agreed between manufacturer and user: – the documentation shall be in accordance with relevant parts of IEC 61082; – reference designations shall be in accordance with relevant parts of IEC 61346; – instructions/manuals shall be in accordance with IEC 62079. – parts lists where provided shall be in accordance with IEC 62027, class B. NOTE See item 13 of Annex B. For referencing of the different documents, the supplier shall select one of the following methods: – where the documentation consists of a small number of documents (for example less than 5) each of the documents shall carry as a cross-reference the document numbers of all other documents belonging to the electrical equipment; or – for single level main documents only (see IEC 62023), all documents shall be listed with document numbers and titles in a drawing or document list; or – all documents of a certain level (see IEC 62023) of the document structure shall be listed, with document numbers and titles, in a parts list belonging to the same level.	P	
17.4	**Installation documents**		
	The installation documents shall give all information necessary for the preliminary work of setting up the machine (including commissioning). In complex cases, it may be necessary to refer to the assembly drawings for details.	P	
17.5	**Overview diagrams and function diagrams**		
	Where it is necessary to facilitate the understanding of the principles of operation, an overview diagram shall be provided. An overview diagram symbolically represents the electrical equipment together with its functional interrelationships without necessarily showing all of the interconnections. NOTE 1 Examples of overview diagrams can be found in IEC 61082 series. Function diagrams may be provided as either part of, or in addition to, the overview diagram. NOTE 2 Examples of function diagrams can be found in IEC 61082-2.	P	
17.6	**Circuit diagrams**		
	A circuit diagram(s) shall be provided. This diagram(s) shall show the electrical circuits on the machine and its associated electrical equipment. Any graphical symbol not shown in IEC 60617-DB: 2001 shall be separately shown and described on the diagrams or supporting documents. The symbols and identification of components and devices shall be consistent throughout all documents and on the machine. Where appropriate, a diagram showing the terminals for interface connections shall be provided. That diagram may be used in conjunction with the circuit diagram(s) for simplification. The diagram should contain a reference to the detailed circuit diagram of each unit shown. Switch symbols shall be shown on the electromechanical diagrams with all supplies turned off (for example electricity, air, water, lubricant) and with the machine and its electrical equipment ready for a normal start. Conductors shall be identified in accordance with 13.2.	P	

	Circuits shall be shown in such a way as to facilitate the understanding of their function as well as maintenance and fault location. Characteristics relating to the function of the control devices and components which are not evident from their symbolic representation shall be included on the diagrams adjacent to the symbol or referenced to a footnote.		
17.7	**Operating manual**		
	The technical documentation shall contain an operating manual detailing proper procedure for set-up and use of the electrical equipment. Particular attention should be given to the safety measures provided. Where the operation of the equipment can be programmed, detailed information on methods of programming, equipment required, program verification, and additional safety procedures(where required) shall be provided.	P	Operating manual
17.8	**Maintenance manual**		
	The technical documentation shall contain a maintenance manual detailing proper procedures for adjustment, servicing and preventive inspection, and repair. Recommendations on Maintenance/service intervals and records should be part of that manual. Where methods for the verification of proper operation are provided (for example software testing programs), the use of those methods shall be detailed.	P	Maintenance manual
17.9	**Parts list**		
	The parts list, where provided, shall comprise, as a minimum, information necessary for ordering spare or replacement parts (for example components, devices, software, test equipment, technical documentation) required for preventive or corrective maintenance including those that are recommended to be carried in stock by the user of the equipment.	P	

18 Verification

Standard: EN 60204-1:2018, EN ISO 12100:2010, EN 13985:2003+A1:2009			
Clause	**Requirement-Test**	**Result**	**Verdict**

18.2	**TABLE: Earth bonding**			P
	Test Current (A)..... :	10A		—
	Ambient (°C)..... :	25		—
Test locations		Conductor Diameter (mm^2)	Voltage Drop (V)	
Most unfavorable case	PE- enclosure		0.77	
	PE- transformer		0.66	
	PE- motor		0.99	
	PE- other parts		0.99	
18.2	**TABLE: Fault loop impedance**			P
	Ambient (°C)..... :	25		—
Most unfavorable case	U_0(V)	244		
	I_a (A)	30		
	$Z_s\Omega$	0.95		
18.3	**TABLE: Insulation Resistance Test**			P
	Test Voltage (V)..... :	1000V a.c.		—
	Ambient (°C)..... :	20		—
Test locations		Insulation Resistance (MΩ)		
Most unfavorable case	PE-L1	100		
	PE-L2	100		
	PE-L3	100		
	PE-N	100		
18.4	**TABLE: Dielectric Test**			P
	Test Voltage (V)..... :	1000V a.c.		—
	Test Duration (s)..... :	1 sec.		—
Test locations		Observation		
Most unfavorable case	L1-PE	□Puncture □Flash-over		
	L2-PE	□Puncture □Flash-over		
	L2-PE	□Puncture □Flash-over		
	N-PE	□Puncture □Flash-over		
CMS-16SW	L1-PE	□Puncture □Flash-over		
	L2-PE	□Puncture □Flash-over		
	L2-PE	□Puncture □Flash-over		
	N-PE	□Puncture □Flash-over		
18.5	**Protection against residual voltages**			
	Where appropriate, tests shall be performed to ensure compliance with 6.2.4.	P	Test Voltage (V) 380AC	
18.6	**Functional tests**			
	The functions of electrical equipment shall be tested. The function of circuits for electrical safety (for example earth fault detection) shall be tested.	P		

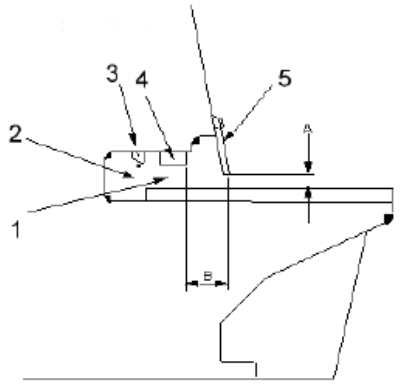
EN 13985:2003+A1:2009			
5	**Safety requirements and/or protective measures**		
5.1	**General**		
	The guillotine shears covered by this standard range in size from small to large machines with a single operator or several operators. The methods or measures to be implemented to eliminate the significant hazards or reduce their associated risks are detailed in this clause in the following manner: – basic design considerations for major guillotine components or systems (see 5.2); – safeguarding against mechanical hazards in the blade area under different modes of production (see 5.3); – protection against hazards due to control system or control component failures (see 5.4); – safeguarding against hazards which can occur during setting, trial strokes, maintenance and lubrication (see 5.5); – safeguarding against other hazards (see 5.6 to 5.8). In addition, the machine shall be designed according to the principles of EN 292 for hazards relevant but not significant which are not dealt with by this standard.		P
5.2	**Basic design considerations**		
5.2.1	Brakes and friction clutches		
5.2.1.1	Fluid or air pressure shall not be used to apply a brake unless means are provided to ensure that, in the event of loss of fluid or air pressure, the integrity of the brake is maintained and the clutch is disengaged. Diaphragms shall not be used to apply a brake.		P
5.2.1.2	The designer shall ensure that: a) the springs used for applying the brake or disengaging the clutch are of compression type and well tried components; b) multiple assemblies are used; c) all the springs are closely uniform in dimension, quality and rating; d) the means of loading the springs are such that, when adjusted, the spring anchorages can be locked to prevent slackening back; e) the arrangements for spring housing and guiding, and of guide pins, are such as to minimize binding; f) the brake can function even if 50 % of the spring assembly has failed.		P
5.2.1.3	The arrangement provided for engagement and disengagement of the clutch and brake shall not affect their safe function. NOTE Combined clutch and brake units are recommended so as to reduce the possibility of the overlapping of their engagement.		P
5.2.1.4	The clutch and brake shall be designed so that failure of components e.g. for power transmission or screws shall not prevent the clutch to be disengaged and the brake to be applied.		P
5.2.1.5	Any heat generated which can cause a hazardous situation shall be dissipated.		P
5.2.1.6	Effective arrangements shall be made to prevent reduction of braking performance due to penetration of lubricants to the brake friction surfaces.		P
5.2.1.7	The clutch and brake shall be designed in such a way that the accumulation of dust, fluid or debris is minimised in areas likely to give rise to inefficient brake or clutch performance and any moisture, dust or lubricating oil, which breaks or corrodes packaging material (e.g. gaskets and		P

	seals), cannot influence the required function adversely (e.g. by obstructing an air channel or otherwise affecting their efficiency).		
5.2.1.8	Band brakes shall not be used on guillotine shears for the purpose of stopping the beam.		P
5.2.1.9	Clutches shall be of a capacity capable of engaging and disengaging the intended stroke, without excessive temperature rise, under conditions of maximum use of the guillotine shears.		P
5.2.1.10	Sufficient working clearances shall be provided so as to ensure that, under the severest conditions of operation and temperature, no undesired movement of the driven members shall take place.		P
5.2.1.11	Arrangements shall be made to prevent the accumulation of debris evolved from frictional surfaces in places where it might give rise to inefficient clutch performance, and for its effective dispersal.		P
5.2.1.12	The clutch and brake and their control system shall be designed so that, in the event of failure of pneumatic, hydraulic or electrical supply, the clutch is disengaged and the brake is immediately applied.		P
5.2.1.13	If diaphragms are used in a clutch system, measures shall be taken to avoid damage by the cutting effect of sharp edges or wearing by rough surfaces. Evacuation of air shall not be prevented due to slackening of the diaphragm, e.g. due to material fatigue.		P
5.2.2	Hydraulic and pneumatic systems - Common features		
5.2.2.1	The general requirements in EN 982 and EN 983 shall be applied in designing hydraulic and pneumatic systems. These systems shall also comply with the particular requirements in 5.2.2, 5.2.3 and 5.2.4.		P
5.2.2.2	Filters and pressure regulators shall be provided.		P
5.2.2.3	Devices shall be provided to ensure that the permitted range of working pressure is maintained.		P
5.2.2.4	Pressurised transparent bowls (e.g. glass, plastic) shall be protected to prevent injury from flying particles without affecting visibility.		P
5.2.2.5	All piping, pipe fittings, passages, surge or storage tanks and cored or drilled holes, shall be free from burrs or foreign matter which might cause damage e.g. to valves or clutch and brake operating parts (see 5.3.4.2.3 of EN 982:1996 and 5.3.4.2.3 of EN 983:1996).		P
5.2.2.6	Each run of piping shall, where practicable, be continuous from one piece of apparatus to another. Precautions shall be taken to prevent damage by thermal expansion. Rigid piping shall be securely supported at frequent intervals to avoid vibration or movement. Care shall be taken to avoid kinking of flexible pipes used to carry fluids. Such kinking can cause traps which prevent the fluid exhausting. This applies particularly to piping feeding the running joint of the clutch and brake.		P
5.2.2.7	Where a drop in pressure could lead to unintended dangerous motion of the beam, pipes and pipe connections shall be chosen to prevent such a loss of pressure. Such pipe connections shall be flanged or welded.		P
5.2.2.8	The support of operating valves shall not depend only on the connected piping. This is to avoid undesirable effects from vibration which might affect both valves and piping.		P
5.2.2.9	Operating valves for clutch and brake shall be so designed as to ensure that, when in the nonoperating position, leakage past the inlet valve will escape sufficiently freely to prevent build-up of pressure in the clutch-operating cylinder.		P
5.2.2.10	Operating valves for clutch and brake shall be so designed that it is not possible for both the inlet		P

	port and the exhaust ports to remain closed at the same time.		
5.2.2.11	Exhaust ports and piping between clutch operating cylinders and valves shall be selected to ensure prompt release of fluid from clutch operating cylinders. Precautions shall be taken to ensure that the exhaust ports of operating valves prevent residual pressure in the cylinder. The valve shall be selected so that the pressure ratio between clutch and brake is such that the residual pressure in the cylinder will not become excessive in the event of a valve fault. NOTE Normally, a ratio of at least 3.5 to 1 between spring pressure in the brake and residual pressure in the cylinder is satisfactory.		P
5.2.2.12	Control valves and other control components (e.g. regulators, pressure gauges) shall be mounted in positions which provide accessibility and protection against damage.		P
5.2.2.13	Where valves are manually or mechanically (as distinct from electrically) operated, the arrangements for restoring the valves shall be positive (i.e. when the actuator of the valve is released, the valve shall automatically move to the safe position). See also 5.4.6. Any unintended movement due dissipation shall be avoided of stored energy according to EN 1037. NOTE The safety position can be the open or closed position of a valve, depending upon the well-tried principles in the hydraulic or pneumatic circuit.		P
5.2.3	**Pneumatic systems**		
5.2.3.1	Where valves or other movable parts of the guillotine shear control system require lubrication, visible automatic means of lubrication shall be provided to introduce the oil into the air line in suitable form. The presence of oil shall be visible.		N/A
5.2.3.2	Where silencing systems are fitted, they shall be provided and installed in accordance with the valve manufacturer´s instructions for use in safety systems and their effect on braking performance shall be taken into account. Only non-clogging direct to atmosphere silencers are permissible to brake/clutch manufacturers´ specifications.		N/A
5.2.3.3	Water separators shall be provided.		N/A
5.2.4	**Hydraulic systems**		
5.2.4.1	The circuit shall be protected by a pressure limiting valve(s). These valves shall not be capable of alteration without the use of a tool; also they shall be set at a pressure which is no more than 10 % higher than the maximum operating pressure.		P
5.2.4.2	In order to prevent unexpected start up of dangerous movement (see EN 1037), hydraulic systems which include accumulators shall allow the fluid pressure to fall when the pressure generating unit is stopped. If this is impossible, the parts of the circuit which are maintained under pressure shall be supplied with a manual discharge valve in addition to the other devices required by standards or rules concerning accumulators (e.g. Relief valves, pneumatic gauges) and bear a clear indication (by means of a descriptive plate) of the hazard (see 5.3.4.5 of EN 982:1996).		P
5.2.4.3	A pressure relief valve(s) shall be provided to protect from damage due to over pressure the annular part of cylinder and other relevant components. The pressure relief valve(s) shall operate at 10 % above the design maximum operating pressure. The pressure relief valve(s) shall be directly operated and its setting sealed. The components it protects shall be designed to sustain the pressure at which the valve is set. The relief valve shall be constructed so that, if a single break in the spring occurs, the space between the windings remains less than one wire thickness. The spring shall be guided.		P

Standard: EN 60204-1:2018, EN ISO 12100:2010, EN 13985:2003+A1:2009			
Clause	**Requirement-Test**	**Result**	**Verdict**

5.2.5	**Electrical systems**		
	The electrical equipment of the machine shall comply with EN 60204-1, together with the following:		
5.2.5.1	The designer of a guillotine shear shall consider whether the limits of the power supply, the physical environment as well as the operating conditions of some components are different than 4.3 and 4.4 of EN 60204-1:1997. In this case, the choice of relevant components has to be made in this respect.		P
5.2.5.2	The emergency stop shall function as a category 0 stop (see 9.2.5.4 of EN 60204-1:1997 and 5.4.5.2) and shall stop all hazardous movements. The emergency stop shall stop all hazardous movements (e.g. beam, back gauges, supports, integral handling devices). A category 1 emergency stop function complying to 9.2.2 and 9.2.5.4.2 of EN 60204-1:1997 may be used for electronic controlled drives for example on machines equipped with automatic feed and/or removal systems or electrical drive of the stroke.		P
5.2.5.3	The minimum degree of protection for operator interface and press-mounted control devices shall be of at least IP 54 according to EN 60529.		P
5.2.5.4	Enclosures of control-gear shall provide a degree of protection of at least IP 54 (see EN 60529).		P
5.2.5.6	Arrangements shall be made to ensure that a short-circuit in the wiring outside the control cabinet (e.g. wiring to a foot pedal) shall not result in an unexpected start-up (see EN 1037).		P
5.2.6	Prevention of unintended gravity fall of the blade during maintenance or repair		
5.2.6.1	Where there is a risk of injury from a gravity fall exists, a mechanical restraint device, e.g. a scotch shall be provided to be inserted in the guillotine shear for use during repair or any necessary intervention between the tools other than normal manual feeding.		P
5.2.6.2	Where the device is not capable of absorbing the entire guillotine shear force, it shall be interlocked to the guillotine shear control so that a closing stroke cannot be performed while the device is in position, and the beam is retained in the upper position (see EN 1037).		P
5.3	**Mechanical hazards in the blade and associated area**		
5.3.1	The major danger zone at guillotine shears is the blade and associated area and protective measures need to be taken to deal with the relevant hazards. This sub-clause indicates how the hazards in the blade and associated area shall be safeguarded. No safeguarding is required where the gap between the closing surfaces cannot exceed 6 mm.		P



Key

1 Crushing hazard
2 Shear hazard
3 Moving blade
4 Moving clamp
5 Fixed guard

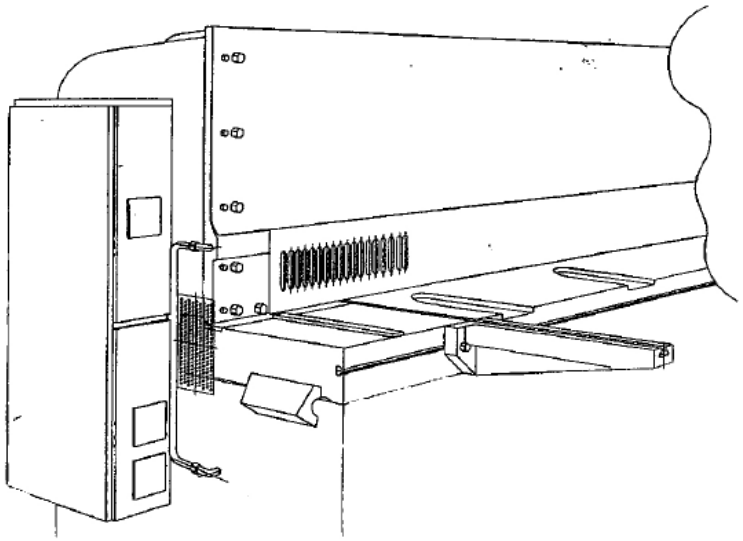
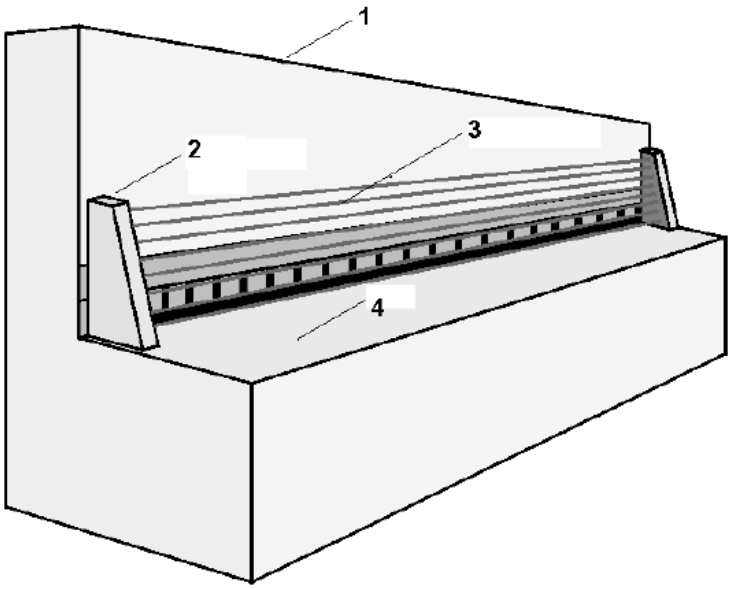
NOTE See Table 2 for values of A and B.

Figure 2 — Feed opening in a fixed guard at the front side of a guillotine shear

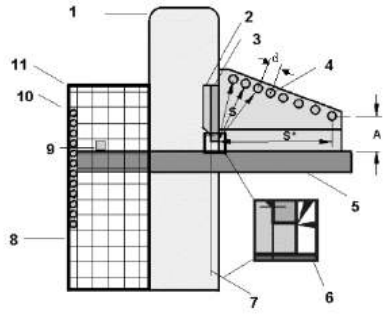
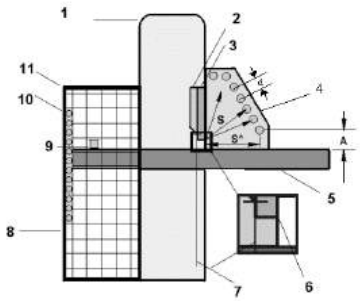
Table 2 — Height of feed openings and minimum related safety distances

A – Height of feed opening (mm)	B – Minimum related safety distance (mm)
A ≤ 6	0
6 < A ≤ 7	15
7 < A ≤ 8	20
8 < A ≦ 10	40
10 < A ≤ 12	65
12 < A ≤ 16	90
16 < A ≤ 20	120
20 < A ≤ 22	165
22 < A≤ 32	190
32 < A ≤ 35	230
35 < A ≤ 38	320
38 < A ≤ 48	400
48 < A ≤ 55	450
55 < A ≦ 120	850

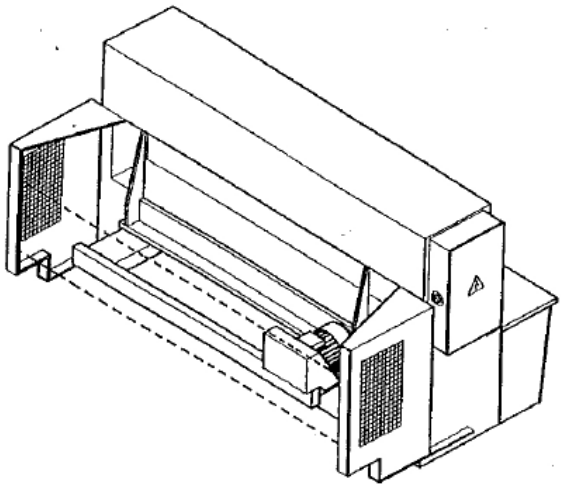
NOTE See Figure 2 for understanding of A and B.

	For guillotine shears with height of feed opening A exceeding 38 mm safeguarding by interlocking guards or ESPE using AOPD is recommended.  **3a - Example of safeguarding using fixed guards**  **Key** 1 Machine 2 Light curtain 3 Detection zone 4 Table **3b - Example of safeguarding using light curtain** **Figure 3 — Guards fitted to guillotine shears to prevent front and side access**		
5.3.2	Guards and devices described in EN 292, EN 953,and 5.3.3.1, 5.3.5, 5.3.6.1 which are appropriate to the protection of any exposed person at the cutting area are listed below. Designers, manufacturers and suppliers shall provide wherever possible fixed guards to prevent access of exposed persons to the moving parts. Where fixed guarding is not practicable, designers, manufacturers, and suppliers shall select safeguarding methods which reduce the risks as far as possible, considering the principal hazards and the mode of production:		P

	a) interlocking guards (see EN 292, EN 953, EN 1088, 5.3.3.2, 5.3.3.3, 5.3.6.2); b) electro-sensitive protective devices (see EN 61496–1, pr EN 61496–2, 5.3.3.4, 5.3.6.3).		
5.3.3	Access from the front		
5.3.3.1	General		
	The selected combination of safeguarding methods shall protect all exposed persons, (i.e. those who can gain access to the danger zone during operation, setting, maintenance, cleaning and inspection activities), as described in 4.2. The provided guards and protective devices shall be at least interfaced with the control system of the guillotine shear in the same category as required for these guards and devices. The machine front table extension shall exceed the front safeguarded area. The relationship between the dimension of the feed opening and the distance to the nearest danger point (plate clamps/cutting line) shall follow Table 2 (see also Figure 2.).		P
5.3.3.2	Fixed guards		
	Where a fixed guard is used it shall prevent access from the front of the guillotine shears to the danger zone (nearest danger point) created by the moving blade and plate clamps. Fixed guards shall comply with EN 292, EN 953 and 5.3.2, 5.3.5, 5.3.6.1. They shall be firmly secured to the machine. The openings giving access to danger zones and related safety distances of the fixed guard shall comply with Table 4 of EN 294:1992. The design of the fixed guard shall allow good visibility of the cutting line. Access shall be prevented to the danger zone via slots or grooves cut in the surface of the work table (see also Table 2).		P
5.3.3.3	Interlocking guards without guard locking		
	Interlocking guards without guard locking shall comply with EN 953 and prevent, in conjunction with fixed guards, access to the danger zone (clamps, cutting line) during any hazardous movement. Initiation of the stroke shall be prevented until the guard gate is closed. The associated interlocking devices shall conform to EN 1088 and be designed and constructed in accordance with 6.2.2 of EN 1088:1995. The associated control system of the guillotine shear shall conform to category 4 of EN 954-1:1996. Interlocking guards without guard locking shall be placed in such a position that the operator does not have time to reach the danger zone before any hazardous movement in the tools area has ceased. Calculation of the safety distance shall be based on the overall response time of the guillotine shear coming to a stop and on the speed of movement of the operator. See EN 999 and annex A.		P
5.3.3.4	ESPE using AOPDs in the form light curtains		
	ESPE using AOPDs in the form of light curtains shall comply with the following: a) light curtains and light beams shall conform to type 4 in accordance with 4.2.2.5 of EN 61496-1:1997, and be designed and constructed according to pr EN 61496-2:1997. The associated part of the control system of the guillotine shear shall conform to category 4 of EN 954-1:1996; b) access to the danger zone shall only be possible through the detection zone of the light curtain. Additional safeguarding shall prevent access to the danger zone from any other direction. The minimum safety distance for the position of the light curtain shall be determined according to annex A; c) the design of the guillotine shear shall ensure that the feed table does not allow persons to stand between the light curtain and the danger zone (see Figure 4). The gap between the front		P

	light beam and the table shall conform to the maximum distance set out in Table 2. The minimum safety distance for the position of the front light beam shall be determined according to annex A with the additional distance C indicated in Figure 4; d) it shall not be possible to initiate any hazardous movement while any part of the body is interrupting the light curtain; e) the means of resetting shall be so positioned that, from that position, there is a clear view of the danger zone. There shall not be more than one reset control device on each detection zone. If the guillotine shear also is safeguarded by means of back AOPDs, a reset control device shall be provided on each detection zone. ESPE using AOPDs in the form of light curtains shall be placed in such a position that the operator does not have time to reach the danger zone before any hazardous movement in the tools area has ceased. Calculation of the safety distance shall be based on the overall response time of the guillotine shear coming to a stop and on the speed of movement of the operator. See EN 999 and annex A. The minimum safety distance shall never be less than 100 mm.  Figure 4a  Figure 4b If A ≤ d then :$S^* = S = (k \times T) + C$ (see Table A1). If A ≥ d then :$S^* = (k \times T) + C$ (see Table A1). If 40 < A ≤ 55 then $S^* = (k \times T) + 450$ If 55 < A ≤ 100 then $S^* = (k \times T) + 850$ The minimum safety distances S and S^* shall never be less than 100 mm. The value of the detection capability as well as the gap between the front light beam and the table shall never exceed 100 mm. **Key** 1 Machine 2 Beam 3 Clamp 4 Light curtain 5 Front table 6 Point of danger (reference for calculation of S ;S') 7 Cutting line 8 Rear side 9 Gauges 10 Light curtain 11 Fixed guard **Figure 4 — Examples of safeguarding using light curtain**		
5.3.4	Where a guillotine shears is provided with adjustable work-piece supports in front of the guillotine shear and back gauges, the design of those back gauges, even where rear work-piece supports are provided, shall be such that it is impossible to adjust them by reaching between the tools. The design of back gauges (powered or not) and rear work-piece supports (if provided) shall be such that it is impossible to adjust them by reaching under the blade.		P
5.3.5	Access from the side		
	Fixed guards shall prevent access to the danger areas created by the blades and clamps from		P

	the sides of the machine (see Figure 3).		
5.3.6	Access from the rear		
5.3.6.1	General		
	Access to the moving blade and powered back gauges and auxiliary devices from the rear shall be prevented (see Figure 5). This shall be done using one or more of the following means: a) fixed guards (see EN 294, EN 953 and 5.3.6.1); b) interlocking guards or interlocking in conjunction with fixed guards (see EN 953, EN 1088 and 5.3.6.2); c) ESPE using AOPDs (see EN 61496-1, prEN 61496-2 and 5.3.6.3). Where it is not possible to operate with a fixed guard, an interlocking guard or an ESPE using AOPD may be provided.		P
5.3.6.2	Fixed guards		
	Fixed guards at the rear of the machine shall be provided to prevent access to the blades and powered back gauges from the rear, and to allow the cut sheet metal to be discharged to a safe place. The relationship between the opening beneath the fixed guard and the distance from the edge of the guard to the nearest danger point and the combination of shielding shall conform to the safety distance in EN 294. The openings in fixed guards shall conform to the safety distances of EN 294:1992 Table 4 and EN 811.		P
5.3.6.3	Interlocking guards or interlocking guards in conjunction with fixed guards		
	Where an interlocking guard is provided and the guard is opened, all dangerous movement shall come to a stop. It shall be ensured that until the guard is closed, the blade, powered back gauges and ancillary devices cannot be set in motion i.e. the guard shall be interlocked in accordance with EN 1088. If whole body access is possible inside the guarded area, a separate reset control is required. The reset and interlocking functions shall fulfil at least S & M (single channel and monitored) e.g. one switch of positive opening type associated to redundant relay(s). The reset device shall be located outside the reach from the guarded area with a good view to it.		P
5.3.6.4	ESPE using AOPDs		
	Where an ESPE using an AOPD is provided it shall prevent access to the hazardous movement of the blade, powered back gauges and ancillary devices at the rear of the guillotine shear. This shall be a system using at least two separate light beams (see 6.1.4 of EN 999:1998). The required safety distance to the nearest trapping point shall be at least 1000 mm when three beams are used; at least 1 200 mm when two beams are used or the safety distance calculated on the basis of the overall response time of the guillotine shear coming to a stop and on the speed of the movement of the operator according to EN 999 and annex A shall be used, the largest of them. It shall be at least a type 2 in accordance with EN 61496-1 and pr EN 61496-2 unless the multiple light beams are achieved by only one emitter/receiver, in which case a type 4 shall be provided. This AOPD type 2 shall be tested automatically at each machine power on and if a multiple light beam is achieved by one emitter/receiver it shall be fitted preferably on a separate support. A reset at the rear of the guillotine shear shall be provided (see 5.4.1.2). The reset functions shall at least fulfil S&M (single channel and monitored). The reset device shall be located outside the reach from the guarded area with a good view to it.		P
5.3.7	At the rear, arrangements, e.g. a chute, shall be provided to reduce the risk of injury from falling cut workpieces		P

	 Figure 5 — Example of ESPE using AOPDs in combination with rear side guards (see 5.3.6.3)		
5.3.8	If the work performed on the guillotine shear requires access to the danger zone from more than one side, the provision of 5.3.3 shall apply on both sides.		P
5.3.9	Where on a guillotine shear the single cycle mode of operation is selected only a single stroke of the blade and clamp shall be possible even if the control device is continuously actuated.		P
5.3.10	Clamping devices		
	Means shall be provided to arrange that the sheet material be clamped before the cutting operation.		P
5.3.11	Other requirements		
5.3.11.1	The blades shall not be fitted by friction only.		P
5.3.11.2	All fastenings on the guillotine shear, such as screws, nuts or glued joints, shall be assembled in such a way that parts will not loosen and cause injury.		P
5.4	**The control and monitoring system**		
5.4.1	Control and monitoring functions		
	This sub-clause applies to all safety related components which directly or indirectly control or monitor the functioning of moving parts of the guillotine shear or its tools. EN 60204-1 shall be followed for the design of electrical systems and EN 954-1 for the safety related parts of the electrical, hydraulic, pneumatic, and mechanical systems.		P
5.4.1.1	Control systems shall include safety functions designed in such a way that controls have to be reactuated in order for the guillotine shear to perform a stroke: a) after changing the mode of control or operation; b) after an interlocking guard has been closed; c) after a manual reset of the safety system (see 5.4.1.2); d) after an operating power failure; e) after a primary pressure failure.		P
5.4.1.2	In the event of an intervention of a safety system (interlocking guard, ESPE using the AOPD), separate manual reset functions are required to restore the normal intended operation: a) if a person can pass through the interlocking guard and fully enter the danger zone; b) if an ESPE using the AOPD is interrupted during any hazardous movement in the cycle; c) if an ESPE using the AOPD protects sides of the guillotine shear from which the guillotine shear is not operated.		P

	Reset control shall be within viewing distance of the danger zone, but out of reach from the danger zone. The reset functions shall fulfil at least a single channel with monitoring (S&M) (see 5.4 of EN 954-1:1996).		
5.4.1.3	This sub-clause applies to guillotine shears fitted on the operator's side with protective devices of the following types, namely: – ESPE using AOPDs; – interlocking guards without guard locking. For machines fitted with these protective devices at a non-operator's side 5.3.6.2 and 5.3.6.3 apply. If a fault occurs in the safety related parts of these protective devices or control system then: a) an unintended start-up shall not be possible; b) the safety functioning of the protective device shall be maintained; c) it shall be possible to stop the machine during the hazardous movement; d) the control system shall stop the machine immediately during the hazardous phase of the closing stroke or, in other cases1), at the latest at the end of the operating cycle; e) the control system shall prevent any initiation of the next operating production cycle until the fault is eliminated. The start and stop functions of interlocking guards or ESPE using AOPD in the safety related parts of the guillotine shear control system shall be redundant and monitored (R&M). This means category 4 according to EN 954-1:1996. In the electrical system, the start and stop functions shall be hardwired. In a pneumatic guillotine shear control system, the valve state shall be monitored by pressure signals or by detection of its position or shall have an inherent monitoring system in which valve failure is self-revealing.		P
5.4.1.4	Where a redundant and monitored control system is required, it shall operate in two separate operating systems. Either system shall be independently capable of stopping the hazardous movement, irrespective of the condition of the condition of the other. Failure of either system shall be detected through monitoring, and another closing stroke prevented. If failure of either system is self-revealing, i.e. the loss of the function itself prevents the next operating cycle, further monitoring of that system is not required.		P
5.4.1.5	The control system of the programmable back gauges and powered work-piece supports shall conform at least to category B of EN 954-1:1996.		P
5.4.2	Programmable electronic systems (PES), programmable pneumatic systems (PPS) and safety related functions.		
5.4.2.1	The use of PES and PPS shall not reduce any level of safety laid down in this standard.		P
5.4.2.2	Where a guillotine shear is controlled by a PES or a PPS, the safety related part of the control system shall not rely solely on the PES or PPS.		P
5.4.2.3	Monitoring functions may be achieved by a PES or a PPS.		P
5.4.3	Selector switches		
5.4.3.1	Where there is a choice of modes of operation, cycle initiation or safety system of the guillotine shear (e.g. setting mode, single cycle, automatic cycle), selector switches shall be provided. The control system shall ensure that start-up is not initiated when the selector switch is operated (see 5.4.1.1).		P
5.4.3.2	Where one selector switch is provided, it shall be used to select the appropriate mode of safeguarding, which can be two or more guards or protective devices (see 5.3.3). Where two or		

	more selector switches are provided and the mode of safeguarding is connected to the control system, the chosen mode of operation shall be automatically linked to the corresponding mode of safeguarding (e.g. interlocking guard with guard locking in automatic cycle and light curtain in single cycle). The selector switch shall not override any safeguarding of the guillotine shear unless additional safeguarding is provided (e.g. perimeter fencing).		
5.4.3.3	If the guillotine shear is designed to be operated also by more than one operator, the level of protection shall be the same for each operator.		P
5.4.3.4	Electrical selector switches shall be in accordance with 9.2.3 of EN 60204-1:1997. The design of electrical selectors switches shall ensure that, for each position not in use, circuits are completely isolated by positively operated contacts, or by redundant and monitored hardware; if the switch is set in an intermediate position, no operation shall be possible.		P
5.4.3.5	The selector switch shall give a clear indication and be key operated (e.g. key switch, password).		P
5.4.4	Position switches		
	The means of operation of the switch and the switch itself shall be designed to maintain, after setting their position, their correct relationship to one another, the operating cam and particularly the stroke. For electrical position switches, see 10.1.4 of EN 60204-1:1997. Using a pneumatic valve as a position switch, the same requirements shall be achieved. Overrun detection shall be provided for machines equipped with ESPE using AOPD and/or interlocking guards: if the crankshaft overruns its normal stopping position by an amount specified by the manufacturer a stopping signal shall be immediately initiated and the machine shall stop at the TDC. No new cycle initiation shall be possible.		P
5.4.5	Control devices		
5.4.5.1	Start control devices such as push buttons and foot switches shall be shrouded to prevent inadvertent operation. Foot switches shall permit access from one direction only and by one foot only. Treadles shall not be used.		P
5.4.5.2	Emergency stop shall function as a category 0 stop according to 4.1.5 of EN 418:1992. The emergency stop shall stop all hazardous movements (e.g. beam, back gauges, supports, integral handling devices). A category 1 emergency stop function complying to 9.2.2 and 9.2.5.4.2 of EN 60204-1:1997 may be used for electronic controlled drives example on machines equipped with automatic feed and/or removal systems or electrical drive of the stroke.		P
5.4.6	Valves		
	Manual override devices shall not be fitted to restraint valves. If manual override devices are incorporated into other valves for test or maintenance purposes, they shall require the use of a tool to effect the override. This override shall be of the non-locking type.		P
5.5	**Tool-setting, trial strokes, maintenance and lubrication**		
5.5.1	The guillotine shear shall be designed so that blade changing (see 7.2.2 l)) maintenance and lubrication can be carried out safely. The need for access and manual intervention during blade changing and maintenance shall be minimised, e.g. an automatic system or remote application may be used for lubrication.		P
5.5.2	The guillotine shall be designed so that all maintenance work can be carried out with the power removed from the machine, unless it is absolutely necessary to make adjustments to machine parts under power. Facilities shall be provided to allow the movement of the blade, beam and back gauges during setting maintenance and lubrication to be carried out with guards and protecting devices in position and operational. Where this is not practicable at least one of the		P

	following facilities shall be provided at the setter position: a) hold-to-run control device or; b) an inching device. For tool setting the devices in a) or b) above shall be positioned at the tool setter position (front or back) and only movements of the blade shall be possible.		
5.5.3	Hold-to-run control devices and inching devices shall be hardwired and the safety related parts of the control system shall conform to category 1 of EN 954-1:1996.		P
5.5.4	The slide/ram movement shall not exceed 6 mm per inching step.		P
5.5.5	If a bar or other device is used to rotate the crankshaft by hand: a) when the main motor is switched off, a device shall prevent re-engagement of the clutch before the flywheel has come to rest. This device may be a motion detector, and the safety related part of the control system shall conform to category 1 of EN 954-1 or the electrical drive control system shall have an integrated speed monitoring which conform to category 3 of EN 954-1:1996; b) it shall not be possible inadvertently to leave the bar in position during normal operation; c) it shall be possible to see at least part of the flywheel to ensure that it is stationary.		P
5.5.6	For adjustment of the blade gap arrangements shall ensure that insertion of feeler gauges between the blades at the cross-over point as it progresses along the length of the blade cannot be carried out unless the beam is moved under controlled conditions (see also 5.5.2).		P
5.6	**Mechanical hazards - Other**		
5.6.1	Access to danger zones at drive and transmission machinery of guillotine shears, and at ancillary devices which are an integral of the guillotine shear shall be prevented at least by means of either: a) fixed guards, where access is required once or less than once per shift (see 6.4.1 of EN 953:1997); b) movable guards interlocked with the control system, where access is required more than once per shift (see 6.4.1 of EN 953:1997); c) an interlocking guard with guard locking and delayed unlocking, if the dangerous movement does not come to a rest before the danger zone can be reached (see 7.3 of EN 1088:1995). The delayed unlocking shall be arranged in such a way that a timer or a motion detector controls the guard locking; d) ESPE using AOPDs (see EN 999:1998). For safeguarding the rear side of a guillotine shear, see 5.3.6.3. For fixed or interlocking guards safety distances against reaching over, reaching under, reaching around and reaching through openings shall be in accordance with EN 294:1992. For reaching over physical barriers, the safety distances shall conform to Table 2 of EN 294:1992.For reaching through ESPE using AOPD the minimum safety distances shall be calculated according to EN 999.		P
5.6.2	Interlocking devices shall conform to the requirements of EN 1088 and their control circuit(s) to at least category 1 of EN 954-1.		P
5.6.3	Ancillary devices which are not controlled by the guillotine shear shall be additionally interlocked to the guillotine shear control system so that during any intervention no hazardous situation can arise. See 1.4.		P
5.7	Slips, trips and falls		

Standard: EN 60204-1:2018, EN ISO 12100:2010, EN 13985:2003+A1:2009			
Clause	**Requirement-Test**	**Result**	**Verdict**
5.7.1	Where raised work stations are provided with the guillotine shear, they shall be provided with adequate guardrails and toe-boards. Safe means of access shall be provided to the work station according to EN ISO 14122. NOTE Adjustment during tool setting, daily inspections and lubrication on raised workstations require a platform and a permanent access. For repair only, no platform is required.		P
5.7.2	Operator's position at guillotine shear shall be designed, constructed and supplied so as to minimise the risk of slips, trips and falls in the guillotine shear areas if these areas are integral parts of the guillotine shear (e.g. by use of profiled slip-resistant flooring).		P
5.8	Protection against other hazards		
5.8.1	Electrical hazards		
	All electrical equipment shall be designed and constructed to prevent electrical hazards (e.g. shock) see EN 60204-1:1997 (see 5.2.5).		P
5.8.2	Thermal hazards		
	Means shall be taken by shielding, insulation or otherwise to prevent burns by accessible parts of the guillotine shear, e.g. metal parts of the hydraulic system, which can reach temperatures higher than 64°C with a contact period of 4 s according to EN 563.		P
5.8.3	High pressure fluid ejection hazards		
	Additional shielding, e.g. screens, shall be provided to flexible piping installed adjacent to an operator´s working position to reduce the risk resulting from a failure in the flexible piping system.		P
5.8.4	Loss of stability/overturning of machinery		
	The designer of a guillotine shear shall ensure stability including work loads, either by design or by provision of fixing points to allow connection to the floor/foundation (see 7.2.2 d)).		P
5.8.5	Hazards generated by noise		
5.8.5.1	The guillotine shear shall be so designed and constructed that risks resulting from the emission of airborne noise are reduced to the lowest level taking account of technical progress and the availability of means of reducing noise, in particular at source. When designing a guillotine shear, the information and technical measure to control noise at source given in EN ISO 11688-1:1998 and EN ISO 11688-2:1998 shall be followed.		P
5.8.5.2	The design shall take into account noise from each source. Appropriate technical measures for reducing noise at the main sound sources of the guillotine shear are listed below: a) fluid transmission damping facilities; b) motor and pump acoustic panels (partial or total), anti-vibration mounts; c) transmission noise flywheel and gearwheel damping facilities; d) pneumatic exhaust silencers; e) power generation source acoustic panels (partial or total); (e.g. hydraulic unit) f) noise at the clamps area damping facilities at the clamps; g) noise at the blades area – h) falling work-pieces damping facilities; i) feeding and transfer systems acoustic enclosures, damping facilities; j) structurally transmitted noise anti-vibration machine mounts. Additional or alternative measures giving an identical or higher noise reduction efficiency can be used. In any case, declared noise emission values are the decisive criterion for the noise emission of a given machine.		P

5.8.5.3	The measurement of noise emission values shall be made according to EN ISO 11202 and, if required, to EN ISO 3746. For very large machines where EN ISO 3746 is not applicable, the determination of sound pressure level shall be done at least: – at a minimum of 5 positions; – located 1,6 m above the reflecting plane; – at a distance of 1 m from the machine (e.g. in front of the control panel). The measurement shall be made during idling and 3 work cycles. The minimum information to be provided in the test report concerning the measurement of airborne noise emissions is the following: – machine data: a) identification of the manufacturer; b) year of construction; c) designation of series or type; d) serial/prototype number of the guillotine shear under test; e) nominal capacity (e.g. thickness and material); f) maximum number of strokes per minute; – operating conditions during measurement: g) strokes per minute; h) description of installation mounting and operating conditions (descriptions of work cycle) (see annex D: D.1, D.2, D.3, D.5); i) force applied in kN; j) specification of the material used for operation during measurement; k) test conditions without load (idle running); – measurements: l) location of the guillotine shear under test, with respect to the reflecting plane [see annex D]; m) measurement procedure [see annex D]; reference to the noise emission standards applied; n) description of microphone positions, work stations and other specified positions [see annex D]; o) measurement time [see annex D]; – results: p) the background sound pressure levels, if the correction factor is required; q) the equivalent continuous A-weighted sound pressure level in the operator砖 position; r) the peak C-weighted instantaneous sound pressure level in the operator砖 position; s) !the sound power emitted where the equivalent continuous A-weighted sound pressure level exceeds 80 dB (A)." NOTE Information on the conditions for noise measurement of guillotine shears is given in annex D. For declaration, see 7.2.2 g).		P
5.8.6	Hazards generated by lasers		
	If the guillotine shear is fitted with a laser (e.g. to indicate the cutting line), the laser shall be of category III A or lower category in accordance with EN 60825-1.		P
5.8.7	Hazards generated by materials and substances		
5.8.7.1	Asbestos linings for clutch and brake shall not be used.		P

5.8.7.2	Adequate means shall be provided to prevent the formation of aerosols and respirable oil mists in unhealthy concentration, e.g. from oil used to lubricate pneumatic systems.		P
5.8.8	Hazards generated by neglecting ergonomic principles		
5.8.8.1	The guillotine shear and its controls shall be designed to provide a good work posture which is not fatiguing.		P
5.8.8.2	The positioning, labelling and illumination of control devices, and facilities for materials and tool set handling shall be in accordance with ergonomic principles.		P
5.8.8.3	Where necessary on the guillotine shear, work stations and the zones in which control devices, guards and protective devices are located shall be lit sufficiently to ensure that all work equipment and materials can be properly seen, and that eye strain is also avoided. In the tools area, at least 300 lux shall be achieved according to EN 1837:1999 and 7.2.2 d).		P
5.8.8.4	Parts of the guillotine shear which weigh more than 25 kg and require to be lifted with a lifting device shall include necessary attachments to accommodate the fitting of a lifting device according to prEN 1005-2.		P
5.8.8.5	Tanks containing hydraulic fluid shall be placed or oriented in such a way that the filler and drainpipes can be easily reached.		P
5.8.8.6	Further guidance on ergonomic principles shall be as given in EN 60204-1, EN 614-1, EN 894-2 and EN 894-3. **Table 3 — Requirements for safeguarding from the front side for different modes of operation - Single cycle or automatic cycle, manual feed** **Protective measure (note 1)** / **Cycle initiation** / **Start and stop function (note 2)** — **El.** / **Hydr./Pneu.** / **Remarks** Fixed guard — Any — S — S — See 5.3.3.2 Interlocking guard without guard locking — Any other than the guard itself — R&M — R&M — See 5.3.3.3 ESPE using the AOPD — Any other than the protective device itself — R&M — R&M — See 5.3.3.4; Use of appropriate safety distance SYMBOLS a) **El.** = electrical b) **Hydr.** = hydraulic c) **Pneu.** = pneumatic (e.g. valve) d) **M** = monitoring (see 3.1.9) e) **R** = redundancy (see 3.1.12) f) **S** = single channel NOTE 1 For tool setting, see 5.5. NOTE 2 See 5.4.1 for the objectives of the control system. **Table 4 — Requirements for safeguarding from the front side for different modes of operation - automatic cycle, solely automatic feed** **Protective measure (note 1)** / **Cycle initiation** / **Start and stop function (note 2)** — **El.** / **Hydr./Pneu.** / **Remarks** Fixed guard — Any — S — S — See 5.3.3.1 Interlocking guard without guard locking — Any other than the guard itself — R&M — R&M — See 5.3.3.3 ESPE using the AOPD — Any other than the protective device itself — R&M — R&M — See 5.3.3.4; Use of appropriate safety distance **SYMBOLS** a) **El.** = electrical b) **Hydr.** = hydraulic c) **Pneu.** = pneumatic (e.g. valve) d) **M** = monitoring (see 3.1.9) e) **R** = redundancy (see 3.1.12) f) **S** = single channel NOTE 1 For tool setting, see 5.5. NOTE 2 See 5.4.1 for the objectives of the control system.		P
6	**Verification of the safety requirements and/or protective measures**		
	Table 5 indicates by crosses the method(s) by which the safety requirements and measures		P

described in clause 5 shall be verified, together with a reference to the corresponding sub-clauses in this standard.

Table 5 — Means of verification of the safety requirements and/or protective measures

Sub-clause	Safety requirements and/or protective measures	Visual inspection (note 1)	Performance check/test (note 2)	Measurement (note 3)	Drawings/ Calculations (note 4)
5.2	**BASIC DESIGN CONSIDERATIONS**				
5.2.1	**Brakes and clutches**				
5.2.1.1	Pressure media	x	x	x	x
	Diaphragms	x			
5.2.1.2 a)	Compression springs in the brake	x			x
	Compression springs in the clutch	x			x
5.2.1.2 b)	Multiple spring assemblies	x			x
5.2.1.2 c)	Uniform springs	x		x	
5.2.1.2 d)	Prevention of slackening back	x			x
5.2.1.2 e)	Spring housing and guiding	x			x
5.2.1.2 f)	Function with 50 % springs	x	x		x
5.2.1.3	Safe function	x	x		x
5.2.1.4	Consequential failure	x		x	x
5.2.1.5	Dissipation of heat	x			x
5.2.1.6	Prevention of lubricant penetration	x			x
5.2.1.7	Foreign matters	x	x		x
5.2.1.8	Band brakes	x			
5.2.1.9	Clutch capacity	x	x	x	x
5.2.1.10	Working clearances	x	x	x	
5.2.1.11	Accumulation and dispersal of debris	x	x		x
5.2.1.12	Failure of energy supply	x	x		x
5.2.1.13	Sharp edges and rough surfaces	x	x		x
	Evacuation of air	x	x		x
5.2.2	**Hydraulic and subsidiary pneumatic systems - Common Features**				
5.2.2.2	Filters	x			x
	Pressure regulators	x	x		x
5.2.2.3	Pressure range devices	x	x		x
5.2.2.4	Pressurised transparent bowls	x			
5.2.2.5	Burrs or foreign matters	x			x

Table 5 *(continued)*

Sub-clause	Safety requirements and/or protective measures	Visual inspection (note 1)	Performance check/test (note 2)	Measurement (note 3)	Drawings/ Calculations (note 4)
5.2.2.6	Continuous piping	x			
	Thermal expansion	x			x
	Rigid piping supporting	x			x
	Kinking of flexible pipes	x	x	x	
5.2.2.7	Pipes and pipe connections	x			x
5.2.2.8	Operating valve supporting	x			x
5.2.2.9	Escape of leakage	x			
5.2.2.10	Inlet port and exhaust ports	x			x
5.2.2.11	Exhaust from cylinders	x	x		x
	Valve exhaust ports	x	x		x
5.2.2.12	Control valves location	x			
5.2.2.13	Valve restoring	x	x		x
5.2.3	**Pneumatic systems (EN 983)**				
5.2.3.1	Visible means of lubrication	x			x
5.2.3.2	Non-logging silencers	x	x		x
5.2.3.3	Water separators	x			x
5.2.4	**Hydraulic systems**				
5.2.4.1	Pressure limiting valve	x	x		x
5.2.4.2	Accumulators discharge	x	x		x
5.2.4.3	Pressure relief valve	x	x	x	x
5.2.5	**Electrical systems**				
5.2.5.2	Emergency stop, category 0 stop, see 5.4.5.2	x	x		x
5.2.5.3	Protection for operator interface IP 54	x			x
5.2.5.4	Protection of control gear IP 54	x			x
5.2.5.5	Identification of conductors	x			x
5.2.5.6	Prevention of an unexpected start-up	x			x
5.2.6	**Prevention of unintended gravity fall**				
5.2.6.1	Mechanical restraint device	x		x	x
5.2.6.2	Interlocking	x	x		x
5.3	**MECHANICAL HAZARDS IN THE BLADE AND ASSOCIATED AREA**				
5.3.1	Gap not exceeding 6 mm	x	x	x	x
5.3.2	Protection of exposed persons	x			x

Table 5 *(continued)*

Sub-clause	Safety requirements and/or protective measures	Visual inspection (note 1)	Performance check/test (note 2)	Measurement (note 3)	Drawings/ Calculations (note 4)
5.3.3	**Access from the front**				
5.3.3.1	Fixed guards	x	x	x	
5.3.3.2	Interlocking guard with guard locking	x	x		x
5.3.3.3	Interlocking guard without guard locking	x	x	x	x
5.3.3.4	**AOPDs (ESPE)**				
5.3.3.4 a)	Type 4	x			
5.3.3.4 b)	Possible access	x		x	
5.3.3.4 c)	Possible standing position	x		x	
5.3.3.4 d)	Initiation prevention	x	x		x
5.3.3.4 e)	Reset function	x	x	x	x
5.3.4	Adjustable work-piece supports and back gauges	x	x		x
	Power operated back gauges	x	x		x
5.3.5	**Access from the side**				
	Fixed guards/slots (EN 294)	x		x	x
5.3.6	**Access from the rear**				
5.3.6.1	Fixed guards	x		x	x
5.3.6.2	Interlocking guards	x		x	x
5.3.6.3	AOPDs (ESPE)				
	Type 2, type 4	x			
	2 beams / 3 beams	x	x	x	x
5.3.7	Rear arrangements	x			x
5.3.8	Continuous stroking	x	x		x
5.3.9	Blade to rest immediately	x	x		x
5.3.10	Access from more than one side, operators protection	x	x		x
5.3.11	Single stroke devices	x	x		x
5.3.12	Clamping devices	x	x		x
5.3.13	**Other requirements**				
5.3.13.1	Blades fitted not by friction only	x			x
5.3.13.2	Fastenings	x			
5.4	**THE CONTROL AND MONITORING SYSTEM**				
5.4.1	**Control and monitoring functions**				
5.4.1.1	Re-actuation of controls	x	x		x

Table 5 *(continued)*

Sub-clause	Safety requirements and/or protective measures	Visual inspection (note 1)	Performance check/test (note 2)	Measurement (note 3)	Drawings/ Calculations (note 4)
5.4.1.2	Manual reset functions	x	x		x
5.4.1.3	Fail-safe condition, redundant and monitored functions	x	x		x
5.4.1.4	Two separate functioning systems	x	x		x
5.4.1.5	Programmable gauges and work-piece supports, category B	x			x
5.4.2	**Programmable systems and safety related functions**				
5.4.2.2	Safety related functions	x			x
5.4.2.3	Monitoring functions	x			x
5.4.3	**Selector switches**				
5.4.3.1	Selector switch	x			x
	No start up initiated	x	x		x
5.4.3.2	Selection of safeguarding modes	x	x		
	Operation/safeguarding linking	x	x		
5.4.3.3	Same protection for each operator	x	x		x
5.4.3.4	Isolation of circuits	x	x		x
	Positively operated contacts	x	x		
	Redundant and monitored hardware	x	x		
	Intermediate position				
	No start-up initiated	x	x		x
5.4.3.5	Visibility and identification	x	x		
5.4.4	Position switches - Relationship	x	x	x	x
5.4.5	**Control devices**				
5.4.5.1	Adequate shrouding	x		x	x
5.4.5.2	Emergency stop of all hazardous movements, category 0	x	x		x
	Tools for manual override of other valves	x	x		x

(continued)

Table 5 *(continued)*

Sub-clause	Safety requirements and/or protective measures	Visual inspection (note 1)	Performance check/test (note 2)	Measurement (note 3)	Drawings/ Calculations (note 4)
5.4.6	**Valves**				
	No manual override on restraint valves	x			
5.5	**TOOLSETTING, TRIAL STROKES, MAINTENANCE, LUBRICATION**				
5.5.1	Minimised need for access	x			x
5.5.2	Movement of the beam with guards and protective devices operational according to 5.3.2	x			x
5.5.2 a)	Hold-to-run control in conjunction with slow speed	x	x	x	x
5.5.2 b)	Inching device	x	x	x	x
5.5.3	Hold to run and inching hard wired	x			x
5.5.4	Inching movement ≤ 6 mm	x		x	
5.5.5 a)	Prevention of clutch re-engagement	x	x		x
	Timer/motion detector monitored	x	x		x
5.5.5 b)	Bar removal	x	x		
5.5.5 c)	View of the flywheel	x			x
5.5.6	Adjustment of blade gap	x	x		(x)
5.6	**MECHANICAL HAZARDS - OTHER**				
5.6.1	**Ancillary devices**				
5.6.1 a)	Fixed guards	x		x	x
5.6.1 b)	Movable interlocking guards	x	x	x	x
5.6.1 c)	Interlocking guards with guard locking	x	x	x	x
5.6.1 d)	AOPDs (ESPE)	x	x	x	x
5.6.2	Interlocking devices of category 1	x	x		x
5.6.3	Ancillary devices interlocking	x	x		x
5.6.4	Ejection hazards	x	x		x
5.7	**SLIPS, TRIPS AND FALLS**				
5.7.1	Guard rails and toe-boards	x		x	x
	Means of access	x		x	x
5.7.2	Shear area	x			x
5.8	**PROTECTION AGAINST OTHER HAZARDS FROM:**				
5.8.1	Electrical	x	x	x	x

(continued)

Table 5 *(concluded)*

Sub-clause	Safety requirements and/or protective measures	Visual inspection (note 1)	Performance check/test (note 2)	Measurement (note 3)	Drawings/ Calculations (note 4)
5.8.2	Thermal hazards	x			x
5.8.3	High pressure fluid ejection	x			x
5.8.4	Stability/overturning	x			x
5.8.5	Noise	x	x	x	x
5.8.6	Lasers	x			x
5.8.7	**Hazards generated by materials and substances**				
5.8.7.1	Materials and substances	x			x
5.8.7.2	Asbestos linings				x
5.8.8	Neglect of ergonomic principles	x	x	x	x
7	**INFORMATION FOR USE**				
7.1	Marking	x			
7.2	Instruction handbook	x			
Annex A	Safety distances	x	x	x	x

NOTE 1 Visual inspection will be used to verify the features necessary for the requirement by visual examination of the components supplied.
NOTE 2 A performance check/test will verify that the features provided perform their function in such a way that the requirement is met.
NOTE 3 Measurement will verify by the use of instruments that requirements are met, to the specified limits.
NOTE 4 Drawings/calculations will verify that the design characteristics of the components provided meet the requirements.

7	**Information for use**		
7.1	**Marking**		
7.1.1	The general requirements laid down in 5.4 of EN 292-2:1991 and 1.7.3 of annex A of EN 292-2/A1:1995 shall be followed and EN 61310-2 shall be taken into consideration.		P
7.1.2	The guillotine shear shall be marked with the following: a) !name and address of the manufacturer and, where applicable, business name and full address of the authorised representative;" b) year of construction; c) !the designation of machinery and the designation of series or type;" d) serial number; e) mass of the guillotine shear, without ancillary devices; f) mass of the major parts and ancillary devices which are intended to be removed using lifting equipment; g) maximum cutting capacity;		P

	h) nominal cutting length; i) supply data for electrical and pneumatic systems (air volume and air pressure); j) overall response time and corresponding safety distance(s) (see annex A).		
7.2	Instruction handbook		
7.2.1	The requirements laid down in 5.5 of EN 292-2:1991 and 1.7.4 of annex A of EN 292-2/A1:1995 shall be followed.		
7.2.2	The instruction handbook shall include the following information: a) a repeat of the information with which the guillotine shear is marked (see 7.1.2); b) a reference to this standard and any other standard used in the design of the guillotine shear; c) copies of any EC certification documents and reports on pressure vessel or control system tests from the Technical Construction File; d) instructions for safe transportation and installation (floor conditions, foundations, fixing points, services, antivibration mountings, lighting, etc.); e) instructions for how the initial test and examination of the guillotine shear and safeguarding system shall be carried out before first use and being taken into service; f) instructions on control systems including circuit diagrams for electrical, hydraulic and pneumatic systems. Where a PES or PPS is provided, the circuit diagrams shall show the clear relationship at the interface between any hardwired part and the PES or PPS; g) A declaration shall be made concerning the airborne noise emission as required by A.1.7.4 f) of EN 292-2/A1:1995 determined in accordance with the methods given in 5.8.5.3 and annex D and using the dual-number form as specified in EN ISO 4871. The declaration shall be accompanied by a statement of the measuring method and the operating conditions applied during the test and values of the uncertainties Kp (A) and Kw (A) using the dual number form according to EN ISO 4871:1996 as follows: 4 dB when using EN ISO 3746:1995; 5 dB when using EN ISO 11202:1996. For example: for a sound power level Lw (A) = 97 dB (measured value); uncertainty K = 4 dB for measurement made in accordance with EN ISO 3746:1995. If the accuracy of the declared emission values is to be verified, measurement shall be made using the same method and the same operating conditions. The noise declaration shall be accompanied by the following statement: "The figures quoted are emission levels and are not necessarily safe working levels. Whilst there is a correlation between the emission and exposure levels, this cannot be used reliably to determine whether or not further precautions are required. Factors that influence the actual level of exposure of the work-force include the characteristics of the work room, the other sources of noise, etc. i.e. the number of machines and other adjacent processes and the length of time of which an operator is exposed to the noise. Also the permissible exposure level can vary from country to country. This information, however, will enable the user of the machine to make a better evaluation of the hazard and risk". !NOTE Information on noise emission should also be provided in the sales literature." h) information on reduction of noise emission, see 5.8.5.2; i) details of any further protection for the operator which may be necessary to deal with residual		P

	risks, e.g. hearing protection, eye protection, foot protection; j) instructions for safe use, any limitation of the size of work-pieces in respect of the safe intended use, additional information on whether the guillotine shear is designed also to work oversized work-pieces considering the risks at the rear and the sides; k) instructions for safe setting, trial strokes, maintenance, repair, cleaning, and programming (where required) on avoidance of danger from all hazards, including ejection hazards created by work-pieces, blades or parts of them, fluids, etc.; l) particular training needed by persons who are appointed to prepare guillotine shears for use, including suitable and sufficient instruction in: – guillotine shear mechanisms; – changing the blade and adjusting the blade; – the maintenance of fluid quality and filter changes; – protective devices; – accident causation and prevention; m) details of any pre-production inspection of the guard or protective device required after maintenance and repair of the tools; n) specification for any fluid to be used in hydraulic systems and for filters, lubrication, transmission system; o) descriptions of foreseeable failure modes and advice on detection, prevention and correction by periodic maintenance; p) instructions for any test or examination necessary after the replacement of component(s) which affects the safety functions; q) instructions for periodic maintenance, test and examination of the guillotine shear, guards and protective devices, including maintenance, testing and examination intervals. It is recommended that checklists be prepared for the operations covered by items e), l) and p). In particular, for the safety examinations there shall be a specific checklist which can be signed by the examiner.		

EMC Test Report

1.TEST RESULTS SUMMARY

Table 1 Test Results Summary

Test Items	Test Results
Power Line Conducted Emission Test	PASS
Radiated Emission Test	PASS
Electrostatic Discharge Test	PASS
RF Field Strength Susceptibility Test	PASS
Harmonic Current Emission Test	PASS
Voltage Fluctuations & Flicker Test	PASS
Electrical Fast Transient/Burst Test	PASS
Surge Test	PASS
Voltage Dips And Interruptions Test	PASS

2. POWER LINE CONDUCTED EMISSION TEST

2.1. Test Standard

EN IEC 61000-6-4:2019

2.2. Power Line Conducted Emission Limit

Frequency MHz	Limits dB(μV)	
	Quasi-peak Level	Average Level
0.15 ~ 0.50	76 ~ 66*	66 ~ 56*
0.50 ~ 5.00	66	56
5.00 ~ 30.00	70	60

Notes: 1. *Decreasing linearly with logarithm of frequency.
2. The lower limit shall apply at the transition frequencies

2.3. EUT Configuration on Test

The following equipments are installed on conducted emission test to meet EN61000-6-4 requirement and operating in a manner, which tends to maximize its emission characteristics in a normal application.

2.3.1. Model Number : QC12K-6×3200
Serial Number : N/A
Manufacturer : Jiangsu Jianghai Machinery Group Co., Ltd.

2.4. Operating Condition of EUT

2.4.1.Setup the EUT and simulators as shown in Section 2.1.

2.4.2.Turn on the power of all equipments.

2.4.3.Let the EUT work in test modes (EUT WORKING) and test it.

2.5. Test Procedure

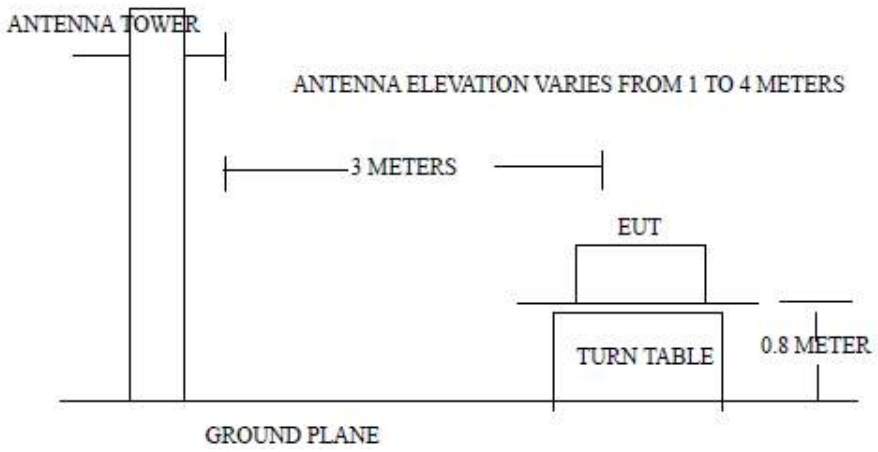
The EUT is put on the ground and connected to the AC mains through a Artificial Mains Network (AMN). This provided 50ohm-coupling impedance for the tested equipments. Both sides of AC line are checked to find out the maximum conducted emission levels according to the EN61000-6 regulations during conducted emission test.
The bandwidth of the test receiver (R&S Test Receiver ESHS30) is set at 10KHz.
The frequency range from 150 KHz to 30 MHz is investigated. The test data are listed in Section 5.6. and the scanning waveform are attached within **Appendix I.**

2.6. Test Result

PASS.

3. RADIATED EMISSION TEST

3.1. Open Site Setup Diagram



3.2. Test Standard

EN IEC 61000-6-4:2019

3.3. Radiated Emission Limit

All emanations from a Class A computing devices or system, including any network of conductors and apparatus connected thereto, shall not exceed the level of field strengths specified below:

FREQUENCY (MHz)	DISTANCE (Meters)	FIELD STRENGTHS LIMITS (dBμV/m)
30 ~ 230	3	50
230 ~ 1000	3	57

Note:(1) The tighter limit shall apply at the edge between two frequency bands.

(2) Distance refers to the distance in meters between the measuring instruments antenna and the closed point of any part of the EUT.

3.4. EUT Configuration on Test

The EN61000-6-4 Class A regulations test method must be used to find the maximum emission during radiated emission test.

3.5. Operating Condition of EUT

3.5.1.Setup the EUT as shown on Section 3.1.

3.5.2.Turn on the power of all equipments.

3.5.3.Let the EUT work in test mode and measure it.

3.6. Test Procedure

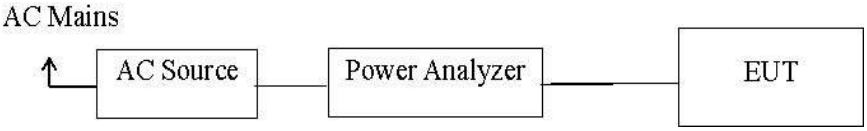
The EUT is placed on a turn table which is 0.8 meter above ground. The turn table can rotate 360 degrees to determine the position of the maximum emission level. The EUT is set 3 meters away from the receiving antenna which is mounted on a antenna tower. The antenna can move up and down between 1 to 4 meters to find out the maximum emission level. Broadband antenna (calibrated by dipole antenna) are used as a receiving antenna.
Both horizontal and vertical polarization of the antenna are set on test.
The bandwidth setting on the test receiver (R&S TEST RECEIVER ESCS20) is 120 KHz.
The EUT is tested in Anechoic Chamber. All the test results are listed in Section 6.7. and all the scanning waveform are attached within **Appendix II.**

3.7. Test Results

PASS

4. HARMONIC CURRENT EMISSION TEST

4.1.Block Diagram of Test Setup



4.2. Test Standard and Limit

4.2.1.Test Standard

EN IEC 61000-6-2:2019

4.2.2.Limits

Table 12 Harmonic Current Test Limit (Class A)

Harmonic order (**n**)	Maximum permissible harmonic current (A)
Odd harmonics	
3	2.30
5	1.14
7	0.77
9	0.40
11	0.33
13	0.21
15≤n≤39	0.15×15/**n**
Even harmonics	
2	1.08
4	0.43
6	0.30
8≤n≤40	0.23×8/**n**

4.3. Test Procedure

The power cord of the EUT is connected to the output of the test system. Turn on the Power of the EUT and use the test system to test the harmonic current level.

4.4. Test Results

PASS.

5. VOLTAGE FLUCTUATIONS & FLICKER TEST

5.1. Block Diagram of Test Setup

Same as Section 4.1..

5.2. Test Standard

EN IEC 61000-6-4:2019

5.3. Operating Condition of EUT

Same as Section 7.3.. The power cord of the EUT is connected to the output of the test system. Turn on the power of the EUT and use the test system to test the harmonic current level.

Flicker Test Limit

Test items	Limits
Pst	1.0
dc	3.3%
dmax	4.0%
dt	Not exceed 3.3% for 500ms

5.4. Test Data

Flicker test Data

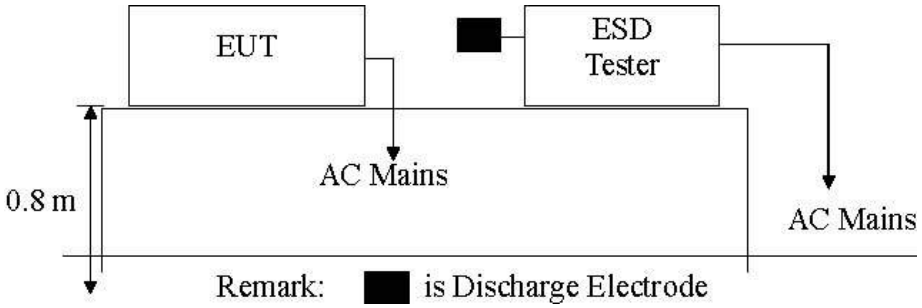
Model No.: QC12K-6×3200 Test Mode: 1		
Items	Reading	Limit
dmax	0.02	4.0%
dc	0.01	3.3%
dt	0.03	Not exceed 3.3% for 500ms
Pst	0.001	1.0

5.5. Test Results

PASS.

6. ELECTROSTATIC DISCHARGE TEST

6.1. Block Diagram of ESD Test Setup



6.2. Test Standard

EN IEC 61000-6-2:2019 (EN61000-4-2:2009)
Severity Level 3 for Air Discharge at 8KV
Severity Level 2 for Contact Discharge at 4KV

6.3. Severity Levels and Performance Criterion

6.3.1.Severity level

Level	Test Voltage Contact Discharge (KV)	Test Voltage Air Discharge (KV)
1.	2	2
2.	4	4
3.	6	8
4.	8	15
X.	Special	Special

6.3.2.Performance criterion: B

6.4. EUT Configuration on Test

The configuration of EUT are listed in Section 3.4.

6.5. Operating Condition of EUT

6.5.1.Setup the EUT as shown in Section 6.1..

6.5.2.Turn on the power of all equipments.

6.5.3.Let the EUT work in test mode (full load) and test it.

6.6. Test Procedure

6.6.1.Air Discharge:

This test is done on a non-conductive surfaces. The round discharge tip of the discharge electrode shall be approached as fast as possible to touch the EUT. After each discharge, the discharge electrode shall be removed from the EUT. The generator is then re-triggered for a new single discharge and repeated 10 times for each pre-selected test point. This procedure shall be repeated until all the air discharge completed.

6.6.2.Contact Discharge:

All the procedure shall be same as Section 6.6.1. except that the tip of the discharge electrode shall touch the EUT before the discharge switch is operated.

6.6.3.Indirect discharge for horizontal coupling plane

At least 20 single discharges shall be applied to the horizontal coupling plane, at points on each side of the EUT. The discharge electrode positions vertically at a distance of 0.1m from the EUT and with the discharge electrode touching the coupling plane.

6.6.4.Indirect discharge for vertical coupling plane

At least 20 single discharge shall be applied to the center of one vertical edge of the coupling plane. The coupling plane, of dimensions 0.5m X 0.5m, is placed parallel to, and positioned at a distance of 0.1m from the EUT. Discharges shall be applied to the coupling plane, with this plane in sufficient different positions that the four faces of the EUT are completely illuminated.

6.7. Test Results

PASS.

Please refer to the following page.

Electrostatic Discharge Test Results

Date: 04/09/2021

Applicant:	*Jiangsu Jianghai Machinery Group Co., Ltd.*	*Test Date:*	*April 09th, 2021*
EUT:	*Shearing Machine*	*Temperature:*	*22℃*
M/N:	*QC12K-6×3200*	*Humidity*	*50％*
Power Supply:	*AC 230V / 50Hz*	*Test Mode*	*Full load*
Test Engineer:	*Deng Yong*		

Air Discharge: ±8KV *For each point positive 10 times and negative 10 times discharge.*

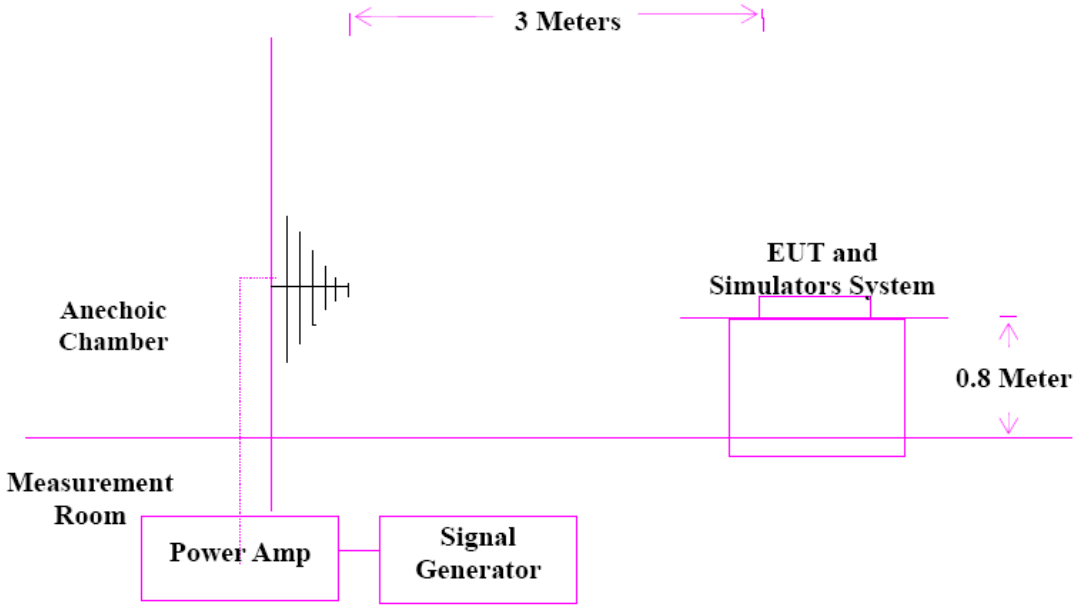
Contact Discharge: ±4KV

Location	***Kind*** *A-Air Discharge C-Contact Discharge*	***Result***
Slots *5 points*	*A*	*PASS*
Metal Part *8 points*	*C*	*PASS*
HCP *3 points*	*C*	*PASS*
VCP *3 points*	*C*	*PASS*

Discharge should be considered on Contact and Air and Horizontal Coupling Plane (HCP) and Vertical Coupling Plane (VCP).

7.RF FIELD STRENGTH SUSCEPTIBILITY TEST

7.1.R/S Test Setup



7.2.Test Standard

EN IEC 61000-6-2:2019 (EN 61000-4-3:2006/A2:2010)
Severity Level 2 at 3V / m

7.3.Severity Levels and Performance Criterion

7.3.1.Severity level

Level	Field Strength V/m
1.	1
2.	3
3.	10
X.	Special

7.3.2.Performance criterion : A

7.4.EUT Configuration on Test

The configuration of EUT are listed in Section 3.4..

7.5.Operating Condition of EUT

Setup the EUT as shown in Section 7.1.

7.6.Test Procedure

The EUT and its simulators are placed on a turn table which is 0.8 meter above the ground.
The EUT is set 3 meters away from the transmitting antenna which is mounted on an antenna tower. Both horizontal and vertical polarization of the antenna are set on test. Each of the four sides of EUT must be faced this transmitting antenna and measured individually.
In order to judge the EUT performance, a CCD camera is used to monitor the EUT.
All the scanning conditions are as follows **:**

Condition of Test	Remarks
1. Fielded Strength	3 V/m (Severity Level 2)
2. Radiated Signal	Modulated
3. Scanning Frequency	80 - 1000 MHz
4. Sweeping time of radiated	0.0015 decade/s
5. Dwell Time	1 Sec.

7.7.Test Results

PASS.

Please refer to the following page.

RF Field Strength Susceptibility Test Results

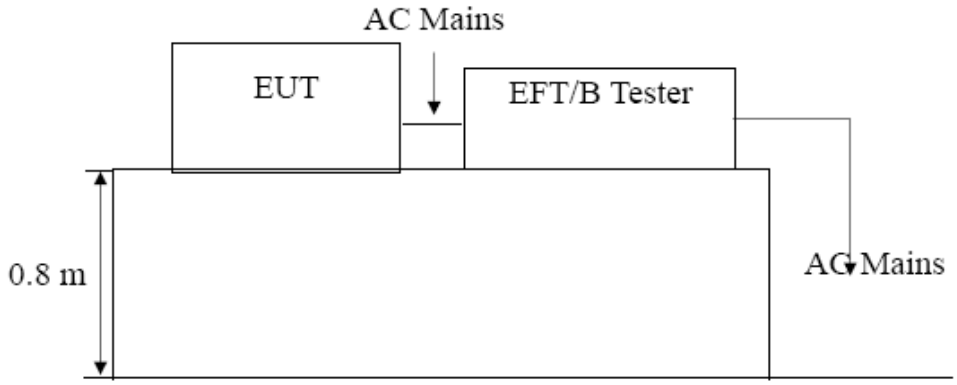
Date: 04/09/2021

Applicant:	*Jiangsu Jianghai Machinery Group Co., Ltd.*	*Test Date:*	*April 09th, 2021*
EUT:	*Shearing Machine*	*Temperature:*	*22℃*
M/N:	*QC12K-6×3200*	*Humidity*	*50％*
Power Supply:	*AC 230V, 50Hz*	*Test Mode*	*Full load*
Test Engineer:	*Deng Yong*	*Frequency Range :*	*80 MHz to 1000 MHz*
Modulation:	☑*AM* ☐*Pulse* ☐*none* *1 KHz* *80%*		
Criterion : A			

	Frequency Rang : ***80-1000***	
Steps	*1%*	*1%*
	Horizontal	*Vertical*
Front	*Pass*	*Pass*
Right	*Pass*	*Pass*
Rear	*Pass*	*Pass*
Left	*Pass*	*Pass*

8.ELECTRICAL FAST TRANSIENT/BURST TEST

8.1.EFT Test Setup



8.2.Test Standard

EN IEC 61000-6-2:2019 (EN61000-4-4:2012)

Severity Level 2 at 1KV

8.3.Severity Levels and Performance Criterion

8.3.1.Severity level

Open Circuit Output Test Voltage ±10％		
Level	On Power Supply Lines	On I/O (Input/Output) Signal data and control lines
1.	0.5 KV	0.25 KV
2.	1 KV	0.5 KV
3.	2 KV	1 KV
4.	4 KV	2 KV
X	Special	Special

8.3.2.Performance criterion : B

8.4.EUT Configuration on Test

The configuration of EUT are listed in Section 3.2..

8.5.Operating Condition of EUT

Setup the EUT as shown in Section 8.1.

8.6.Test Procedure

The EUT is put on the table which is 0.8 meter high above the ground. This reference ground plane shall project beyond the EUT by at least 0.1m on all sides and the minimum distance between the EUT and all other conductive structure, except the ground plane beneath the EUT, shall be more than 0.5m.

8.6.1.For input and output AC power ports: The EUT is connected to the power mains by using a coupling device which couples the EFT interference signal to AC power lines. Both polarities of the test voltage should be applied during compliance test and the duration of the test is 2 mins.

8.6.2.For signal lines and control lines ports: It's necessary to test.

8.6.3.For DC output line ports: It's unnecessary to test.

8.7.Test Results

PASS.

Please refer to the following page.

Electrical Fast Transient/Burst Test Results

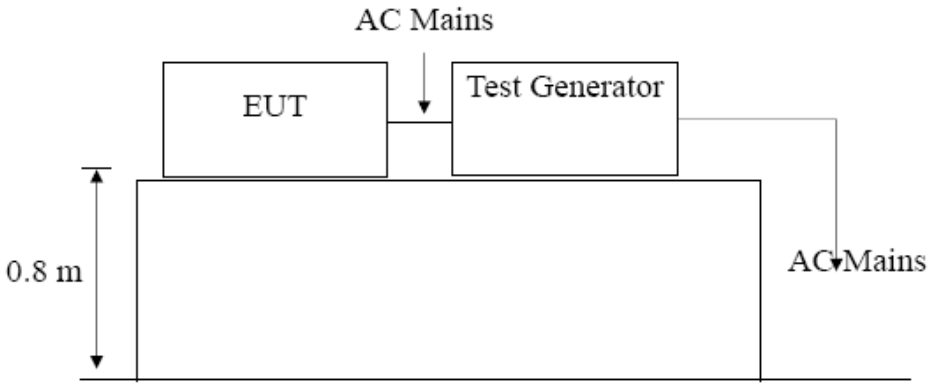
Date: 04/09/2021

Applicant :	*Jiangsu Jianghai Machinery Group Co., Ltd.*	*Test Date:*	*April 09th, 2021*
EUT :	*Shearing Machine*	*Temperature:*	*22 ℃*
M/N :	*QC12K-6×3200*	*Humidity*	*50 %*
Power Suppy:	*AC 230V, 50Hz*	*Test Mode :*	*Full load*
Test Engineer :	*Deng Yong*		
Inject Place : AC Mains			

Inject Line	*Voltage KV*	*Inject Time(s)*	*Inject Method*	*Results*	*Inject Line*	*Voltage KV*	*Inject Time(s)*	*Inject Method*	*Results*
L	*±1*	*120*	*Direct*	*PASS*					
N	*±1*	*120*	*Direct*	*PASS*					
L N	*±1*	*120*	*Direct*	*PASS*					

9.SURGE TEST

9.1.Surge Test Setup



9.2.Test Standard

EN IEC 61000-6-2:2019 (EN61000-4-5:2014)
Severity Level 2 for Line to Neutral at 1.0KV

9.3.Severity Levels and Performance Criterion

9.3.1.Severity level

Severity Level	Open-Circuit Test Voltage KV
1	0.5
2	1.0
3	2.0
4	4.0
*	Special

Performance criterion : B

9.4.EUT Configuration on Test

The configuration of EUT are listed in Section 3.2..

9.5.Operating Condition of EUT

9.5.1.Setup the EUT as shown in Section 9.1..

9.5.2.Turn on the power of all equipments.

9.5.3.Let the EUT work in test mode (Full load) and test it.

9.6.Test Procedure

1) Set up the EUT and test generator as shown on Section 9.1
2) For line to line coupling mode, provide a 0.5KV 1.2/50us voltage surge (at open-circuit condition) and 8/20us current surge to EUT selected points.
3) At least 5 positive and 5 negative (polarity) tests with a maximum 1/min repetition rate are conducted during test.
4) Different phase angles are done individually.
5) Record the EUT operating situation during compliance test and decide the EUT immunity
criterion for above each test.

9.7.Test Results

PASS.

Please refer to the following page.

Surge Immunity Test Results

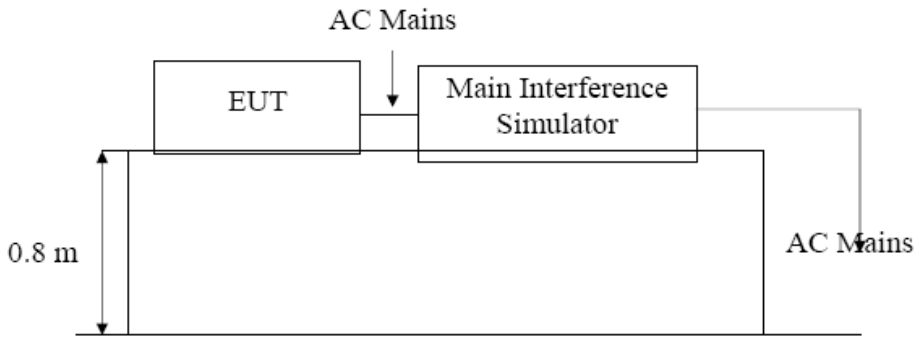
Date: 04/09/2021

Applicant:	*Jiangsu Jianghai Machinery Group Co., Ltd.*	*Test Date:*	*April 09th, 2021*
EUT:	*Shearing Machine*	*Temperature:*	*22℃*
M/N:	*QC12K-6×3200*	*Humidity*	*50%*
Power Supply:	*AC 230V, 50Hz*	*Test Mode:*	*Full load*
Test Engineer:	*Deng Yong*		

Location	*Polarity*	*Phase Angle*	*No of Pulse*	*Pulse Voltage (KV)*	*Result*
L-N	*+*	*0*	*5*	*1.0*	*PASS*
	+	*90*	*5*	*1.0*	*PASS*
	+	*180*	*5*	*1.0*	*PASS*
	+	*270*	*5*	*1.0*	*PASS*
	-	*0*	*5*	*1.0*	*PASS*
	-	*90*	*5*	*1.0*	*PASS*
	-	*180*	*5*	*1.0*	*PASS*
	-	*270*	*5*	*1.0*	*PASS*

10.VOLTAGE DIPS AND INTERRUPTIONS TEST

10.1.Voltage Dips and Interruptions Test Setup



Remark: Combination wave generator and decoupling network are included in test generator.

10.2.Test Standard

EN IEC 61000-6-2:2019 (EN61000-4-11:2004)

10.3.Severity Levels and Performance Criterion

10.3.1.Severity level

Test Level %U_T	Voltage dip and short interruptions %U_T	Duration (in period)
0	100	250p
40	60	5p
70	30	0.5p

10.3.2.Performance criterion : C & B

10.4.EUT Configuration on Test

The configuration of EUT are listed in Section 3.2.

10.5.Operating Condition of EUT

10.5.1.Setup the EUT as shown in Section 10.1..

10.5.2.Turn on the power of all equipments.

10.5.3.Let the EUT work in test mode (SPEAKERS Playing) and test it.

10.6.Test Procedure

1) Set up the EUT and test generator as shown on Section 10.1.
2) The interruptions is introduced at selected phase angles with specified duration. 3) Record any degradation of performance.

10.7.Test Result

PASS.

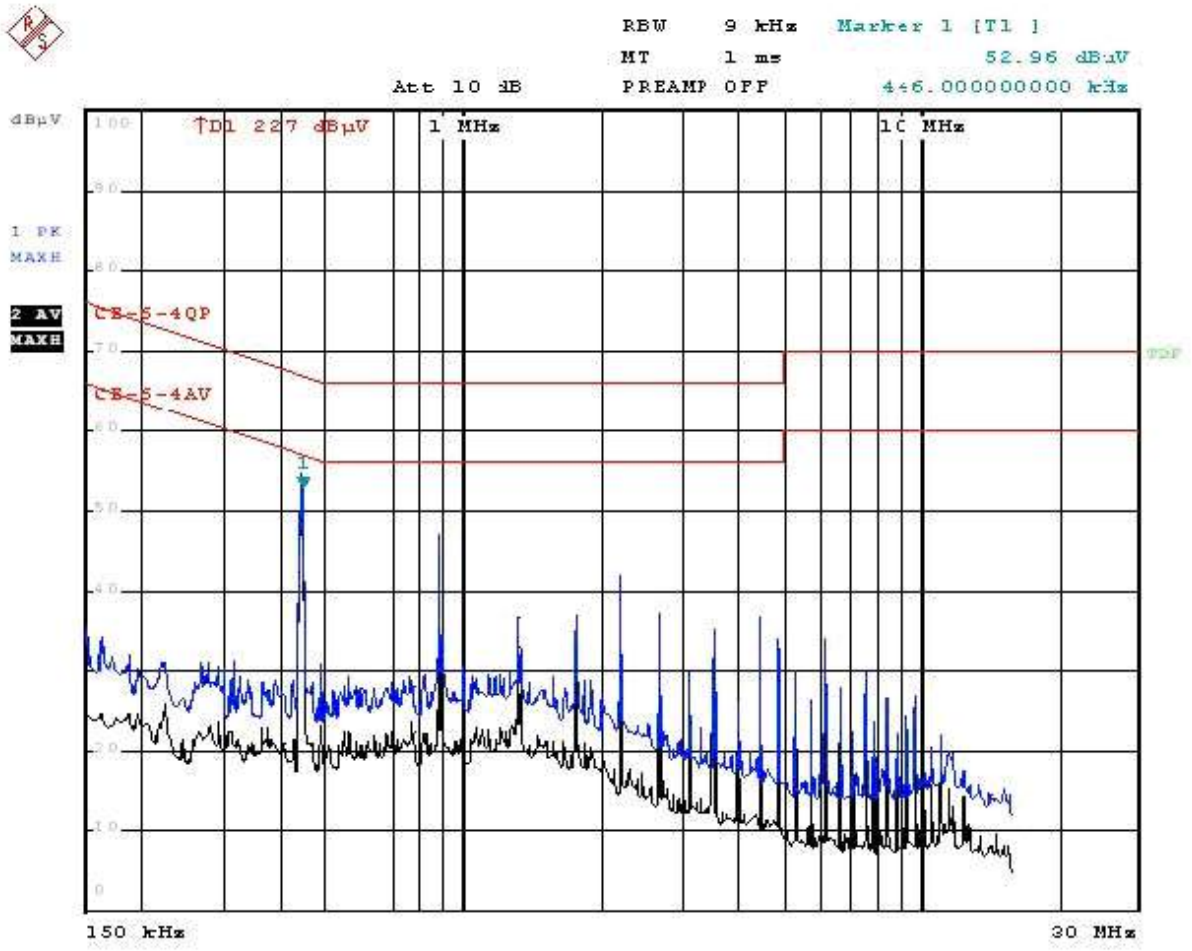
Please refer to the following page.

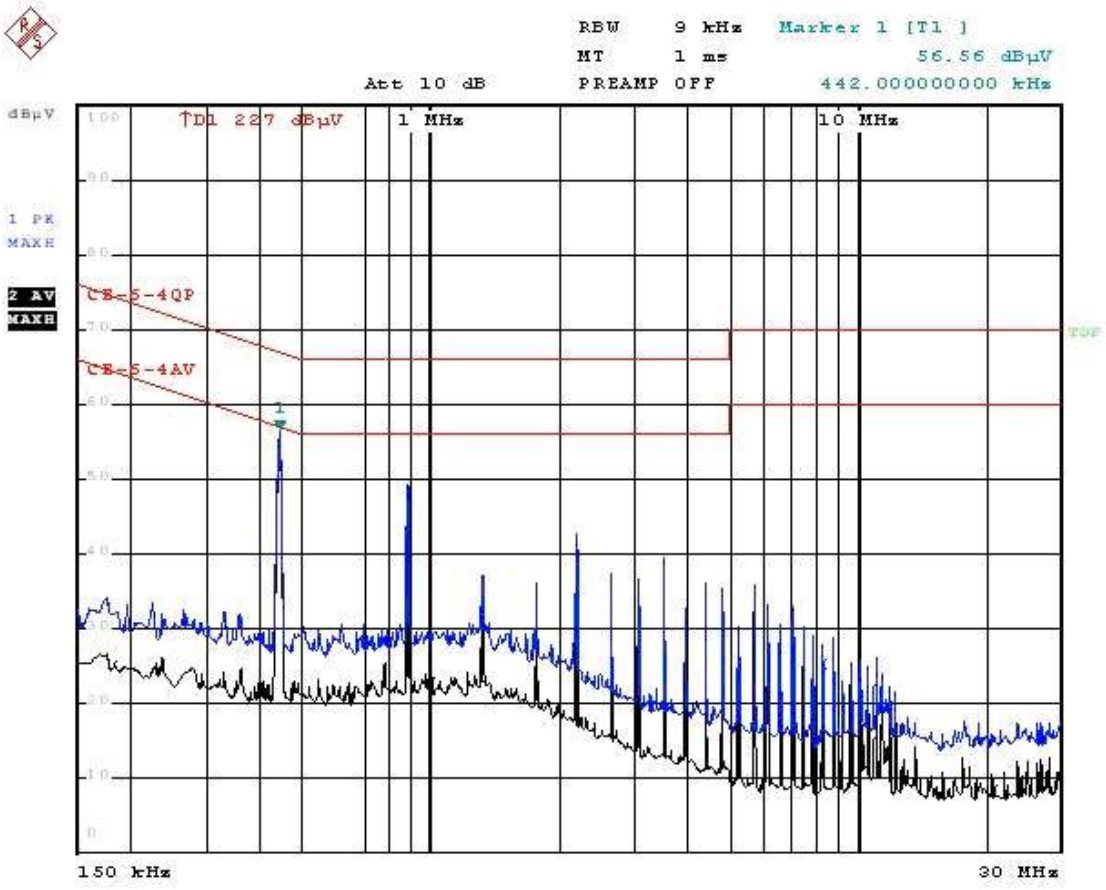
Voltage Dips And Interruptions Test Results

Date: 04/09/2021

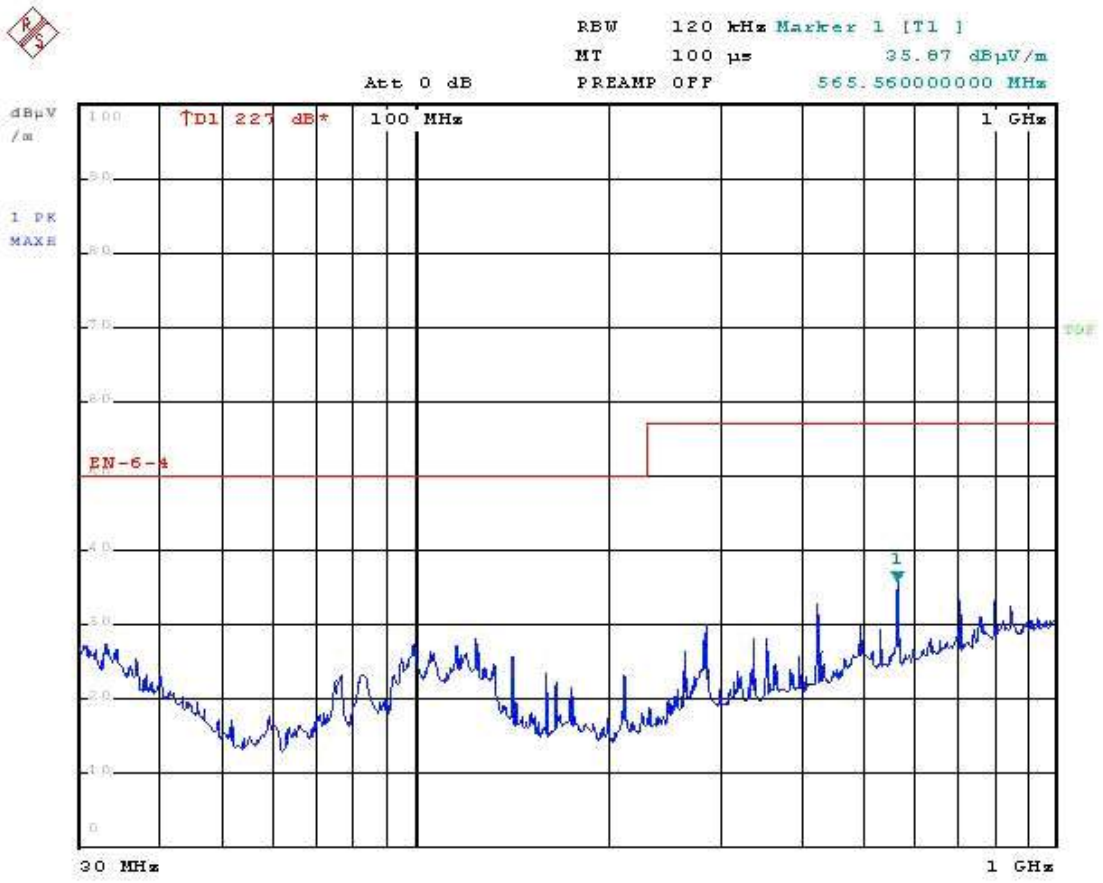
Applicant:	*Jiangsu Jianghai Machinery Group Co., Ltd.*		*Test Date:*	*April 09th, 2021*	
EUT:	*Shearing Machine*		*Temperature:*	*22 ℃*	
M/N:	*QC12K-6×3200*		*Humidity*	*50 %*	
Power Supply:	*AC 230V / 50Hz*		*Test Mode :*	*Full load*	
Test Engineer:	*Deng Yong*				
Test Level % UT	*Voltage Dips & Short Interruptions % UT*	*Duration (in period)*	*Phase Angle*	*Criterion*	*Result*
0	*100*	*250P*	*0º~360º*	*C*	*PASS*
40	*60*	*5P*	*0º~360º*	*C*	*PASS*
70	*30*	*0.5P*	*0º~360º*	*B*	*PASS*

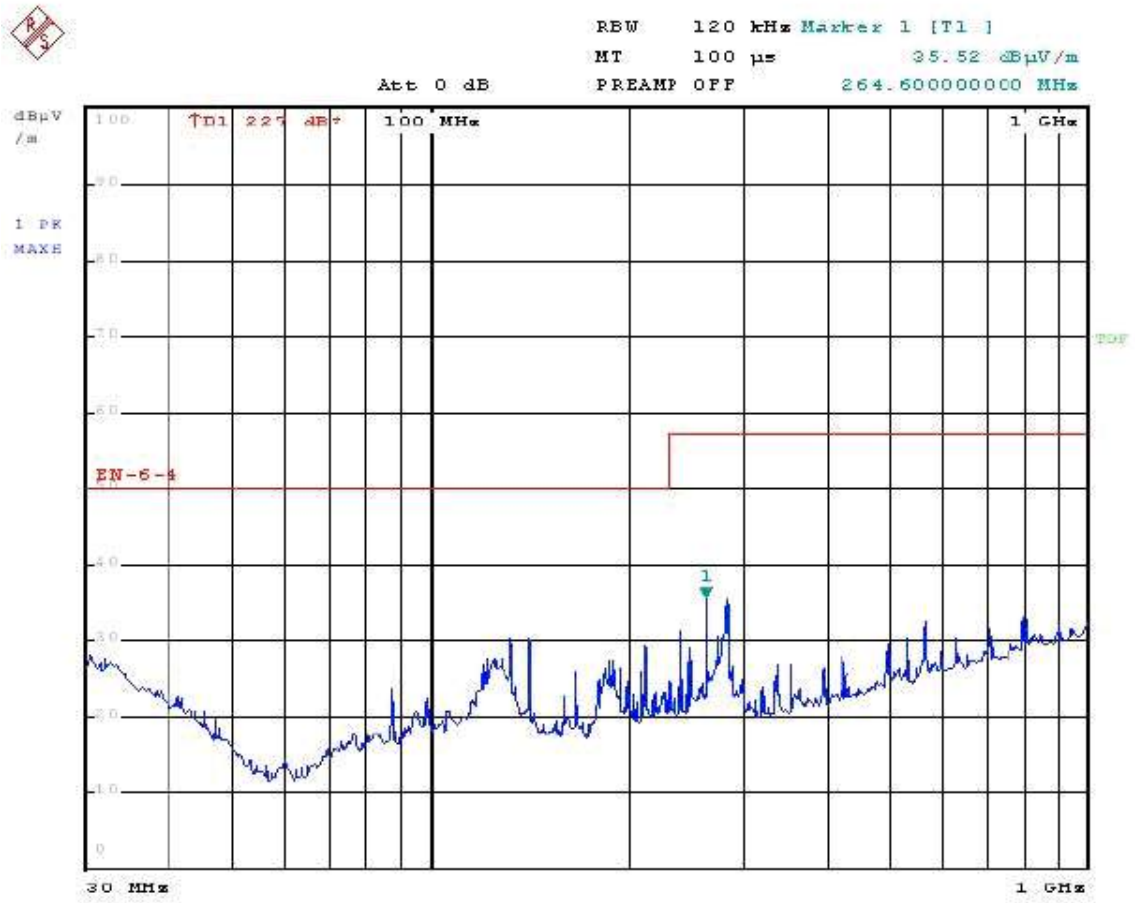
APPENDIX I


RBW 9 kHz
Marker 1 [T1]
MT 1 ms
52.96 dBµV
Att 10 dB
PREAMP OFF
446.000000000 kHz
dBµV
D1 22.7 dBµV
1 MHz
10 MHz
1 PK
MAXH
2 AV
MAXH
CE-5-4QP
CE-5-4AV
150 kHz
30 MHz


RBW 9 kHz
MT 1 ms
PREAMP OFF
Att 10 dB
Marker 1 [T1]
56.56 dBµV
442.000000000 kHz
dBµV
D1 227 dBµV
1 MHz
10 MHz
1 PK
MAXH
2 AV
MAXH
CB-5-4QP
CB-5-4AV
TOP
150 kHz
30 MHz

APPENDIX II


RBW 120 kHz
MT 100 µs
PREAMP OFF
Marker 1 [T1]
35.87 dBµV/m
565.560000000 MHz
Att 0 dB
dBµV/m
1 PK MAXH
D1 22? dB*
100 MHz
1 GHz
EN-6-4
1
30 MHz
1 GHz


RBW 120 kHz
MT 100 µs
Att 0 dB
PREAMP OFF
Marker 1 [T1]
35.52 dBµV/m
264.600000000 MHz
dBµV/m
1 PK MAXH
TD1 227 dBµ
100 MHz
1 GHz
EN-6-4
1
30 MHz
1 GHz

Photos of the sample

Picture 1

Manual de funcionamiento de E21S

(Versión: V1.05)

ESTUN AUTOMATION CO., LTD

Total Solution Supplier

Contenido

Prefacio

Este manual describe el funcionamiento del dispositivo de control numérico E21S y está destinado a operadores instruidos para el funcionamiento del dispositivo. El operador debe leer este manual y Conozca los requisitos de operación antes de usar este dispositivo.

El dispositivo E21S proporciona un control de software completo y no tiene ningún dispositivo de protección mecánica para el operador o la máquina herramienta. Por lo tanto, en caso de mal funcionamiento, la máquina herramienta debe proporcionar dispositivo de protección para el operador y parte externa de la máquina herramienta. ESTUN no se hace responsable por cualquier pérdida directa o indirecta causada por el funcionamiento normal o anormal del dispositivo.

ESTUN se reserva el derecho de modificar este manual en caso de agregar funciones o imprimir error.

Capítulo 1 Descripción general del producto

1.1 Introducción del producto

Este producto está equipado con el dispositivo de control numérico dedicado de la máquina de corte que es aplicable a varios usuarios. Basado en garantizar la precisión del trabajo, el costo del control numérico cizalla se reduce significativamente.

Las características y funciones de este producto son las siguientes:

- El tope trasero se puede controlar. El
- ángulo de corte se puede controlar. El
- espacio de corte se puede controlar. El
- tiempo de carrera se puede controlar.
- Control de posicionamiento inteligente.
- Posicionamiento unilateral y bidireccional que elimina eficazmente la holgura del husillo. Funciones
- de retracción.
- Búsqueda automática de referencias. Copia de seguridad
- y restauración de parámetros de una tecla. Indexación de
- posición rápida.
- Espacio de almacenamiento de 40 programas, cada programa tiene 25 pasos.
- Protección de apagado.

1.2 Panel de operaciones

El panel de operación se muestra en la Figura 1-1.

Figura 1-1 Panel de operaciones

Las funciones de las teclas del panel se describen en la Tabla 1-1.

Tabla 1-1 Descripción de las funciones clave

Llave	Función descriptiva
	Tecla Eliminar: elimina todos los datos en el área de entrada en la parte inferior izquierda de expositor
	Tecla Enter: confirma el contenido de entrada. Si no se ingresa ningún contenido, la tecla tiene la función similar a la tecla de dirección  .
	Tecla de inicio: puesta en marcha automática, la esquina superior izquierda de la tecla es la operación LED indicador. Cuando se inicia la operación, este indicador LED está encendido.
	Tecla de parada: detener la operación, la esquina superior izquierda de la tecla es Detener LED indicador. Al inicializar el arranque normal y sin operación, este indicador LED está encendido.
	Tecla de dirección izquierda: avanzar página, eliminar cursor
	Tecla de dirección derecha: página hacia atrás, quitar cursor
	Tecla de dirección hacia abajo: seleccione el parámetro hacia abajo
	Interruptor de función: cambie entre diferentes páginas de funciones
	Clave simbólica: símbolo de entrada del usuario o diagnóstico de inicio.
	Tecla numérica: al configurar el parámetro, valor de entrada.
	Tecla de punto decimal: cuando se configura el parámetro, ingrese el punto decimal.
	Tecla de movimiento manual: en caso de ajuste manual, haga el objeto de ajuste se mueve hacia adelante a baja velocidad.
	Tecla de movimiento manual: en caso de ajuste manual, haga el objeto de ajuste se mueve hacia atrás a baja velocidad.
	Tecla de selección de alta velocidad: en caso de ajuste manual, presione esta tecla y presione  simultáneamente, hacer objeto de ajuste muévase en dirección creciente a alta velocidad, luego presione  , hacer que el objeto de ajuste se mueva en dirección decreciente a alta velocidad.

1.3 Visualizador

El dispositivo de control numérico E21S adopta una pantalla LCD de matriz de puntos de 160*160. El área de visualización se muestra en**Figura 1-2**.

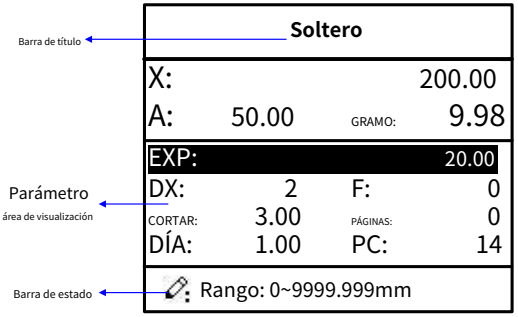


Figura 1-2Área de visualización

- Barra de título: muestra información relevante de la página actual, como su nombre, etc. Área de
- visualización de parámetros: muestra el nombre del parámetro, el valor del parámetro y la información del sistema.
- Barra de estado: área de visualización de información de entrada y mensaje de aviso, etc.

Las paráfrasis de acortamiento en esta página se muestran en la Tabla 1-2.

Tabla 1-2 Las paráfrasis del acortamiento

Acortamiento	Descripción
X	La posición actual del tope trasero
A	El ángulo de corte actual
GRAMO	La distancia de separación actual
XP	La posición deseada del tope trasero
DX	Distancia de retracción del tope trasero
CORTAR	Retraso de corte
DÍA	Retraso de retracción
F	Valor de salida de la función
PÁGINAS	pieza de trabajo preestablecida
PC	Pieza actual

Capítulo 2 Instrucciones de operación

2.1 Procedimiento básico de operación

El procedimiento básico de cambio y operación del dispositivo se muestra en**Figura 2-1**.

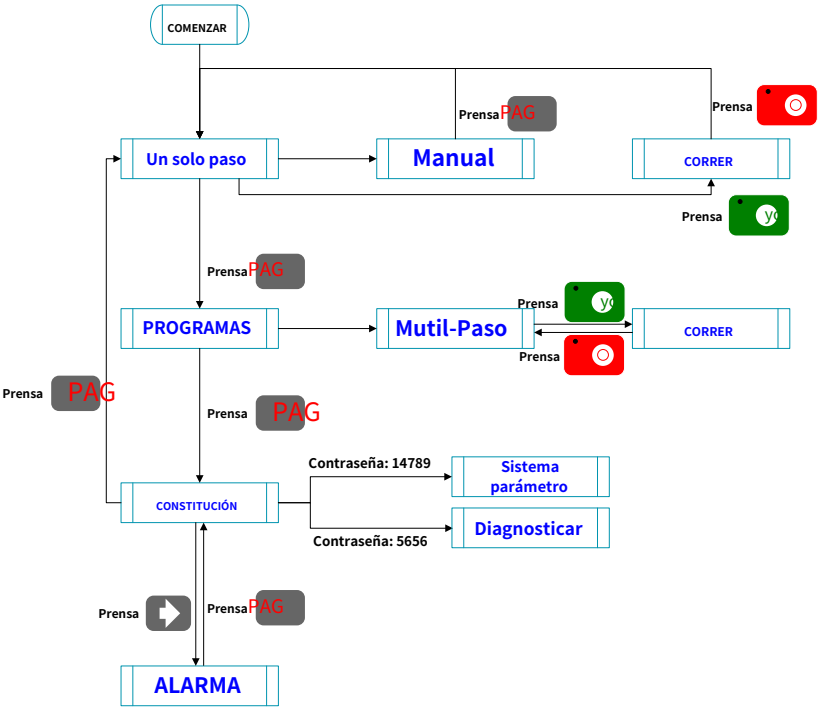


Figura 2-1 Flujo operativo básico

2.2 Programación

El dispositivo tiene dos métodos de programación, que son la programación de un solo paso y programación de varios pasos. El usuario puede configurar la programación según la demanda real.

2.2.1 Programación en un solo paso

La programación de un solo paso generalmente se usa para procesar un solo paso para terminar la pieza de trabajo Procesando. Cuando el controlador está encendido, ingresará automáticamente a la página del programa de un solo paso.

Pasos de operación

Paso 1 Después de iniciar, el dispositivo ingresará a la página de configuración del programa de un solo paso automáticamente, como se muestra en**Figura 2-2**.

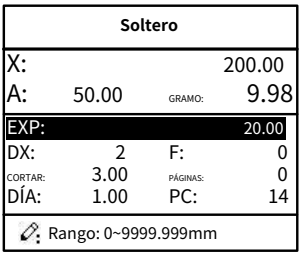


Figura 2-2Página de configuración del programa de un solo paso

Paso 2 Hacer clic , seleccione el parámetro que debe configurarse, presione la tecla numérica para ingresar valor del programa, presione para completar la entrada.

[Nota]El parámetro solo se puede configurar cuando el indicador de parada está encendido.

El rango de configuración del parámetro de un solo paso se muestra en la Tabla 2-1.

Tabla 2-1 Configurar rango de parámetro de paso único

Nombre del parámetro	Unidad	Rango	Observaciones
X	milímetro/pulgada	-	Posición actual del eje X, no se puede modificado.
A	°	-	Posición actual del eje A, no se puede modificado.
GRAMO	milímetro/pulgada	-	Posición actual del eje G, no se puede modificado.
XP	milímetro/pulgada	0~9999.999	Posición del programa del eje X.
DX	milímetro/pulgada	0~9999.999	Distancia de retracción del eje X;

Nombre del parámetro	Unidad	Rango	Observaciones
DÍA	s	0~9,99	En caso de un solo paso, tiempo de retraso para el eje X concesión.
CORTAR	s	0~9,99	Hay un tiempo de retraso para que el cortador vaya a la siguiente paso de trabajo, después de que deja la parte superior muerta centro. [Nota] Solo el parámetro**CutDelay Es.**es ajustado a**1**, mostrando este parámetro.
F	Ninguno	0~3	Las funciones configuran la salida.
PÁGINAS	Ninguno	0~9999	Número de piezas de trabajo preestablecidas.
PC	Ninguno	0~9999	Número de pieza de trabajo actual.

Paso 3 Prensa  , el sistema se ejecutará de acuerdo con este programa, como se muestra en**Figura 2-3**.

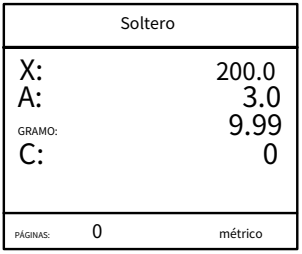


Figura 2-3Página de operación de un solo paso

- - - - Fin

Ejemplo de operación

En la página del programa de un solo paso, programe la posición del tope trasero a 80,00 mm, distancia de retracción a 50 mm, tiempo de espera de concesión a 2 s y pieza de trabajo a 10.

Los pasos de la operación se muestran en la Tabla 2-2.

Tabla 2-2 Pasos de operación del ejemplo de un solo paso

Pasos de operación	Operación
Paso 1	Hacer clic  , seleccione el parámetro “XP”.
Paso 2	Ingrese 80.00 por tecla numérica.
Paso 3	Hacer clic  , confirme el ajuste de este parámetro.

Pasos de operación	Operación
Etapa 4	Hacer clic, seleccione el parámetro “DX”, el parámetro “DLY”, “PP” parámetro respectivamente.
Paso 5	Configure el parámetro a 50 mm, 2 s, 10 por tecla numérica.
Paso 6	Hacer clic, el sistema se ejecuta de acuerdo con este programa.

2.2.2 Programación de varios pasos

El programa de varios pasos se utiliza para procesar una sola pieza de trabajo de diferentes pasos de procesamiento, realizar la implementación consecutiva de varios pasos y mejorar la eficiencia del procesamiento.

Paso de operación

Paso 1 Encendido, el dispositivo ingresa automáticamente a la página de configuración de parámetros de un solo paso.

Paso 2 Hacer clic, cambie a la página de administración de programas, como se muestra en la Figura 2-4.

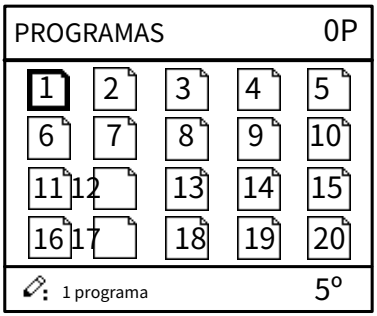


Figura 2-4Página de gestión del programa

Paso 3 Hacer clic, seleccione el número de serie del programa o ingrese el número del programa directamente, como la entrada "1".

Etapa 4 Hacer clic, ingrese a la página de configuración del programa de varios pasos, como se muestra en**Figura 2-5**.

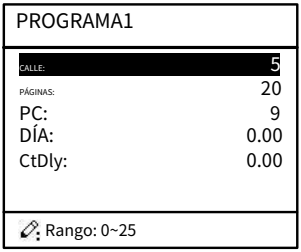


Figura 2-5Página de configuración del programa de varios pasos

Paso 5 Hacer clic , seleccione el parámetro de programación de varios pasos que requiere configuración, entrada configuración de valor, haga clic en y la configuración surtirá efecto.

Paso 6 Al finalizar la configuración, haga clic en , ingrese a la página de conjunto de parámetros de paso, como se muestra en**Cifra 2-6**.

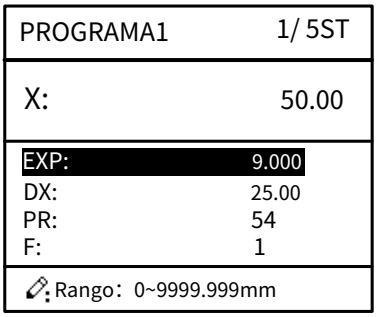


Figura 2-6Página de conjunto de parámetros de paso

Paso 7 Hacer clic , seleccione el parámetro de paso que debe configurarse, ingrese el valor del programa, hacer clic y la configuración surtirá efecto.

Paso 8 Hacer clic para cambiar entre pasos. Si el paso actual es el primer paso, haga clic en para ingresar a la última página de configuración de parámetros de paso; si el paso actual es el último, hacer clic para entrar en la primera página de configuración de parámetros de paso.

El rango de configuración de parámetros de varios pasos se muestra en la Tabla 2-3.

Tabla 2-3 Rango de configuración de parámetros de varios pasos

Nombre del parámetro	Unidad	Rango	Observaciones
CALLE	Ninguno	0-25	Configure el número total de pasos de procesamiento de este programa
PÁGINAS	Ninguno	0~99999	Número de pieza de trabajo a procesar, pieza decreciente cuando es mayor que cero; cuenta creciente negativa.
PC	Ninguno	0~99999	Número de pieza de trabajo terminada
DÍA	s	0~9,99	Tiempo entre la señal de retractación y la concesión ejecución.

Nombre del parámetro	Unidad	Rango	Observaciones
CtDly	s	0~9,99	Hay un tiempo de retraso para que el cortador vaya a la siguiente paso de trabajo, después de que deja la parte superior muerta centro. [Nota] Solo el parámetro**CutDelay Es.**es ajustado a**1**, mostrando este parámetro.
X	milímetro/pulgada	Ninguno	Posición actual del eje X, no se puede modificar.
XP	milímetro/pulgada	0~9999.999	Posición del programa del eje X.
DX	milímetro/pulgada	0~9999.999	Distancia de concesión del eje X.
PR	-	1~99	Repita las veces requeridas por este paso.
F	-	0~3	Salida de configuración de función F

Paso 9 Hacer clic  , el sistema operará de acuerdo con este programa, como se muestra en**Figura 2-7**.

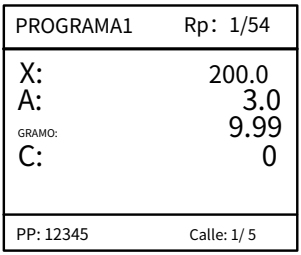


Figura 2-7Página de operación de programación de varios pasos

- - - - Fin

Ejemplo de operación

[Fondo]Una pieza de trabajo requiere procesamiento 50 como se muestra a continuación;

- Primera cizalla: 50 mm;
- Segundo corte: 100 mm;
- Tercer cizallamiento: 300 mm;

[Análisis]según pieza de trabajo y condiciones tecnológicas de la máquina herramienta:

- Primera cizalla: la posición del eje X es de 50,0 mm, concesión de 50 mm; La segunda
- cizalla: la posición del eje X es de 100,0 mm, concesión de 50 mm; La tercera cizalla: la
- posición del eje X es de 300,0 mm, concesión de 50 mm;

Edite el programa de procesamiento de esta pieza de trabajo en el programa No. 2.

El procedimiento de operación se muestra en la Tabla 2-4.

Tabla 2-4 Pasos de operación del ejemplo de programación de varios pasos

Paso de operación	Operación
Paso 1	En la página de configuración de parámetros de un solo paso, presione  entrar página de selección de programa.
Paso 2	Ingrese "2", haga clic en  , ingrese la configuración de parámetros generales de varios pasos página del programa 2.
Paso 3	Seleccione "Paso del programa", ingrese "3", haga clic en  , el ajuste toma efecto.
Etapa 4	Seleccione "PP", ingrese "50", haga clic en  , la configuración surtirá efecto.
Paso 5	Similar al paso 3 y al paso 4, ajuste “DLY” a 3 respectivamente.
Paso 6	Hacer clic  para ingresar a la página de configuración del primer paso del parámetro de paso.
Paso 7	Seleccione "XP", ingrese 50, haga clic  , la configuración surtirá efecto.
Paso 8	Similar al paso 7, configure la "distancia de concesión" y "repetir veces” a 50, 1 respectivamente.
Paso 9	Hacer clic  para ingresar a la página de configuración del segundo paso del parámetro de paso, el método de configuración es similar al del primer paso.
Paso 10	Hacer clic  nuevamente, para ingresar a la página de configuración del tercer paso del paso parámetro, el método de configuración es similar al del paso uno y segundo paso.
Paso 11	Hacer clic  , regrese a la página de configuración del primer paso.
Paso 12	Hacer clic  , el sistema funcionará de acuerdo con este programa.

[Nota]

- Al completar la programación de varios pasos, debe volver al paso inicial antes de iniciar el sistema; de lo contrario, el programa comenzará a procesar la posición en el paso actual.

- Presione la tecla de dirección izquierda y derecha para circular pasando la página y navegando entre todos los parámetros de paso.
- El programa se puede llamar y revisar de nuevo.
- Al completar el procesamiento de todas las piezas de trabajo (50 en el ejemplo), el sistema se detiene automáticamente. Reiniciar directamente comenzará otra ronda de procesamiento de 50 piezas de trabajo.

2.3 Configuración de parámetros

El usuario puede configurar todos los parámetros necesarios para el funcionamiento normal del sistema, incluidos parámetro del sistema, parámetro del eje X.

Paso 1 En la página de administración del programa, haga clic en  para entrar en la página de constantes de programación, como se muestra en la**Figura 2-8**. En esta página, se puede configurar la constante de programación.

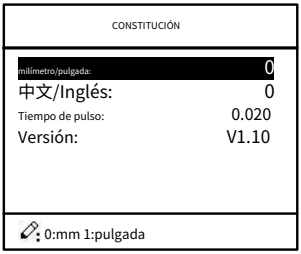


Figura 2-8Página constante de programación

El rango de configuración de la constante de programación se muestra en la Tabla 2-5.

Tabla 2-5 Rango de configuración constante de programación

Nombre del parámetro	Unidad	Rango	Por defecto	Observaciones
X-té. en	milímetro	0-9999.99	0	Introduzca la posición actual del eje X cuando enseñar habilitar.
milímetro/pulgada	-	0 o 1	0	- 0: mm - 1 pulgada
中文/Inglés	-	0 o 1	0	- 0:中文 - 1: inglés
X-té. En	milímetro	0~9999.999	10	Introduzca la posición actual del eje X cuando enseñar habilitar.
G-té. En	milímetro	0~9,99	0	Introduzca la posición actual del eje G cuando enseñar habilitar.
Tiempo de pulso	s	0.000~1.000	0.020	La duración de la señal de pulso.
Versión	-	Ninguno	-	Información de la versión del software, V se refiere a la versión, 1 indica la versión número, y 0 indica versión nivel.

Paso 2 Introduzca la contraseña "1212", haga clic en  para entrar en la página de configuración de parámetros del sistema, como se muestra en la**Figura 2-9**.

Figura 2-9Página de configuración de parámetros del sistema

Paso 3 Incremente el parámetro, el rango de configuración del parámetro se muestra en**Tabla 2-6**.

Tabla 2-6 Descripción del parámetro del sistema

Parámetro	Unidad	Rango	Por defecto	Descripción
X-dígitos	-	0-3	1	Punto decimal mostrado por la posición del eje X parámetro
X-seguro	milímetro	0-9999.999	10	El eje X mantiene la velocidad baja en este rango
Retraso de paso	s	0-9.99	0.5	Intervalo entre la señal de paso de cambio válido y operación de cambio de paso ejecutada
Retraso de corte es.	-	0 o 1	0	- 0: deshabilitar - 1: habilitar
MaxCut Demora	s	0~9,99	0	Establece el tiempo máximo de retardo de corte.
A-Habilitar	-	0 o 1	1	- 0: deshabilitar - 1: habilitar
A-máx	°	2.50 o 3.00	3.00	El valor máximo del ángulo de corte.
Habilitar G	-	0 o 1	1	- 0: deshabilitar - 1: habilitar
Codificador G Dir.	-	0 o 1	0	- 0: Disminuir - 1: Aumentar
GMF	-	1~99999999	40	Factor de multiplicación del eje G, utilizado para el convertir entre pulsos y mm.
GDF	-	1~99999999	1	Factor de división del eje G, utilizado para la conversión entre pulsos y mm.

Etapa 4 Hacer clic P, volver a la página de constantes de programación.

- - - - Fin

2.4 Movimiento manual

En el modo de un solo paso, el movimiento del eje se puede controlar presionando la tecla manualmente. Este

El método ayuda al usuario a ajustar la máquina herramienta y la pieza de trabajo.

Paso 1 En la página de configuración de parámetros de un solo paso, haga clic en , o para entrar manualmente página, como se muestra en**Figura 2-10**.

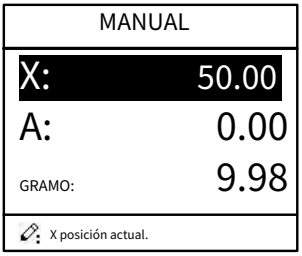


Figura 2-10página de manuales

Paso 2 Hacer clic , opere a baja velocidad en dirección creciente.

Hacer clic , opere a baja velocidad en dirección decreciente.

Hacer clic , haga clic al mismo tiempo, y operar a alta velocidad en aumento dirección (esta operación solo es válida cuando se utiliza un convertidor de frecuencia como accionamiento).

Hacer clic , haga clic al mismo tiempo, y operar a alta velocidad en disminución dirección (esta operación solo es válida cuando se utiliza un convertidor de frecuencia como accionamiento).

Paso 3 Hacer clic volver a la página de configuración de parámetros de un solo paso.

- - - - Fin

Capítulo 3 Alarma

El dispositivo puede detectar anomalías internas o externas automáticamente y enviar una alarma inmediato. El mensaje de alarma está disponible en la lista de alarmas.

Paso 1 En la página de gestión de programación, haga clic en  para entrar en la página de constantes de programación.

Paso 2 En la página de programación constante, haga clic en  para entrar en la página "Historial de alarmas" para ver todas Historial de alarmas.

Como se muestra en**Figura 3-1**, se pueden ver las últimas 6 alarmas, el número de alarma y las causas en esta página.

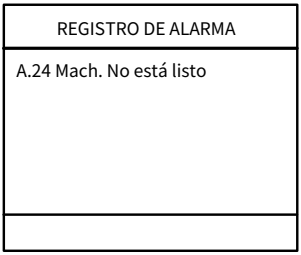


Figura 3-1Página de historial de alarmas

El historial de alarmas y el mensaje se muestran en la Tabla 3-1.

Tabla 3-1Número de alarma y mensaje de alarma

Número de alarma	Nombre de la alarma	Descripción de la alarma
A.01	Piezas alcanzadas	El conteo alcanza el valor preestablecido
A.02	X.Pos < min.	Posición actual del eje X más allá de la límite mínimo
A.03	Pos.X > máx.	Posición actual del eje X más allá de la límite máximo
A.04	-	La posición actual del eje X más allá el límite suave
A.05	Un eje MAX	Posición actual del eje A más allá de la límite máximo
A.06	Un eje MÍN.	Posición actual del eje A más allá de la límite mínimo
A.07	Eje G MAX	Posición actual del eje G más allá de la límite máximo
A.08	Eje G MÍN.	Posición actual del eje G más allá de la límite mínimo

Número de alarma	Nombre de la alarma	Descripción de la alarma
A.11	Trabajo terminado	Cuando el conteo alcanza el valor preestablecido, el sistema se apaga automáticamente.
A.12	Fuera de UDP	En el modo de un solo paso y de varios pasos, el control deslizante no está en el punto muerto superior.
A.22	Codificador anulado.	El voltaje del codificador es demasiado bajo
A.24	Mach. no está listo	La señal de la bomba no es válida
A.25	Ángulo anormal	Error de entrada de ángulo
A.26	X Detener Err	El motor del tope trasero tiene una parada anormal.
A.28	Error X V2	La velocidad del motor del tope trasero es anormal en el modo de baja velocidad.
A.29	Error X V3	La velocidad del motor del tope trasero es anormal en el modo de alta velocidad.
A.32	XPos < 0	La posición del eje X ha excedido el cero punto en modo manual, debe girar atrás.
A.41	Paraca. error	-
A.42	Apagado	-
A.43	Falla del sistema	-

Apéndice Fallo común y resolución de problemas

Fenómenos de falla	Solución de problemas
Cuando se enciende, el dispositivo no mostrar.	- El electrodo de la terminal de suministro de energía es error conectado; por favor vea la información de placa de potencia. - El voltaje es demasiado bajo. - El tomacorriente no está conectado.
Cuando la programación del eje X es funcionando, el motor de tope trasero no moverse, pero el motor Y AXIS se mueve.	Dos motores están invertidos. Vuelve a conectarte.
Cuando el programa está funcionando, el motor no se mueve.	- Compruebe si la parte mecánica ha sido bloqueado o el control deslizante vuelve al punto muerto superior. - Compruebe si el cableado del motor está conectado. Bueno.
El motor no puede cambiar de alta velocidad a baja velocidad.	- Compruebe si la señal de velocidad alta-baja ha enviado o la potencia del motor es demasiado pequeña. - Compruebe si el parámetro de distancia la conversión es correcta.
Cuando el sistema está en varios pasos programación, el programa no puede cambio de paso.	Compruebe cuando el control deslizante está en el punto muerto superior,**PASO** terminal está conectado a +24V o no.
Cuando el sistema está en varios pasos programación, el programa no puede contar.	Compruebe cuando el control deslizante está en el punto muerto superior,**PASO** terminal está conectado a +24V o no.
Cuando la programación está funcionando, el dispositivo pierde el control.	- Compruebe si el cable del codificador está conectado o no. - Compruebe si el cableado de dirección del motor está correcto (X+, X-, A+, A-, G+, G-).
Cuando la programación está funcionando, la posición real del sistema no se mostrará o cambiar	Compruebe si el cableado del codificador es correcto o El cable del codificador está bien conectado.

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ESTUN

CORTADORA HIDRÁULICA DE PLACA OSCILANTE SERIE QC12Y-6

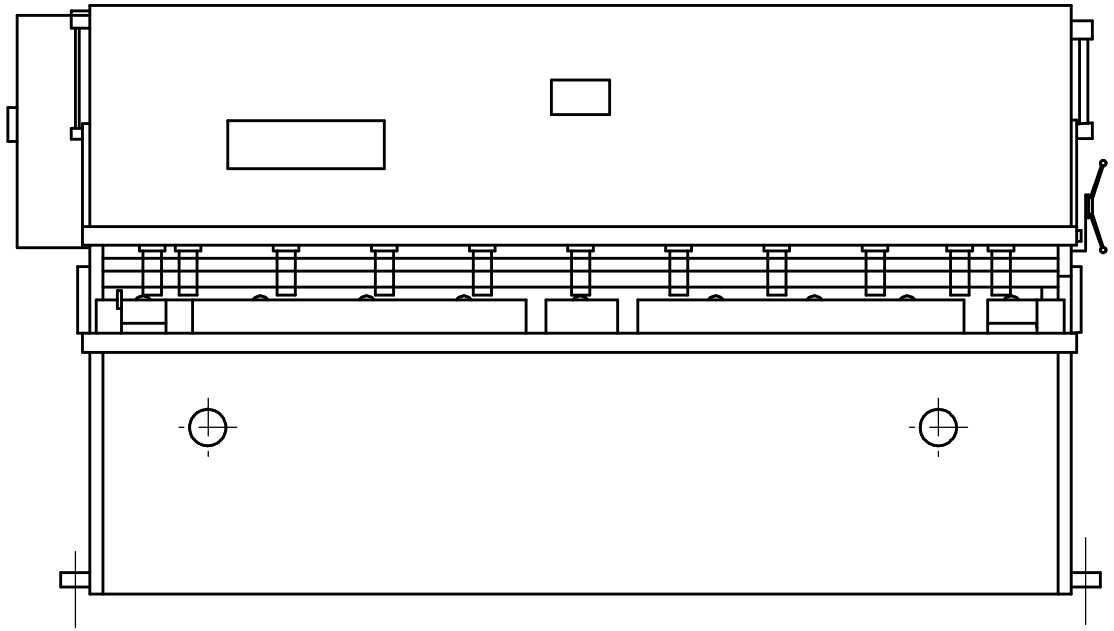
OPERACIÓN MANUAL

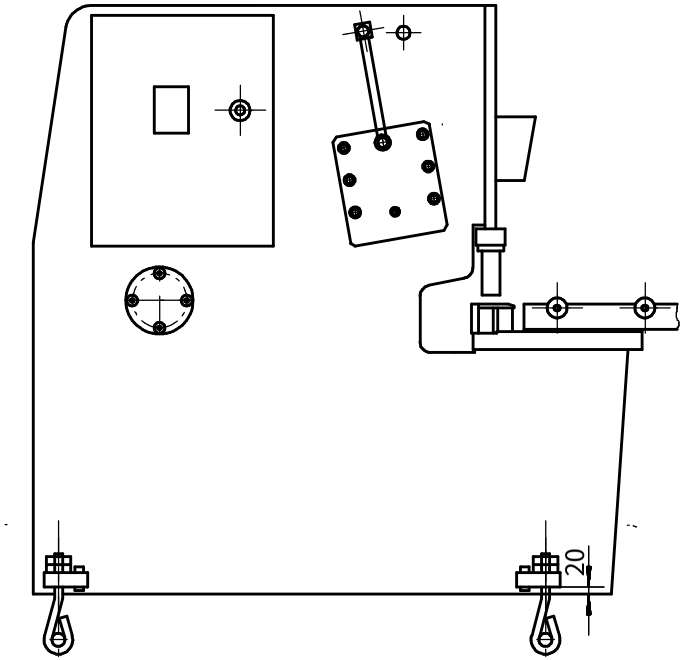
Espesor de corte: 6 mm

Ancho de corte: mm

Sin entrega.:

1、Foto de contorno de la máquina





Observación: la dimensión de la apariencia puede referirse a la lista de parámetros

2、Datos fundamentales

No.	Nombre		Valor	Comentarios de la unidad	
1	Espesor máximo de corte 2		6	mm	
	Ancho máximo de corte		2000/2500/3200/4000	mm	
3	Resistencia de las hojas de cizallamiento		450	N / mm ^{2}	
4	Ángulo de cizallamiento		1°30′		
5	Longitud máxima del tope trasero		600	mm	
6	Número de trazos		18/20/14/14	min^1	
7	Distancia entre columnas verticales 2170/2700/3420/4220 8			mm	
	Longitud de la hoja 2050/2600/3300/4100			mm	
9	Altura de la mesa de trabajo		800	mm	
10	Motor principal	Escribe	Y132M-4		
		Poder	7.5	kW	
11	Motor para la espalda Indicador	Escribe	Y802-6		B3Doble fuera del eje
		Poder	0.55	kW	
12	bomba de engranajes	Escribe	NT3-G25F / NT3-G20F		
		Fluir	25/20	mL / r	
		Presión	32	MPa	
13	En general dimensión	L	2580/3130/3840/4630	mm	
		W	1530/1530/1675/1850	mm	
		H	1600/1600/1620/1700	mm	

3 Aplicación, funciones y características principales

Esta máquina se utiliza para cortar placas de acero con un espesor de 1-6 mm y un ancho de 2000/2500/3200/4000 mm.

La resistencia de las placas a cortar debe ser de 450 N / mm^2. Si las placas de otra resistencia deben cortarse, el grosor de las mismas debe reducirse.

Esta máquina adopta toda la estructura de placa de acero soldada, conducción hidráulica, el retorno del cilindro de nitrógeno se utiliza.la máquina se caracteriza por un funcionamiento suave, poco ruido, fácil operación, buena rigidez y alta precisión

El ajuste de la holgura de la hoja de apertura es rápido y simple, Tiene tope delantero y trasero El equipo del tope trasero es de accionamiento mecánico, Hay un indicador de revoluciones para mostrar el valor, y se puede ajustar manualmente de manera fácil y confiable.El bloque frontal se cuenta por la escala y fija la posición por bloque Tiene instalación para luces de corte, puede ajustar al azar el reposacabezasC s cantidad de carrera para mejorar la eficiencia de trabajo para cortar placas estrechas La rejilla se utiliza como dispositivo de protección, la máquina dejará de funcionar automáticamente Cuando se abre la rejilla, se garantiza un funcionamiento seguro

4. HYDRAULIC DRIVING SYSTEM

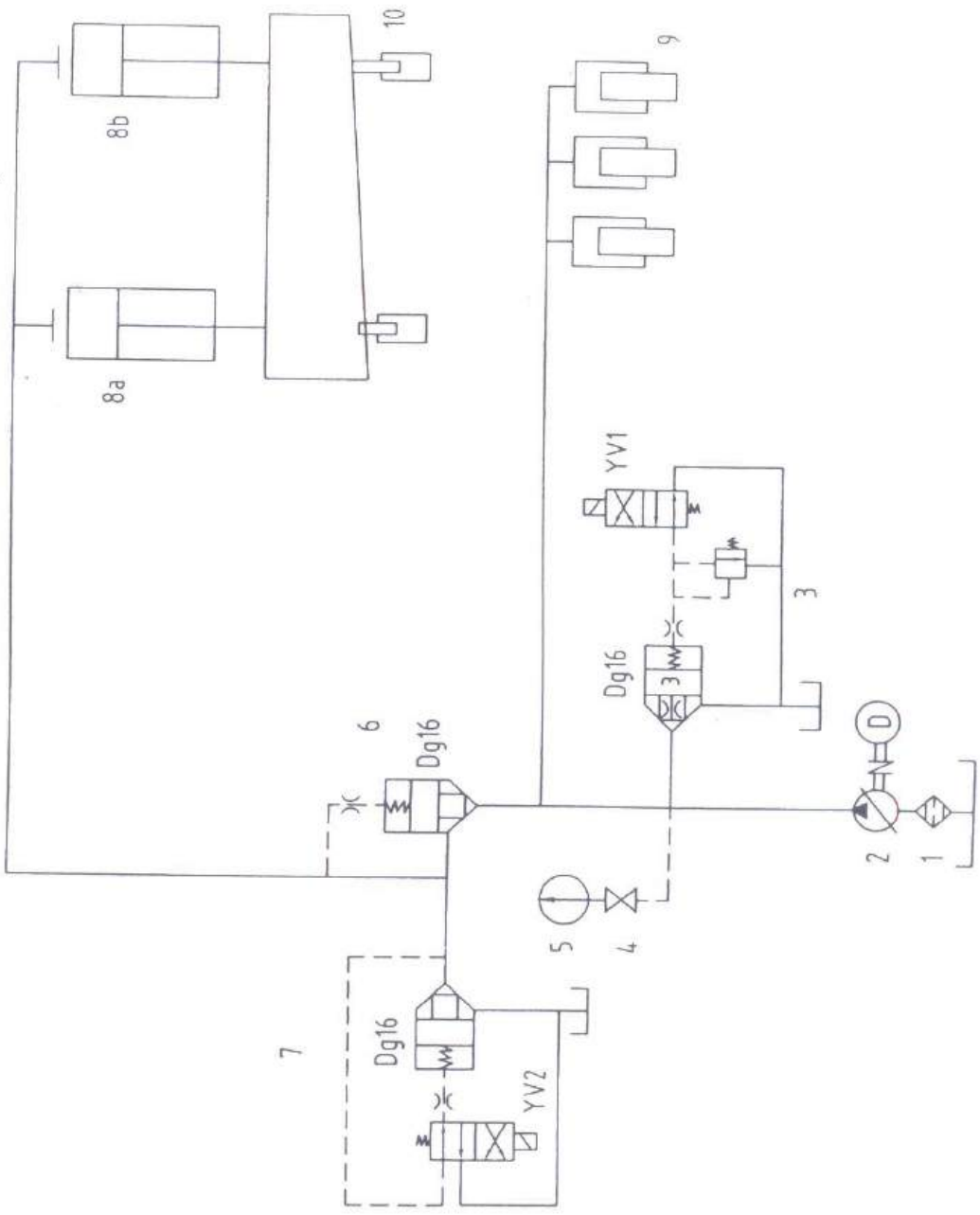
Pressure oil is provide by pump 2, and max. working pressure is 18MPa, To p knife rest return by Nitrogen cylinder 13, and cylinder pressure is about 5MPa.

Hydraulic system principle see attached drawing, oil enter into combination valve and holding cylinders through oil pipe, then oil enter in electromagnetic directional valve through orifice, and finally back to oil tank.

Because of orifice, it cause different pressure in the two sides of orifice and open the cone valve, then oil return to oil tank. Now main oil circle without pressure and machine doen not work. when YV1 of valve 3 and YV2 of valve 7 power on, pressure of main oilway increase, holding cylinder 9 press, oil enter into combination valve7 and cylinder 8throuth cone valve 6, YV2 power on and cone valve closed, main cylinder will working down. when top knife rest move to bottom dead point, YV1 and YV2 power off, all oilway unloading, oil in main cylinder back to oil tank through combination valve 7, and oil in holding cylinder return to oil tank through combination valve 3.

Failure and Remotion of hydraulic system

Apperance of damage	Reasons	Way of remotion
The oil line is formed without pressure. And No action of the top rest.	the Magnetic Directional valve's electric plug not touch well	Examine and repair the Electric plug
	The pith of the Magnetic Directional valve is blocked up or coarse. And there is no operation. The valve pith of the combined valve has sundries at the mouth of the sealing washer, There is no sealing effect. The throttle hole of the combined valve is blocked up.	Examine, strip and clean.
The return of the top rest is slowly or can't return to top dead point. Top rest and swaging cylinder can't work harmoniously	Nitrogen pressure of nitrogen cylinder is not enough	Fill the Nitrogen cylinder to increase pressure.
	Magnetic valve isn't arriving position	Check the magnetic valve


10
9
8b
8a
YV1
3
Dg16
6
Dg16
2
1
5
4
7
Dg16
YV2

5.La estructura de la máquina

(1) Estructura

Esta máquina tiene una estructura de estructura unida por soldadura con buena rigidez.Se colocan dos cilindros a la izquierda y a la derecha de las columnas verticales, la viga de la hoja móvil se coloca en la superficie de la mesa de trabajo para que la viga de la hoja inferior se pueda ajustar ligeramente. también tiene una bola de alimentación en la mesa de trabajo Fácil de operar

(2) Descanso superior

EsoC s hecho de placas de acero unidas entre sí mediante soldadura que garantiza una rigidez fina, utiliza un manguito excéntrico (8) como punto de apoyo para hacer un giro recíproco para terminar el corte de las placas accionado por dos cilindros y un cilindro de retorno

La hoja del soporte superior y la superficie de apoyo es vertical y forma una curva, de modo que el espacio entre las hojas superior e inferior puede ser idéntico

(3) Equipo de estampación

Consiste en varios cilindros de aceite de estampación (figura 4) que se montan en la tabla de soporte en la parte delantera del bastidor.El cabezal de embutición superará la fuerza de tracción del resorte (18) y presionará hacia abajo después de que el cilindro de aceite de estampación esté lleno de aceite. Presione la placa con fuerza Después de terminar el corte, vendrá volver a su posición original con la ayuda de la fuerza de tracción del resorte La presión del swag se puede aumentar a medida que el grosor es cada vez más grande

(4) Calibre delantero y trasero

Calibrador frontal: se coloca en la superficie de la mesa de trabajo. El valor se muestra en una escala de medición para ajustar el bloque en movimiento, luego llega el valor de bloque necesario Es más conveniente utilizar el calibre frontal para cortar placas más delgadas

El tope trasero (figura 6) está instalado en el apoyo superior y se mueve hacia arriba y hacia abajo con el apoyo superior. el ajuste del tope trasero es impulsado por el motor de 0 55kw a través del engranaje reduce la velocidad y es impulsado por la varilla Simplemente presionando el botón de ajuste D + D (oD -D) Puede ajustar moviendo la placa del indicador hacia adelante (o hacia atrás) Si el valor de ajuste necesario no se alcanza mediante el ajuste automático, girando manualmente la rueda de mano (41) para encontrar el ajuste manual de modo que pueda alcanzar el valor necesario Por lo tanto, el ajuste del tope trasero es conveniente y de confianza

El rango de ajuste del tope trasero es de 20 a 600 mm Cuando la longitud de una chapa de metal a cortar es mayor que la distancia máxima del tope trasero. La placa de tope (29) debe llevarse a la posición final Y, el cojinete (36) y el plano oblicuo en la viga de soporte (33) puede elevar la tabla de calibre (29) para que la placa de diferente longitud se pueda cortar al azar

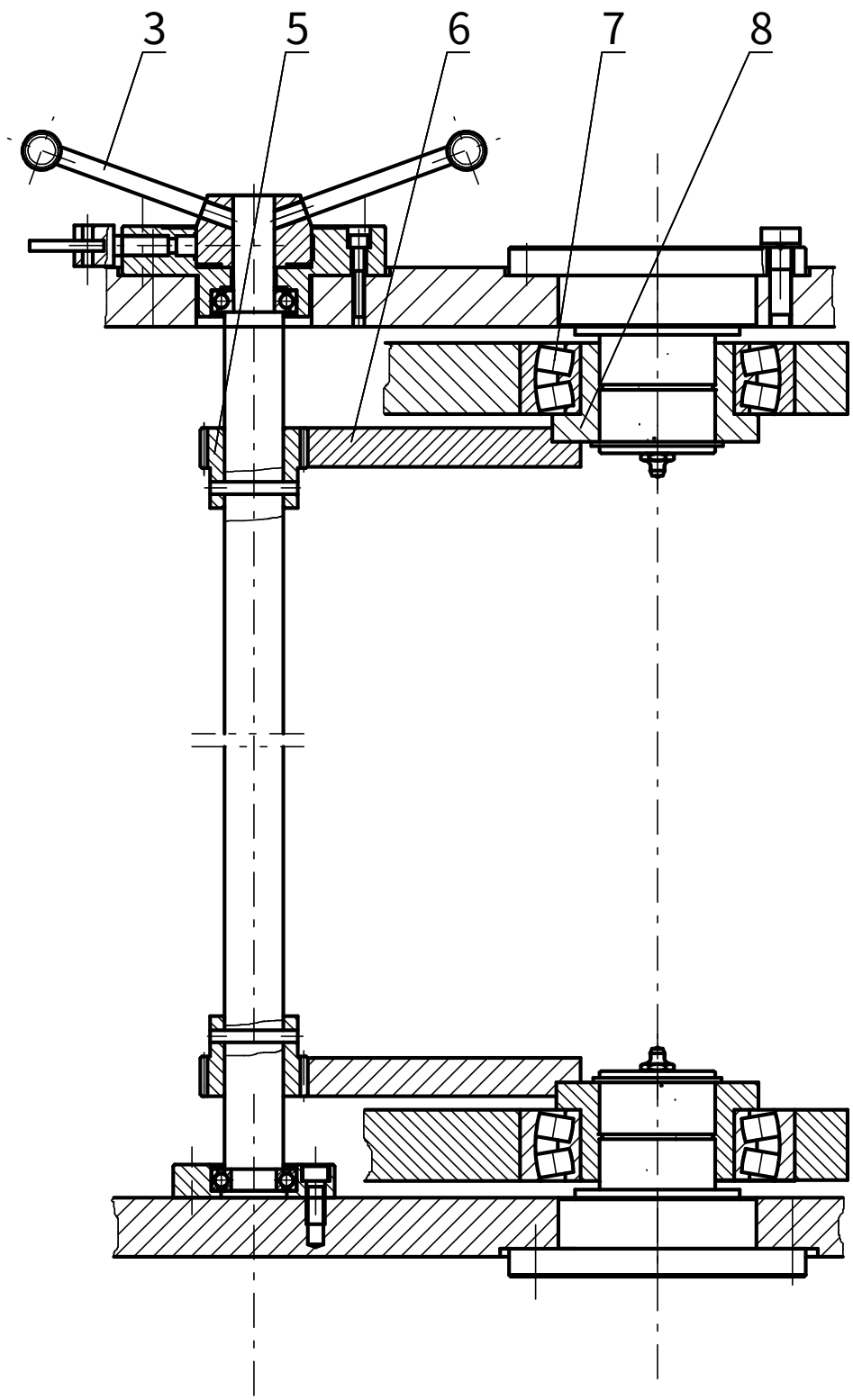


Fig 2 Ajuste de la holgura del mecanismo de las cuchillas

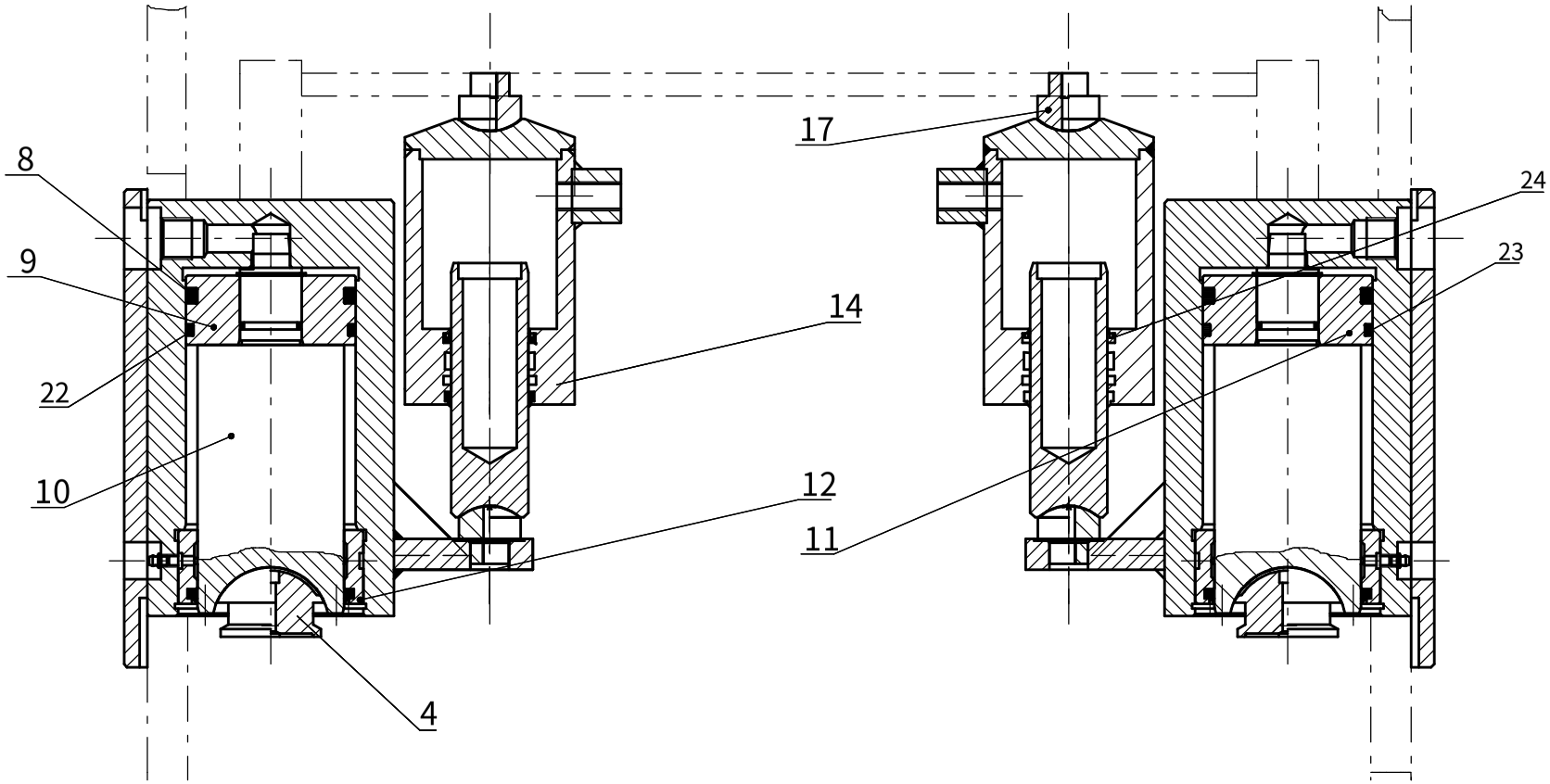


Fig. 3 Cilindro de aceite y cilindro de carrera de retorno

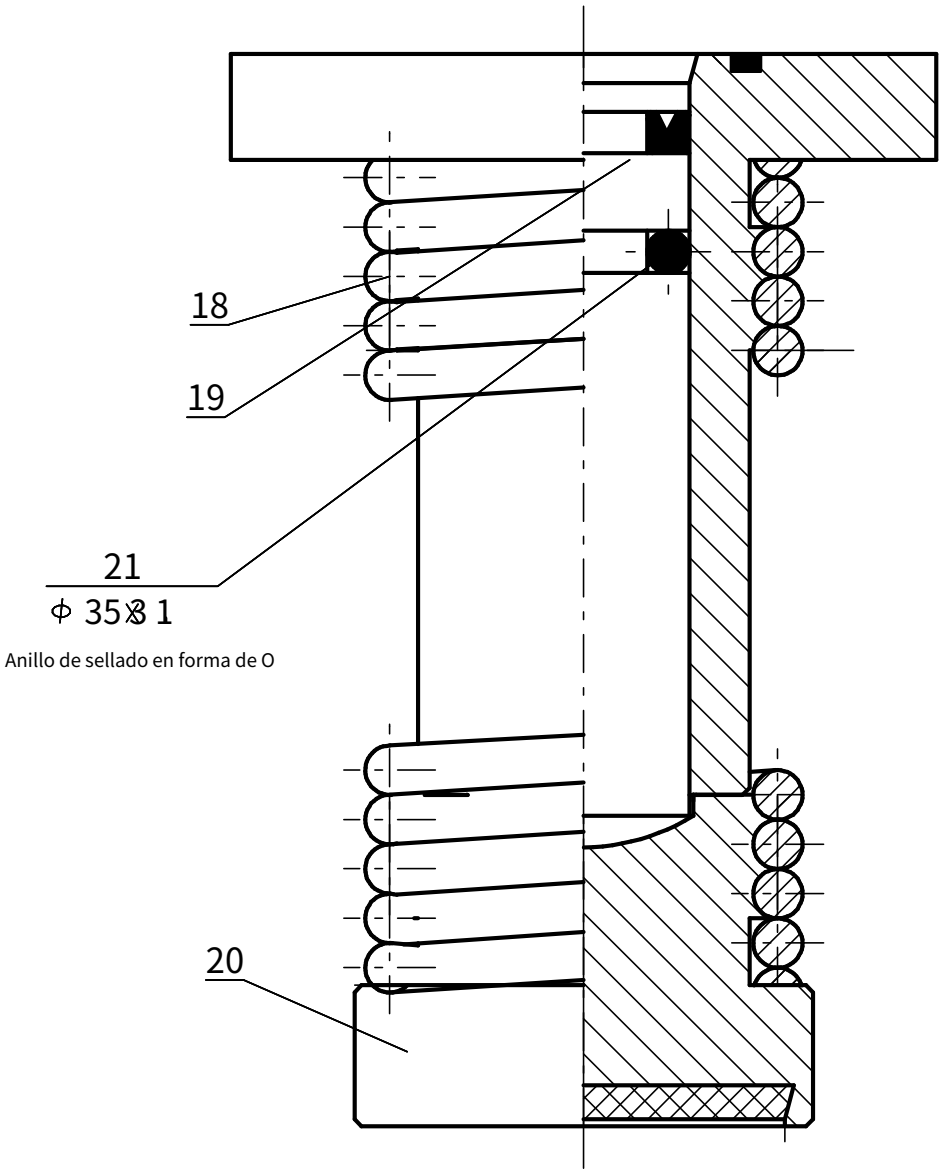


Figura 4 Cilindro de aceite de estampación

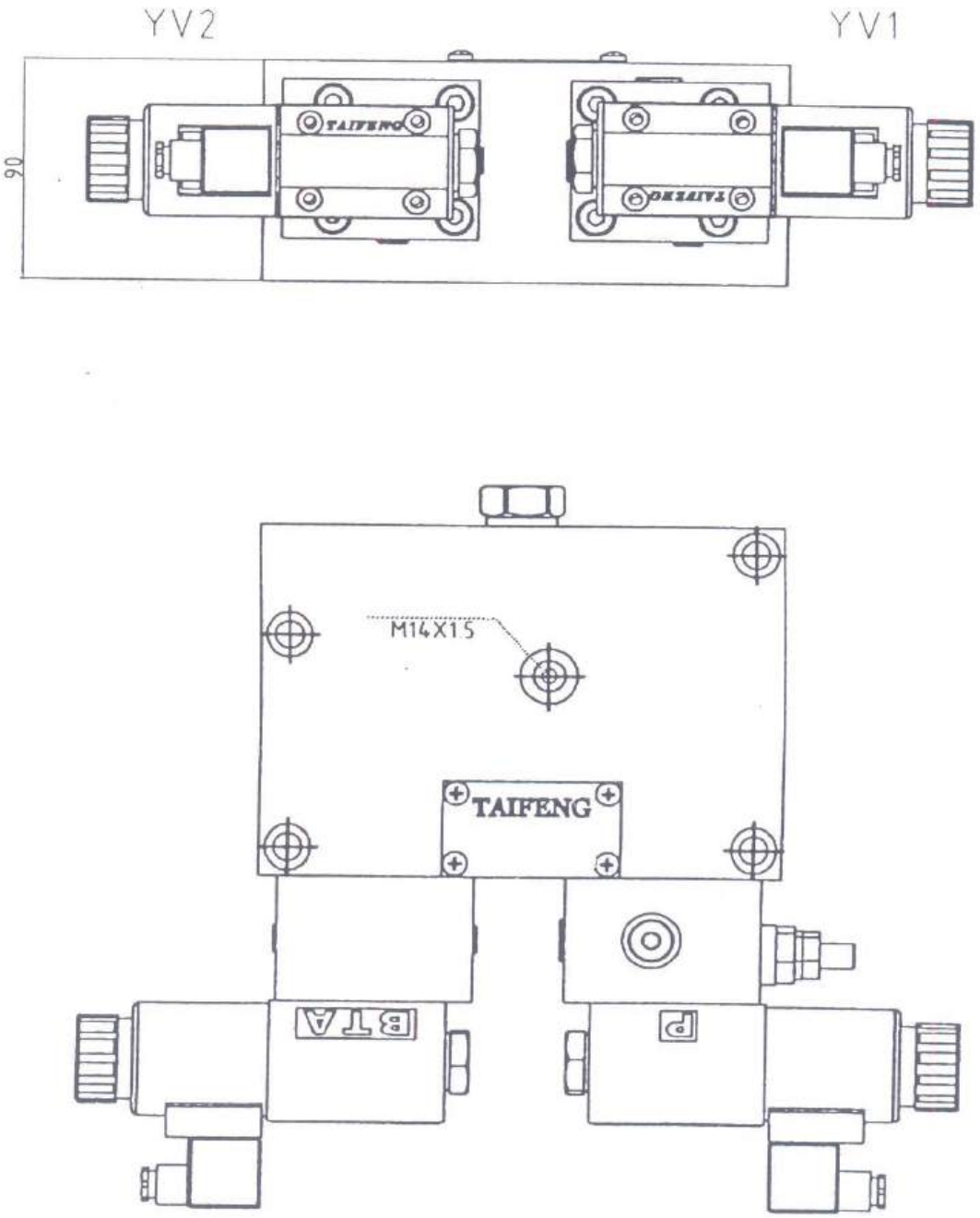


Fig 5 Combined Valve

Automóvil club británico

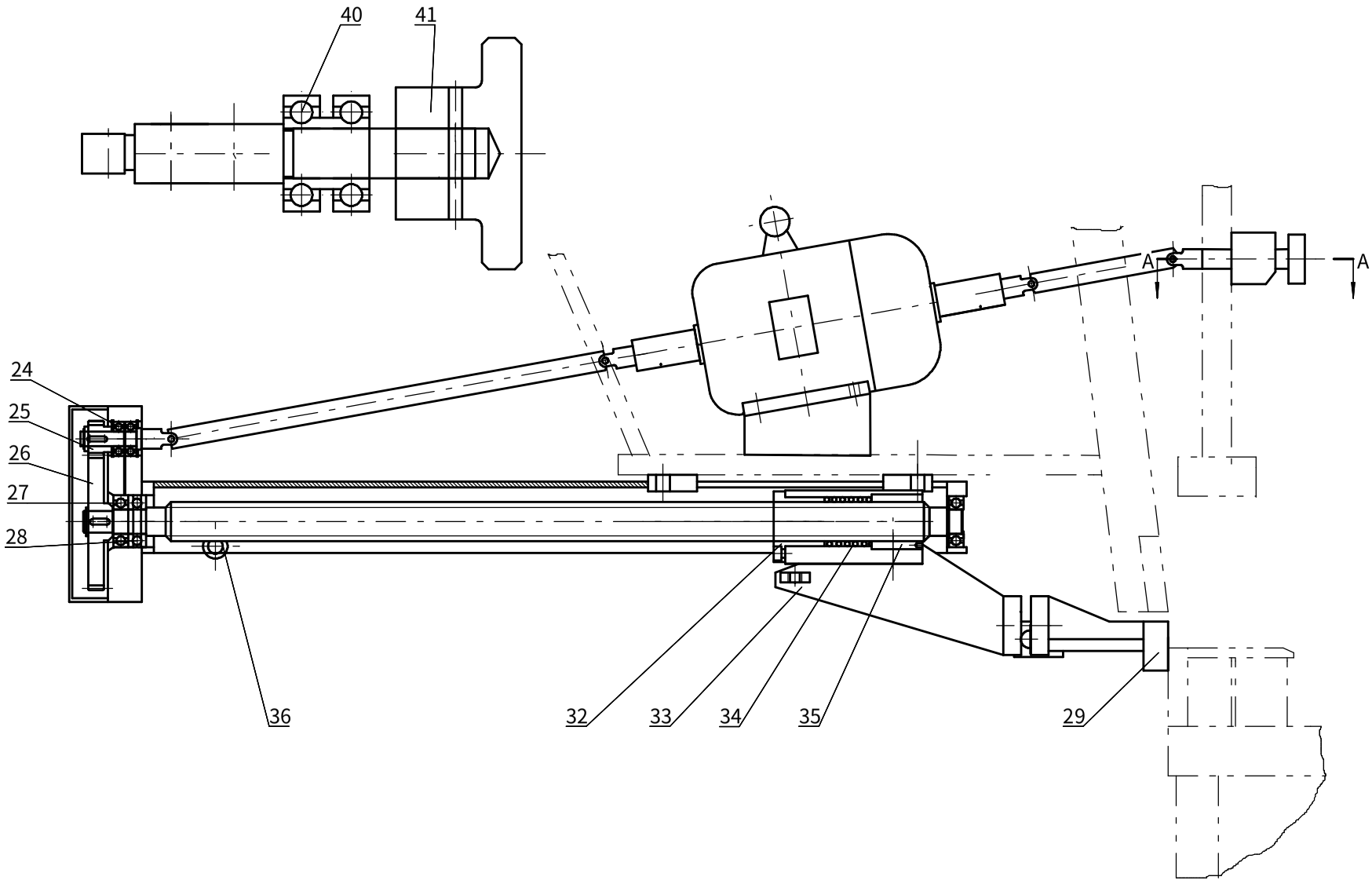


Figura 6 atrás Indicador

6.Sistema eléctrico de la máquina

El suministro eléctrico para la máquina es 380V, 50HZ, 3 PH El motor adopta 380V, 3 PH Y el transformador de control adopta 380V, 2 PH.Y la salida de 220V del transformador de control es para las luces Y.110 V es para el bucle de control Después de ser conmutada , 29V alimenta la válvula solenoide y el relé contador 6V es para el indicador .

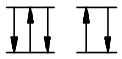
La caja de control está fijada en el lado izquierdo de la máquina La caja eléctrica está equipada con un mecanismo de enclavamiento y un botón de parada de emergencia, para controlar la fuente de energía de la máquina.

Espere el interruptor de pedal SF, todos los componentes de operación de la máquina están fijados en la estación de botones en la parte delantera de la máquina La función de cada componente de operación está marcada con el símbolo .

Las instrucciones de la operación son las siguientes: Gire la manija de enclavamiento mecánico hacia la D CerrarD posición A continuación, encienda la alimentación y encienda el botón de la llave (), y el circuito de control alimentado. Indicador HL2 () se enciende si la máquina está encendida

Presione el botón SB3 O SB4 (+ ⌐|— -) alargar y reducir la distancia del tope trasero Hay interruptores de carrera (SQ4, SQ5) en la posición Max y Min del tope trasero para limitar la carrera .

Presione el botón SB2 () para poner en marcha el aceite bomba Hay un indicador en el botón SB2 para indicar si la bomba de aceite está funcionando .

Gire el interruptor SA3 () para elegir la cizalla modo Cuando el botón SA3 está en la posición (la máquina ), cortará la placa con D Un solo golpe D Cuando el botón SA3 está en la posición (), la máquina  cortará el plato con D Carrera continuaD Cuando el botón SA3 está en la posición de D Un solo golpeD ,el portacuchillas superior bajará cuando se pise el pedal y el portacuchillas superior llegará a la posición muerta hacia arriba si suelta el botón SF Presione el botón SF si necesita corte de nuevo la placa de corte Recuerde no aflojar el pedal SF si la placa no se ha cortado por completo o la hoja de corte se dañará Cuando el SA3 esté en el posición D Carrera continuaD , presione el pedal SF (recuerde no presionarlo durante mucho tiempo o será un solo golpe) Y la máquina continuará cortando la placa Presione hacia abajo el SF nuevamente, la máquina dejará de cortar continuamente la placa .

Además, la máquina tiene el ajuste de la longitud de corte, contador, etc.Gire el botón ) para ajustar el (longitud de corte

Gire el interruptor SA2 ) para encender el (luces

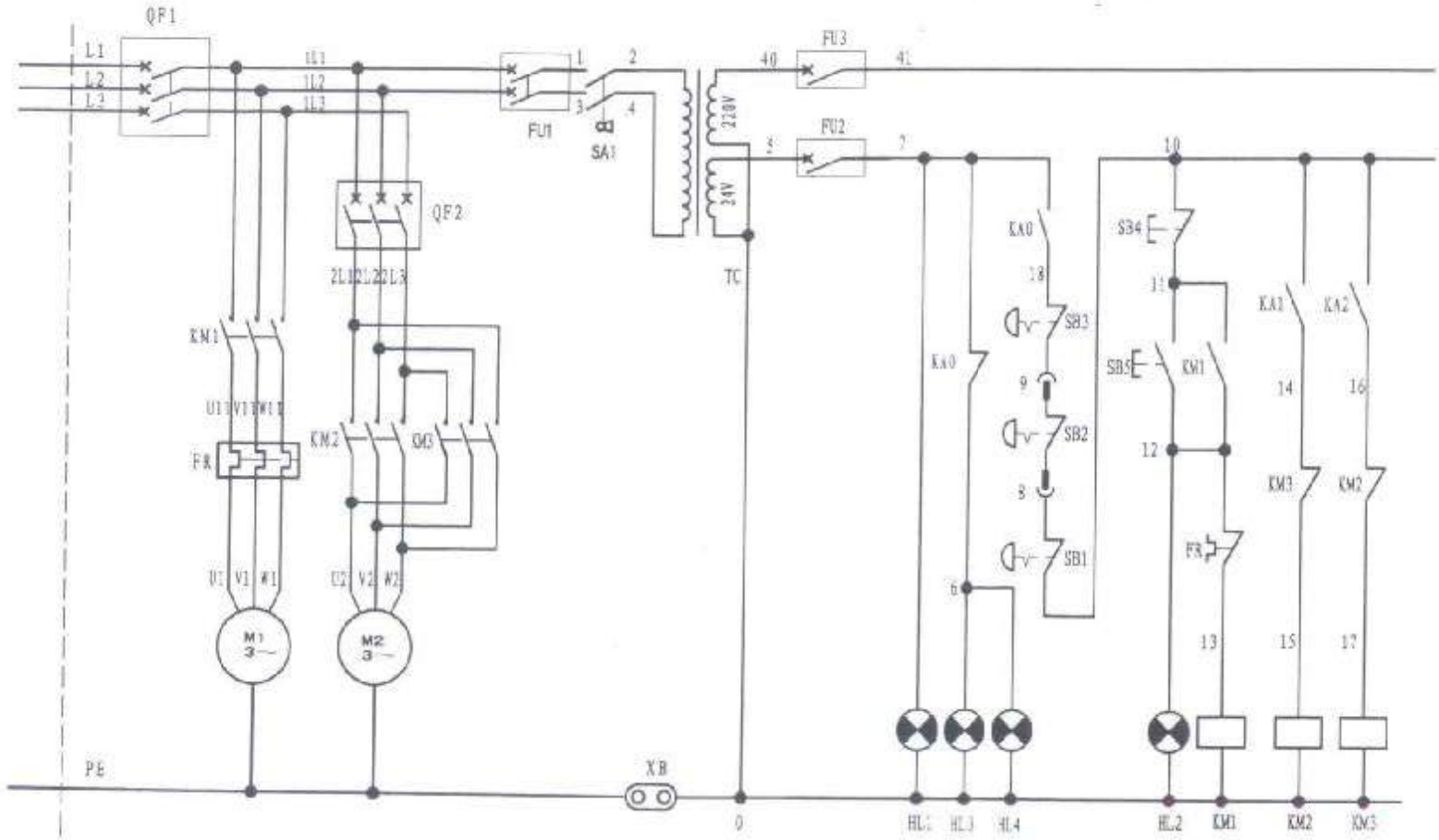
Recuerde bloquear el interruptor SA1 y el enclavamiento eléctrico en la caja de control al salir de la máquina .

E10 La máquina debe estar bien conectada a tierra .

HYDRAULC SWING PLATE SHEARING MACHINE

Total: Page:16

Outside	Air switch	Oil pump motor	Backgauge motor	Primary protection	Power lock	Power transformer controller	Secondary protection	Power indicator	Urgent stop	Oil pump working and stop	Backgauge control Protection



1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20

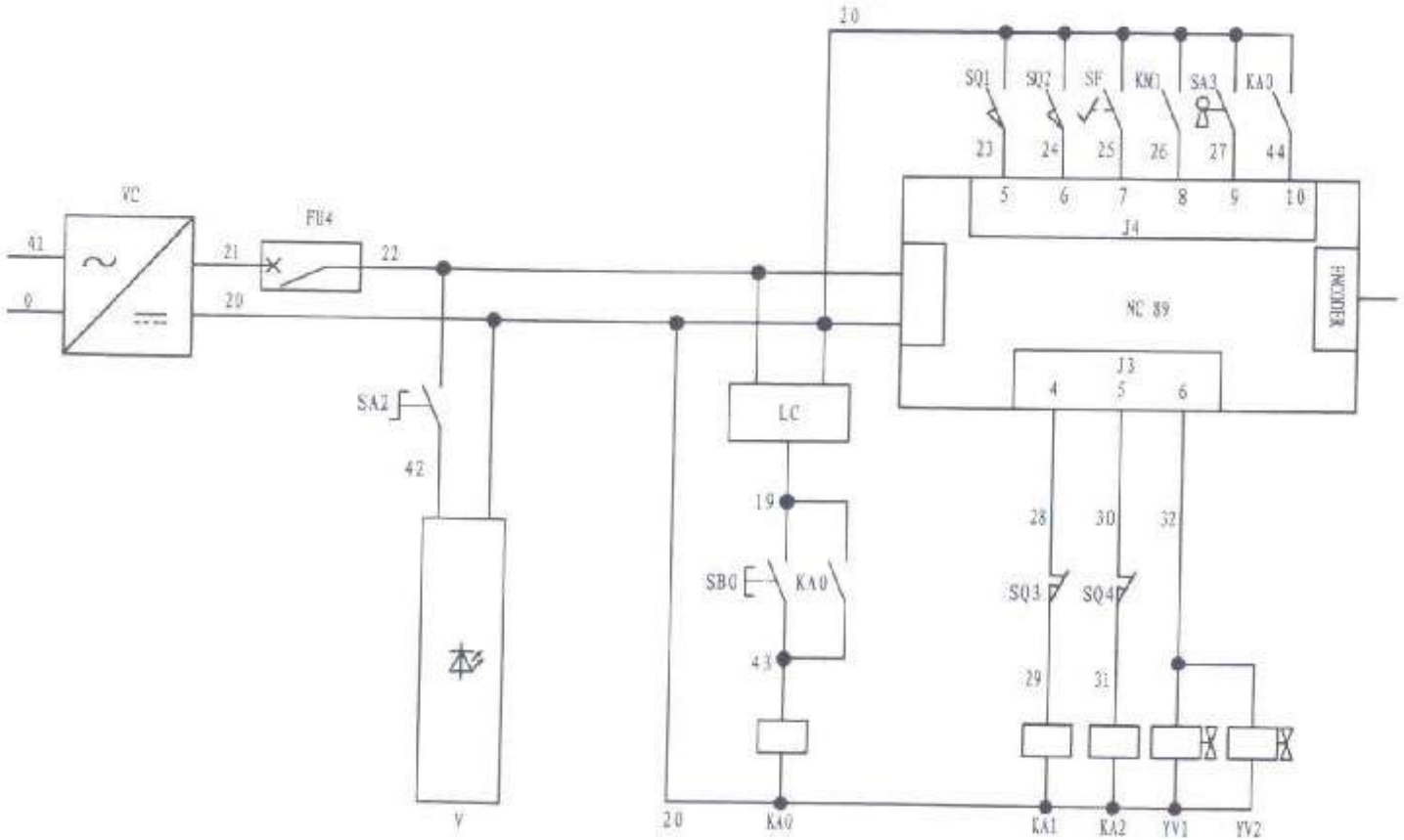
A B C D E

HYDRAULIC SWING PLATE SHEARING MACHINE

Total:

Page: 17

Power switch	Protection	Lighting	Potoelectric switch	NC8S	Upper limit	Lower limit	Foot down	Oil pump	Function trasform	Encoder



A B C D E

21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40

List of electric equipment

list 1

Electric code	Designation and Application	Type	Qty.	Remark
QF1	Breaker	NSC60E3040	1	
FR	Thermo Relay	LRD-32C	1	
QF2	Breaker	C32NC63P	1	
FU1	Breaker	C32NC32P	1	
SA1	Key Switch	SB2BG21C	1	
TC	Controlling Transformer	JBK5-400	1	
A1-A3	Photo switch	E 3JK-5M1	3	omron
FU2 FU3 FU4	Breaker	C32NC41P	3	
HL1	Indicator	XB2-BVB3PC	1	white
SB1 SB2 SB3	Emergcncy rutton	XB2 BS542C	3	red self-locking
SB4	Button	XB2 EA142	1	
SB5	Green button	XB2 BW 33B1C	1	
KM1	Contactor	LC1-D1810C	1	
KM2 KM3	Genernal relay	LC1-09B5C		

7.Polipasto, transporte e instalación

(1)La máquina es transportada por el diagrama para izar (Fig 10).

(2)Cimentación de la máquina: a La dimensión de la cimentación puede referirse al Diagrama de instalación de la cimentación (figura 11).

b.La tierra alrededor de la base debe apisonarse La profundidad depende de la textura del suelo

(3)La instalación de la máquina

Mientras se instala y fija la máquina, se debe desmontar la cubierta de la bola rodante y se debe medir una regla recta de un metro en los dos cojines.C s tolerancia puedeC t ser más de 0,2 mm en el nivel entrecruzado por cada 1000 mm

8.Lubricación

El formulario de llenado de la pistola de aceite se utiliza para lubricar todos los puntos de lubricación principales.Los siguientes son los puntos de lubricación:

No.	Nombres del sitio petrolero	Llenado de aceite Monto	Tiempo	marca de Aceite lubricante
1	Cada uno de los puntos del lado superior e inferior para cilindro de retorno izquierdo y	pequeña	una vez por dieciséis horas	Calcio grasa ZG-3 (GB491-65) aceite machanical N46 (GB443-84)
2	derecho Cada uno de los puntos de y justo para la mudanza atornillar el tope trasero	medio	una vez por 8 horas	
3	La izquierda y la derecha cada uno un punto para el apoyo del columpio punto de ing en el descanso superior	pequeña	una vez por 24 horas	
4	La izquierda y la derecha cada uno punto de la manga del eje para ajuste del eje libre	pequeña	uno para 48 horas	
5	Cada uno de los puntos de posición varilla para izquierda y derecha cilindro	medio	una vez por 8 horas	
6	Cada punto de bloque de amortiguación para cilindro izquierdo y derecho	medio	una vez por 8 horas	4 # grafito de litio grasa (Q / SY 1000-65)

NTOE: 1 En uso práctico, la grasa ZG (50%) debe mezclarse con aceite mecánico (50%)
2.La grasa de litio y grafito debe mezclarse con aceite mecánico (30%) en uso 3 El aceite del tanque de aceite debe cambiarse una vez al año por lo general

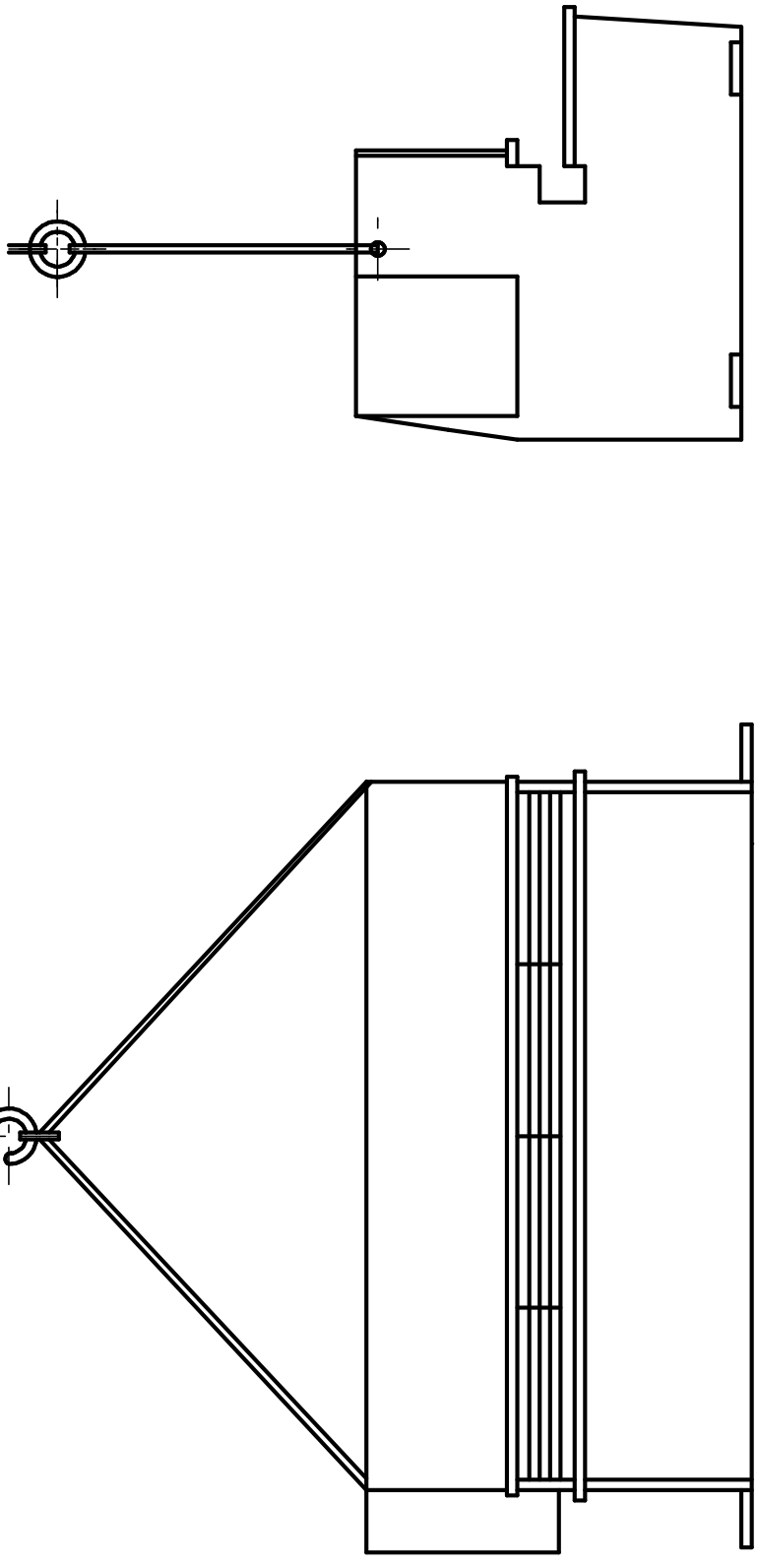
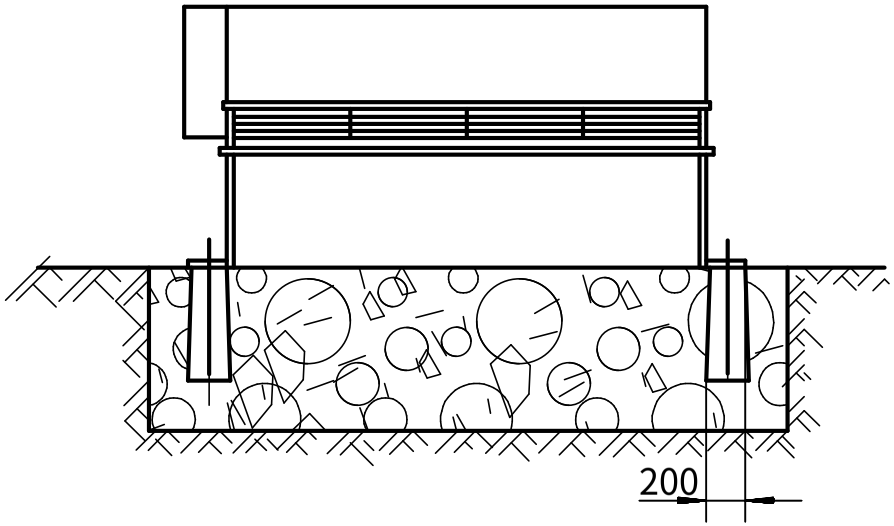
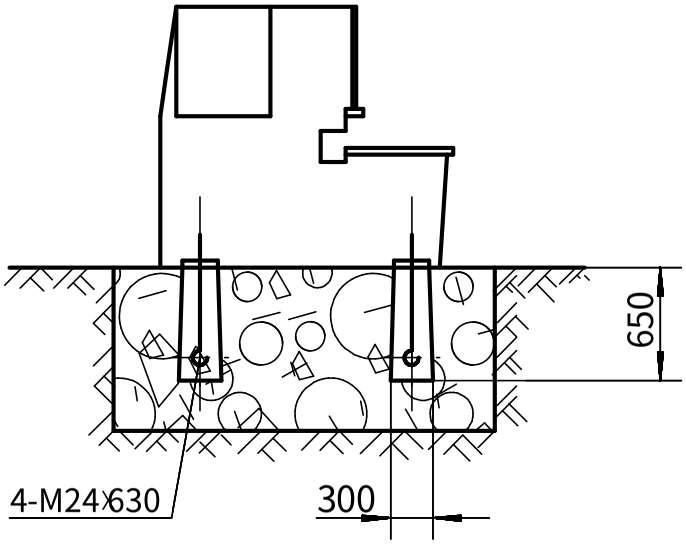
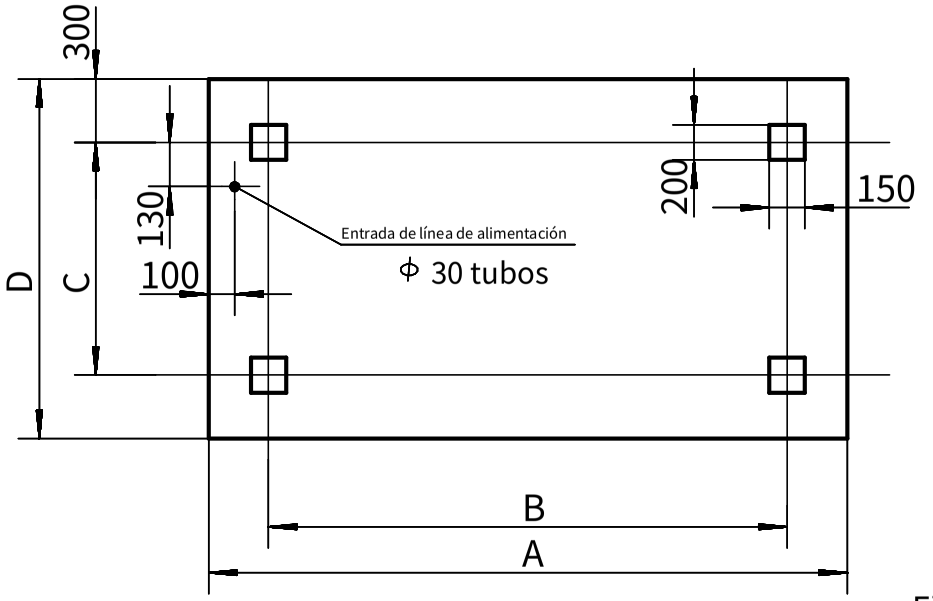


Figura 11 Diagrama de elevación e instalación







Producto / dimensión	2000	2500	3200	4000
A	3000	3500	4200	5000
B	2330	2880	3582	4382
C	1150	1150	1350	1500
D	1900	1900	1900	2250

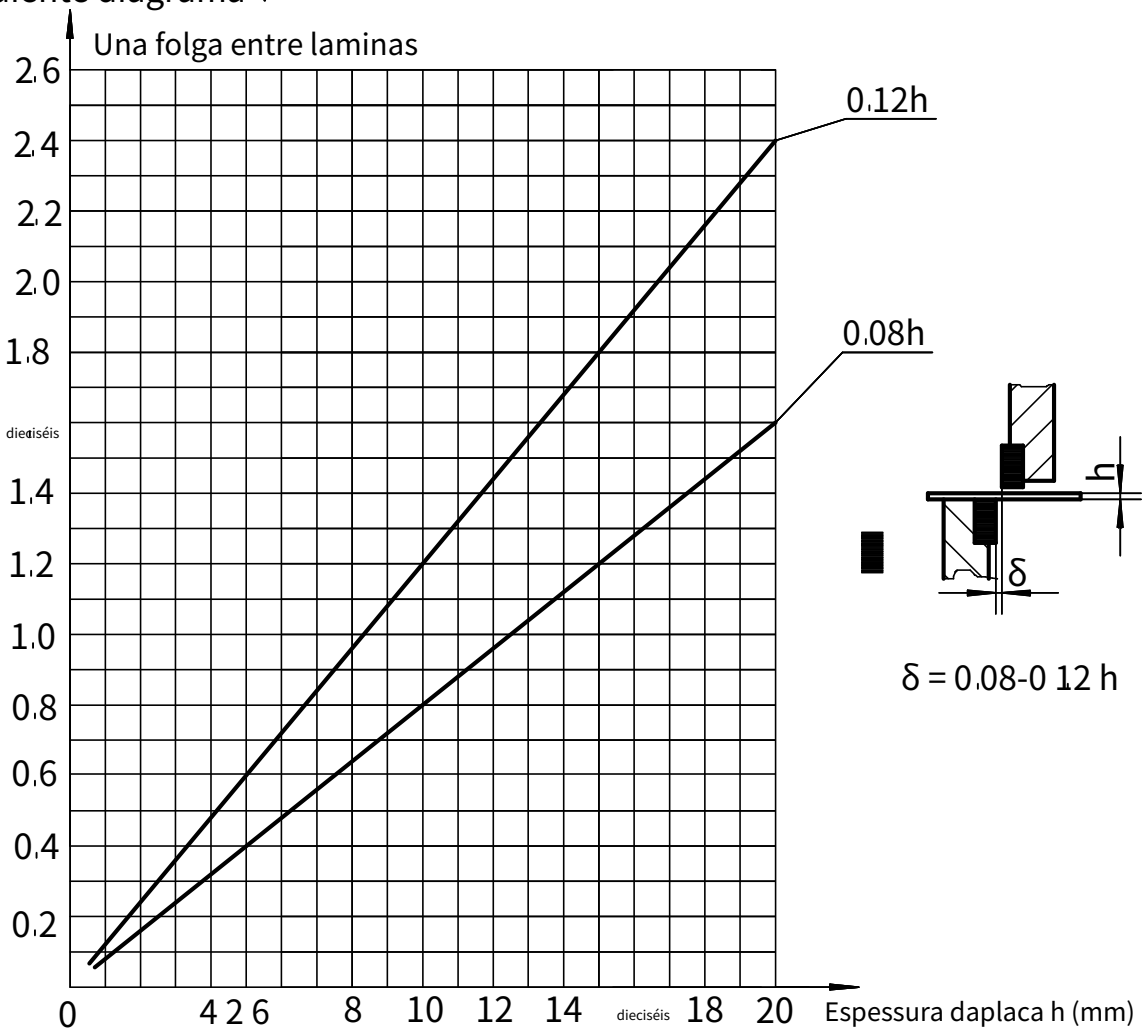
NOTA: La profundidad de la base.
depende de la textura del suelo

Fig 12 Diagrama de cimentación de instalación

9.Ajuste y funcionamiento

1.Ajuste de la holgura de los filos

Si las formas correctas de ajustar la holgura de los filos de corte son los factores importantes que afectan la calidad de corte y la vida útil de las cuchillas, la selección de la holgura puede referirse a siguiente diagrama .



Afloje los tornillos (3), durante el ajuste de la holgura (ver 2) Luego gire la manija para solicitar la graduación y los tornillos de bloqueo al final La válvula de bola (a la derecha de la máquina, fuera de los cilindros) se usa para medir el grado de uniformidad para la holgura del borde de corte en la parte superior y cuchillas inferiores Los detalles usan: como un solo golpe, cuando el descanso superior se mueve al punto muerto inferior, la válvula de bola de giro rápido, cierra la vía de aceite para dejar que el descanso superior se detenga en el punto muerto inferior Luego, solo un poco para abrir y cerrar la bola. válvula, el resto superior subirá cada vez más, por lo que puede medir el grado de uniformidad de la holgura del filo

2 Preparación para la operación:

(1) Limpie la tierra aceitosa para cada parte, observe la línea de índice de la válvula de bola debe apuntar a D comienzoD posición .

(2) Llene de grasa lubricante cada pieza .

(3) Llenar la filtración 46 # aceite hidráulico de congelación inferior a aceite tanque .

(4) La puesta a tierra de la máquina, encender, examinar la coordinación de cada equipo eléctrico .

3 Operación

(1) Encienda la máquina para que funcione en vacío muchas veces, solo intente corte placas de diferentes espesores (desde placas delgadas a gruesas) después de asegurarse de que todo esté bien .

(2) Durante el cizallamiento, abra el interruptor del manómetro, observe válvula de presión de la vía de aceite, si aparece algo anormal, ajuste la válvula de flujo para alcanzar el estándar .

(3) Si algo como ruido anormal o tanque de aceite demasiado caliente Aparece inmediatamente detenga la máquina y examínela (la temperatura más alta para el tanque de aceite debe mantenerse por debajo de 60°C)

10 Técnica de seguridad y mantenimiento

1 Los operadores deben familiarizarse con la máquinaC s estructura y función La máquina es operada por varias personas al mismo tiempo Por lo tanto, debe haber una persona en general a cargo de ella y trabajo directo

2 DonC t ponga las manos en las cuchillas superior e inferior para evitar accidentes

3 DonC No ponga nada sobre la mesa de trabajo para evitar accidentes. .

4 Examine el filo del borde de la hoja a tiempo, si encuentra que el borde de la hoja está desafilado a tiempo para afilarlo o cambiarlo, simplemente afile el borde de la hoja C El grosor está bien

5.Examine cada parte de la máquina a intervalos regulares Mantenga la máquina y el suelo cercano limpios El aislamiento debe estar bien

6 Mantenga limpio el filtro de aceite en forma de red que está instalado en la entrada de aceite de la bomba de aceite Deje que el filtro de aceite mantenga las cantidades de aceite, si el filtro de aceite está bloqueado, la cantidad de aceite se reducirá, hace que la bomba de aceite Vaciar y afectar la vida útil de la bomba de aceite.

7 DonC t Llene aire comprimido de oxígeno u otro gas inflamable en el cilindro de nitrógeno. El nitrógeno debe procesarse lentamente en el cilindro de nitrógeno.

8 Llene el nitrógeno en el cilindro de nitrógeno con la herramienta de llenado, la presión de llenado es de aproximadamente 5 MPa

9.Debe descargar nitrógeno primero antes de dejar salir el cilindro de nitrógeno

Problema del sistema eléctrico

Problema	Causa probable	Acción correctiva
Motor principal puedenC t empezar	Parada de emergencia presionada	Restablecer parada de emergencia
	Protección térmica activa	Restablecer térmica dispositivo de protección
	Módulo de parada de emergencia no reiniciar	Restablecer la parada de emergencia módulo

Problema de mecanismo

Rebaba en borde cortado	Cuchillas desafiladas	Gire o afile las cuchillas: vea el cambio de cuchillas vea el cambio de cuchillas
	Valor correcto de holgura excesiva de la cuchilla	Ajuste la holgura a un Ver ajuste de la hoja
	Las deformaciones de material de mala calidad	Segundo stock que está lleno de no se pueden cortar tan limpias o exacto como acero de alta calidad
Placa cortada no paraller	Tope trasero perdido paralelismo con hoja para	Ajustar el tope trasero ver MANTENIMIENTO ajuste del tope trasero
	No hay suficiente fuerza de sujeción	Aumentar el cilindro trasero presión alrededor de 4 5MPa a 5 5MPa
Por encima o por debajo cortes de tamaño	Encimera	Ajustar el contador
	Latigazo trasero	Compruebe la tuerca del tornillo del tope trasero.
	Procedimiento de configuración incorrecto	Alswys trae la espalda parada del indicador hacia la final de la mesa configuración
Meciéndose en pesado cizallamiento	Cizalla no nivelada	Ver instalación-nivelación
No se corta corte de capacidad	Presión de ariete insuficiente	Ver problema hidráulico. Presión puedenC t aumentar
	La válvula de bola debe estar cerrada	Abra la válvula de bola en el lado derecho de la máquina.
Ram puedeC t volver a la posición superior	Bola semicircular desplazamiento	Compruebe el extremo del vástago del pistón en el cilindro principal.Restablezca la bola semicírculo en él.

11 Lista de rodamientos

No	Número de código de rodamiento	Nombre del rodamiento	Especificación	Precisión Calificación	Cant.	Adecuado Posición
7	3518	Doble centrípeto Rollo de superficie de bola Soportando	d = 90, D = 160, H = 40		2	Resto superior
24	80202	Rodamiento de bolas centrípeto único a prueba de polvo	a = 15, D = 35 H = 11		2	calibre trasero
27	80205	- ídem-	a = 25, D = 52, H = 15		4	- ídem-
28	8305	Rodamiento de bolas de empuje de una sola dirección	a = 25 D = 52, H = 18		2	- ídem-
36	180502	Rodamiento de bolas centrípeto simple con anillo de sellado	a = 15, D = 35, H = 14		2	- ídem-
40	180502	- ídem-	a = 15, D = 35, H = 14		2	- ídem-
30	941/12	Rodamiento solamente con anillo de presión	d = 12, D = 17 B = 12		2	- ídem-

12 Lista de equipo

No	Nombre	B	a	metro	Z	da	β	fa		H	Precisión Calificación	Cantidad de material		Calor Dirección de tratamiento	Giratorio
5	Piñón	20	20°	2		25	50		1	45	9FH	GB10095	45	2		
6	Engranaje en forma de abanico	18	20°	2		250	500		1	45	9HK	GB10095	45	2		
25	Engranaje	18	20°	2		17	34		1	45	8GJ	GB10095	45	1		
26	Engranaje	16	20°	2		68	136		1	45	8GJ	Gb10095	45	1		

13、Lista de accesorios básicos adjuntos para la máquina

No	Nombre	Especificación	Cant. 、	Observación
	Pistola de aceite	200cm ^{3}	1	
	Herramienta de llenado		1	
	Antena		1	

14、Lista de piezas de fácil uso adjuntas para la máquina

No	Nombre	Especificación o parte de la marca que pertenece a		Cant. 、
13	Anillo de polvo	d95	Cilindro de aceite	2
dieciséis	Anillo de polvo	d65	Cilindro de carrera de retorno	2
21	bucle de sello en forma de O	35X3 5	estampar	10/8/12 /15
22	bucle de sello en forma de O	110X5 、7	Cilindro de aceite	1
23	Lazo de sellado en forma de O	100X5 、7	Cilindro de aceite	1

15 Lista de piezas de fácil desgaste proporcionadas por los suscriptores

No	Nombre	Material	Peso	Cant.	Partes pertenecientes a
1	Cuchilla superior	6CrW2Si		Portaherramientas 2/2/3/4	
2	Hoja inferior	6CrW2Si		2/2/3/4	framenork
17	bloque de semicírculo	ZQSn10-1		4	cilindro de retorno
4	bulbo	ZQSn10-1		2	Cilindro de aceite
32	Tornillo	QT500		2	Calibrador trasero
35	Tornillo	QT500		2	Calibrador trasero
20	Bloque de cojín	Ether Polyuerthane		10/8/12/15	estampar cilindro

CORTADORA HIDRÁULICA DE PLACA OSCILANTE

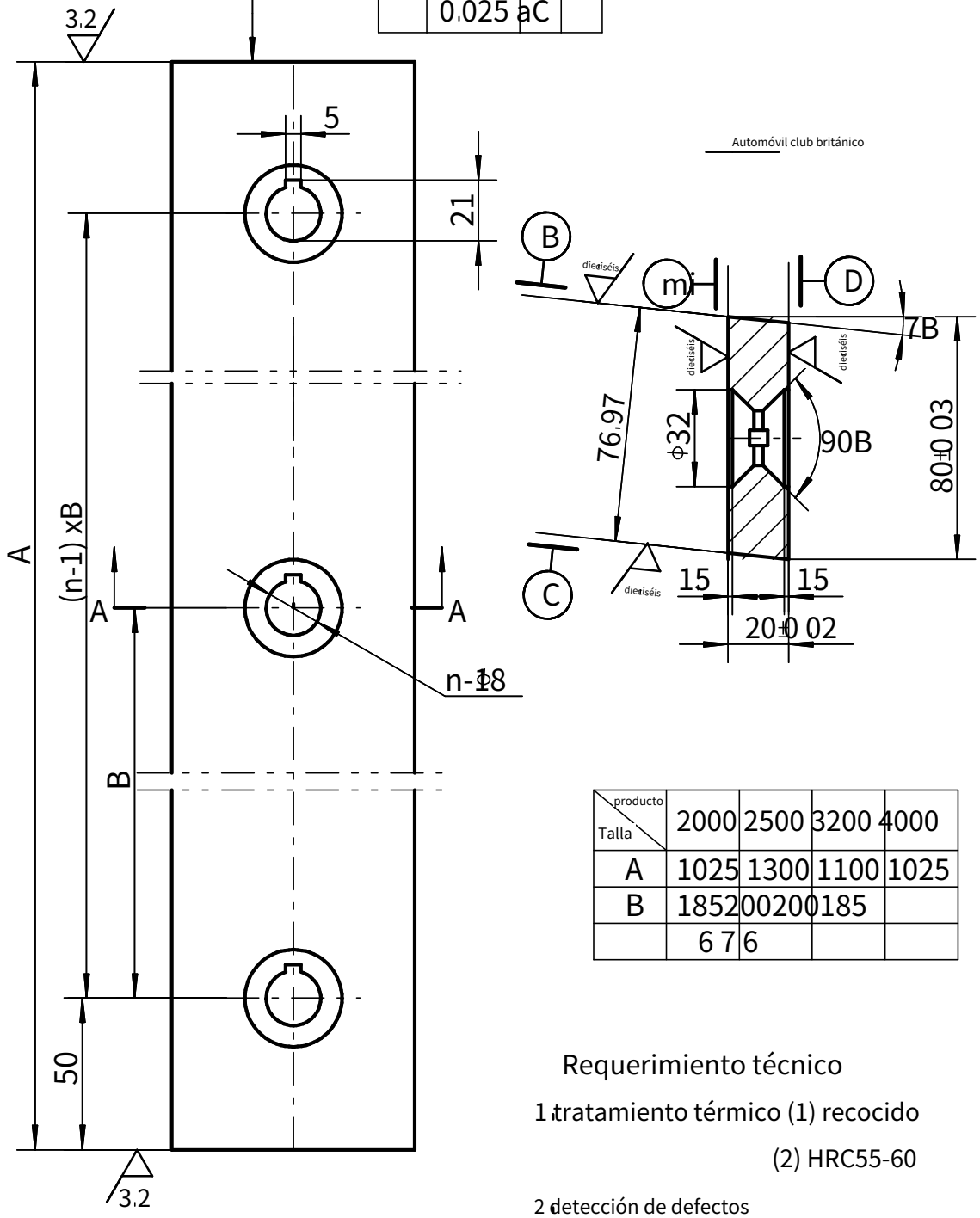
Total:

Página: 31

Superficie de dos lados

⊥	0.012 ED	
	0.025 aC	

Otros 12.5



producto / Talla	2000	2500	3200	4000
A	1025	1300	1100	1025
B	1852	00200	185	
	6 7	6		

Requerimiento técnico

1. tratamiento térmico (1) recocido

(2) HRC55-60

2. detección de defectos

3. La hoja no debeC ser embotado

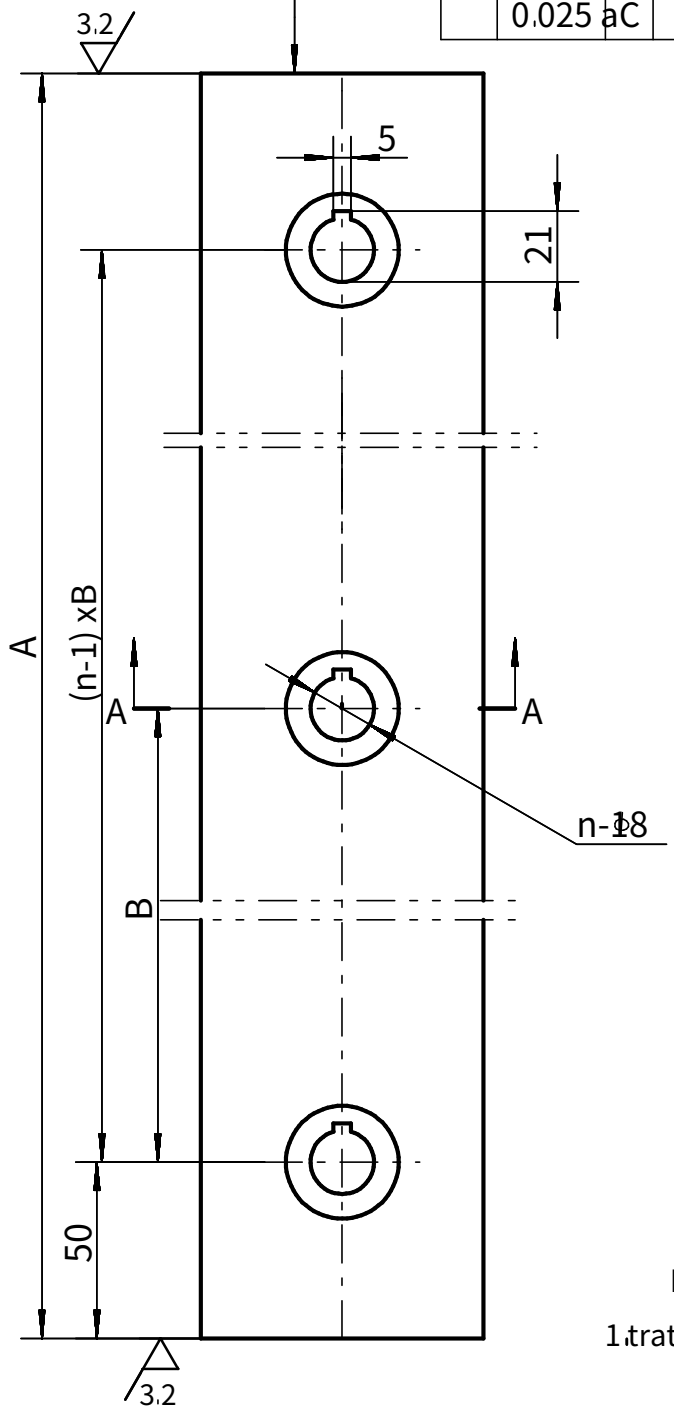
1	Cuchilla superior	6CrW2Si	1: 2	
No.	Nombre	Material	Escala	Observación

CORTADORA HIDRÁULICA DE PLACA OSCILANTE	Total:
	Página: 32

Dos lados

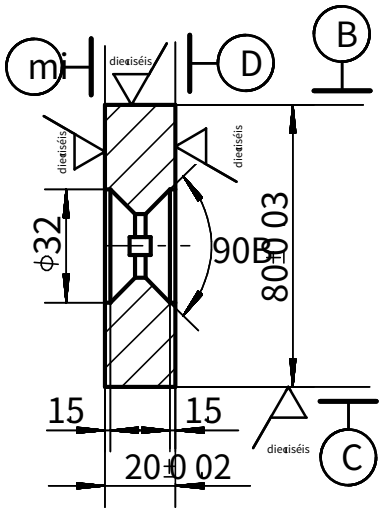
⊥	0.012 ED	
	0.025 aC	

Otros 12.5



Automóvil club británico

girar



producto / Talla	2000	2500	3200	4000
A	1025	1300	1100	1025
B	185	200	200	185
norte	6	7	6	6

Requerimiento técnico

1. tratamiento térmico (1) recocido

(2) HR C55-60

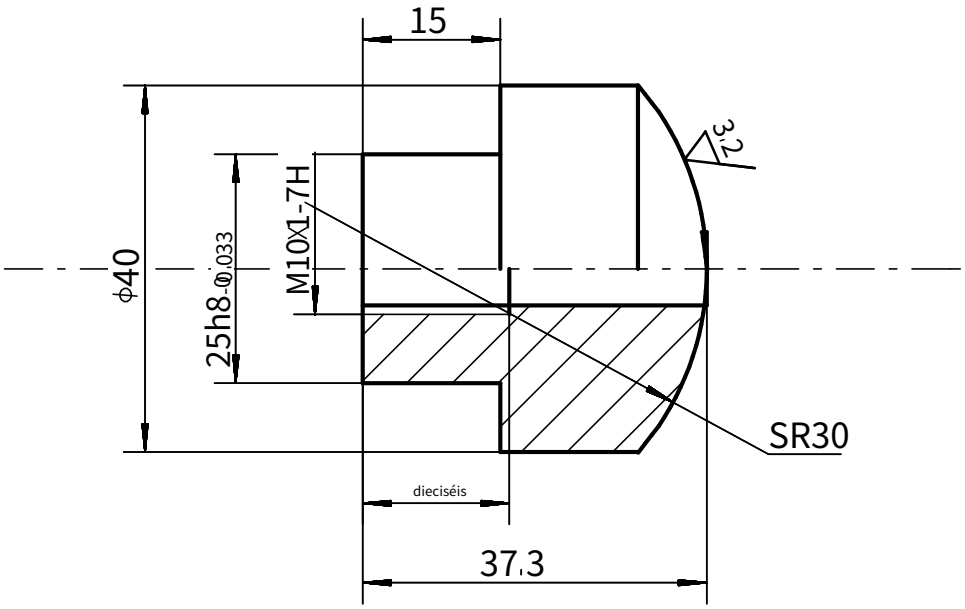
2. detección de defectos

3. La hoja no debeC ser embotado

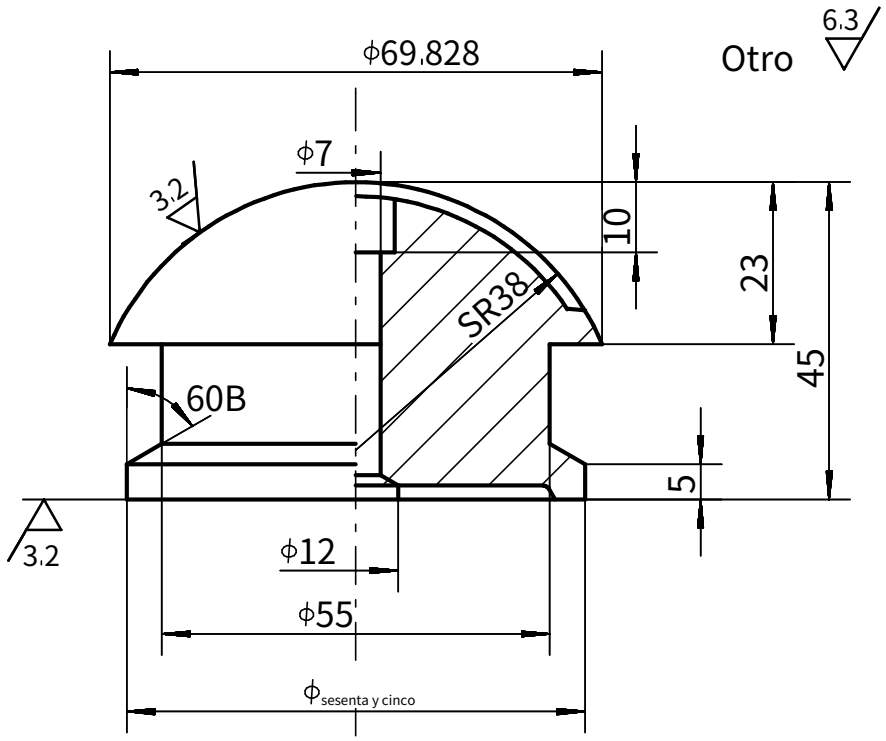
2	Hoja inferior	6CrW2Si	1: 2	
No.	Nombre	Material	Escala	Observación

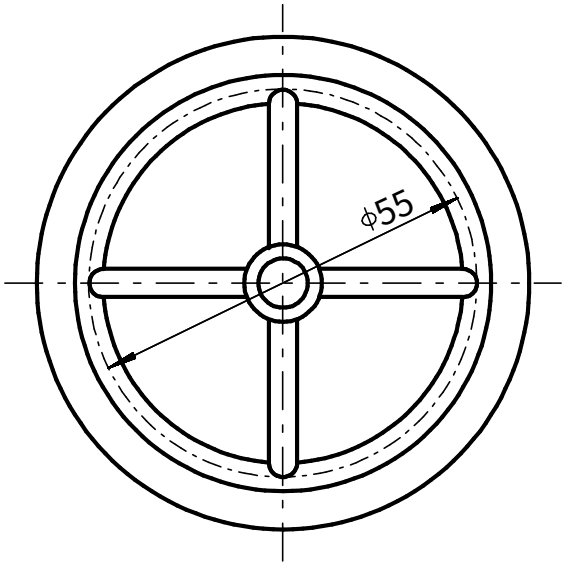
CORTADORA HIDRÁULICA DE PLACA OSCILANTE	Total:
	Página: 33

Otro 6,3

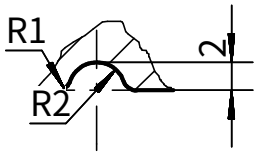


17	bloque semicírculo 4 # Zine Base Metal	1: 1	
No.	Material del nombre	Escala	Observación



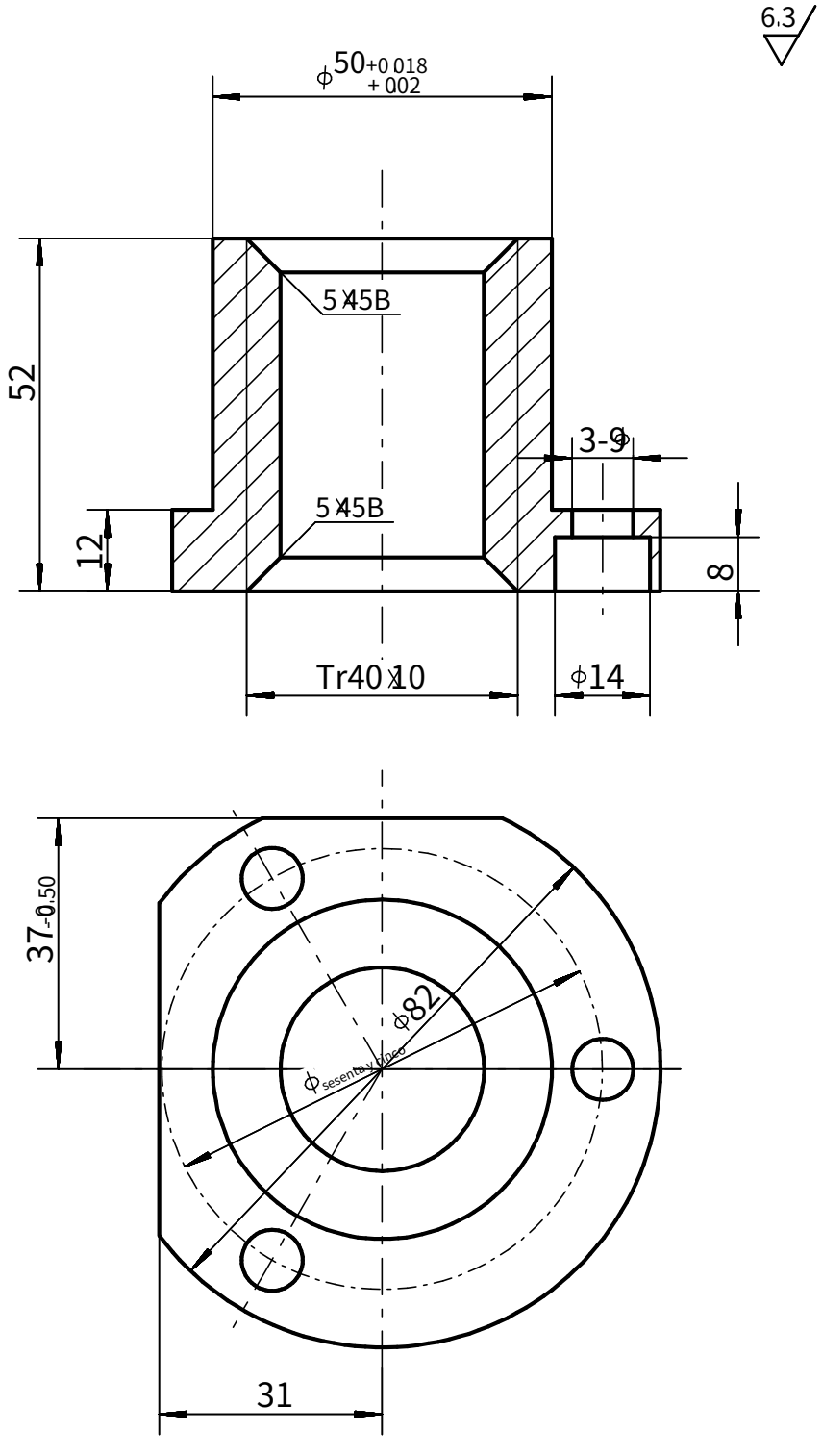


piscina de aceite
2: 1



4	Bulbo	Material de aleación	1: 1	
No.	Nombre	de base de zinc 4 #	Escala	Observación

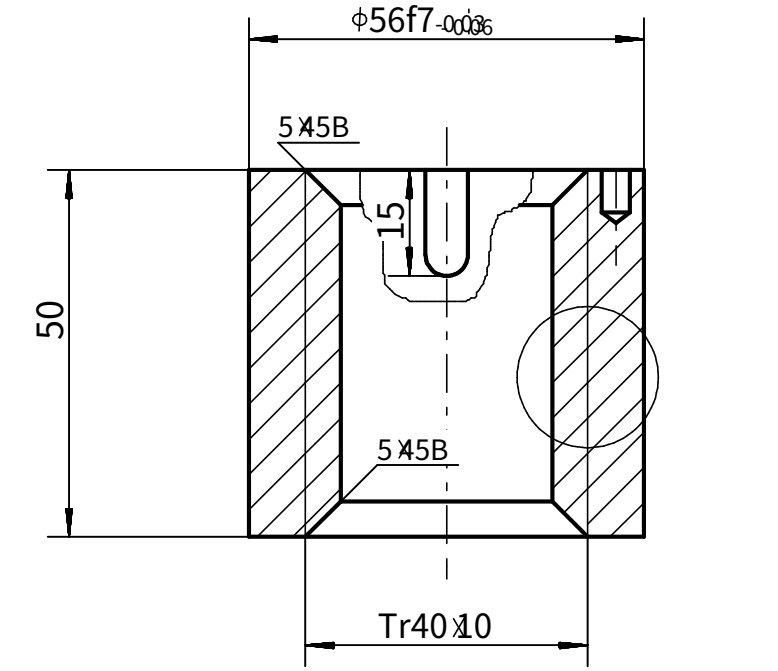
CORTADORA HIDRÁULICA DE PLACA OSCILANTE	Total:
	Página: 35

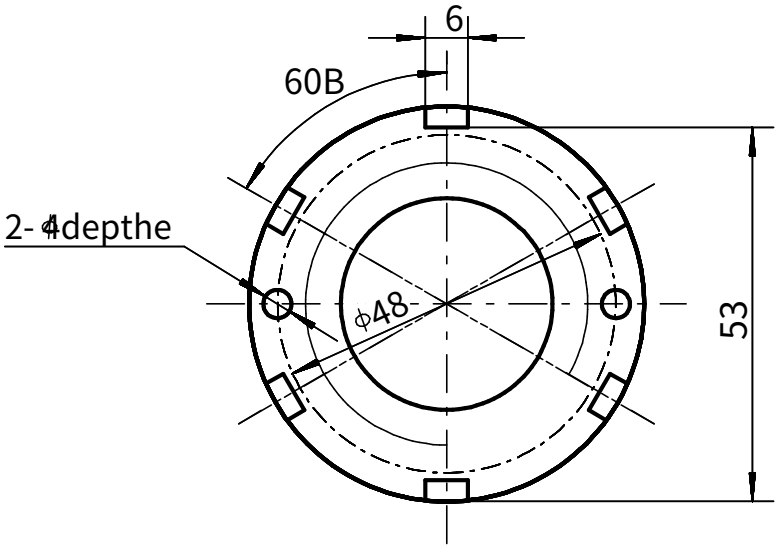


32	Tornillo	ZQSn10-1	1: 1	
No	Nombre	Material	Escala	Observación

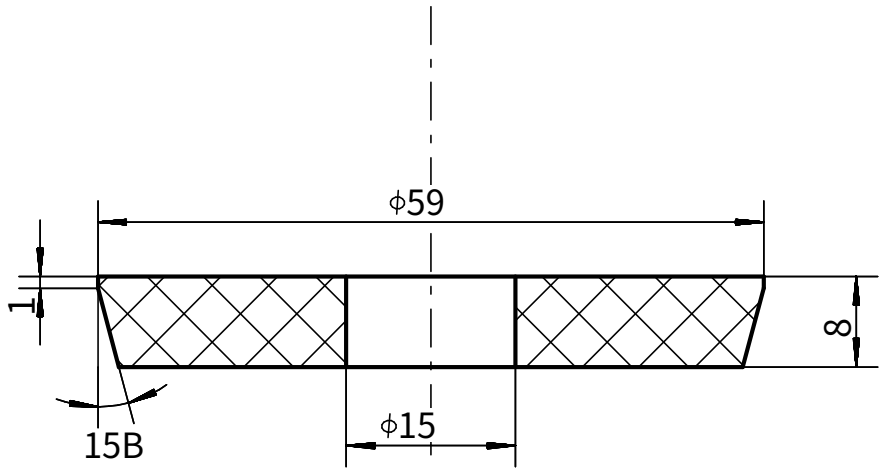
CORTADORA HIDRÁULICA DE PLACA OSCILANTE	Total:
	Página: 36

6.3





35	Tornillo	ZQSn10-1	1: 1	
No	Nombre	Material	Escala	Observación



3220	Bloque de cojín Éter Poliuretano	1: 1	
No.	Material del nombre	Escala	Observación

CORTADORA HIDRÁULICA DE PLACA OSCILANTE SERIE QC12Y-6

CERTIFICADO DE CALIDAD

Espesor de corte: 6 mm

Ancho de corte: mm

Sin entrega.:

CALIDAD CERTIFICADO	Total Página 1

Esta máquina ha demostrado ser excelente a través de un examen y se le permite salir de fábrica.

Inspector:

Jefe del Departamento de Inspección:

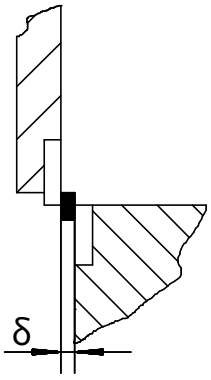
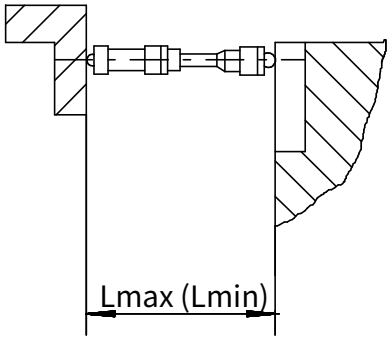
Fecha:

CALIDAD CERTIFICADO

Total:
Página 2

I、 Inspección accuary geométrica

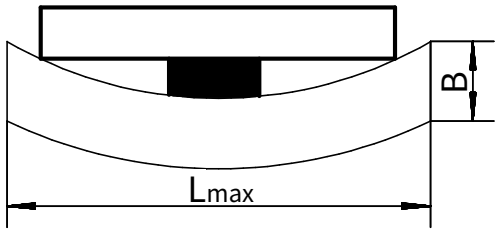
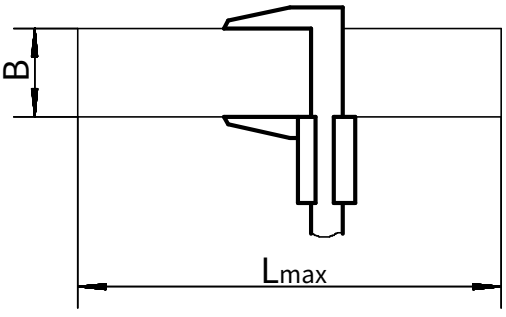
GB / T14404

No	Inspección Artículo	Diagrama	Tolerancia (mm)			Medición
1	Uniformidad entre la liquidación de los bordes de las cuchillas		canshear en toda su longitud			
			espesor	Freno Escribe	columpio Escribe	
			⩽ 2.5	0.02	0.04	
			> 2.5-8	0.05	0.06	
			> 8-16	0.08	0.10	
			> 16	0.10	0.16-0.24	
2	Paralelismo entre el fondo hoja y indicador		accuary att he le ng th calificación		de 1000	
			I		0.10	
			II		0.20	
			III		0.50	

CALIDAD CERTIFICADO

Total:

II 、 Accuary de trabajo

Ningún artículo de inspección	Inspección de forma y diagrama	precisión	
		Medida de (mm)	tolerancia (mm)
Doblado 1 rectitud la regla de nivel de inspección en la superficie de la placa cortada y mida el Grado: II de holgura de la pieza de trabajo por palpador, el error se calcula hacia fuera con el valor máximo dentro de un metro de largo .	 Coloque la pieza de trabajo en una mesa nivelada y use la precisión: 0 25 ,	En la longitud de 1000, Calificación: I precisión: 0 45' Calificación:III precisión: 0 75	
Paralelismo de pieza de trabajo	 Mida el ancho de la pieza de trabajo con un pie de rey en muchos lugares Error se calcula con el valor de grado accuary dentro de 1000 mm de largo	En la longitud de 1000, Calificación: I precisión: 0 15 Calificación: II precisión: 0 30 Calificación:III precisión: 0 75	

CORTADORA HIDRÁULICA DE PLACA OSCILANTE SERIE QC12Y-6

LISTA DE EMPAQUE

Espesor de corte: 6 mm

Ancho de corte: mm

Sin entrega.:

EMBALAJE LISTA

QC12Y-6x Cizalla de oscilación hidráulica

Numero de referencia :

Dimensiones de la caja X X

(LWH): Peso bruto:

Neto Peso:

N0	Nombre y especificación	Cant.	Observación
1	Motor principal	1 juego	
2	Soporte delantero	3 pieza	
3	Interruptor de pedal	1 juego	
4	Anillo de sellado en forma de O 35×3 5	10/8/12/15	
5	Anillo de sellado en forma de O 110×5 7	1 juego	
6	Anillo de sellado en forma de O 100×5 7	1 juego	
7	Anillo de polvo d95	2 juegos	
8	Anillo de polvo d65	2 juegos	
9	Palpador Foundation Bolt	4 grupo	
10	M24 500	1 juego	
11	200cm3 pistola de aceite	1 juego	
12	herramienta de llenado	1 juego	
13	Tecla de encendido para botón de llave	2 juegos	
14	archivos adjuntos (manual de operación certificado de calidad, lista de empaque)	1 pieza	
15			

Inspector de embalaje:

Fecha:

Certificate – Сертификат – 證明書 – Certificat – 증명서 – شهادة

Certificate of Compliance

No. 3Z210415.JJMUQ79

Certificate's Holder:	Jiangsu Jianghai Machinery Group Co., Ltd. No. 1 Jianghai Road, Libao, Haian, Jiangsu, China
Certification ECM Mark:	ENTE CERTIFICAZIONE MACCHINE – European Conformity – SAFETY COMPLIANCE MARK – Type Approved
Product:	Shearing Machine
Model(s):	QC12K-6×3200, QC12Y, QC12K
Verification to:	Standard: EN ISO 12100:2010, EN 60204-1:2018, EN 13985:2003+A1:2009, EN IEC 61000-6-2:2019, EN IEC 61000-6-4:2019 related to CE Directive(s): 2006/42/EC (Machinery) 2014/30/EU (Electromagnetic Compatibility)

Remark: This document has been issued on a voluntary basis and upon request of the manufacturer. It is our opinion that the technical documentation received from the manufacturer is satisfactory for the requirements of the ECM Certification Mark. The conformity mark above can be affixed on the products accordingly to the ECM regulation about its release and its use.

Additional information and clarification about the Marking:

CE

The manufacturer is responsible for the CE Marking process, and if necessary, must refer to a Notified Body. This document has been issued on the basis of the regulation on ECM Voluntary Mark for the certification of products. RG01_ECM rev.3 available at: www.entecerma.it

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Reviewer
Technical expert
Amanda Payne

Approver
ECM Service Director
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