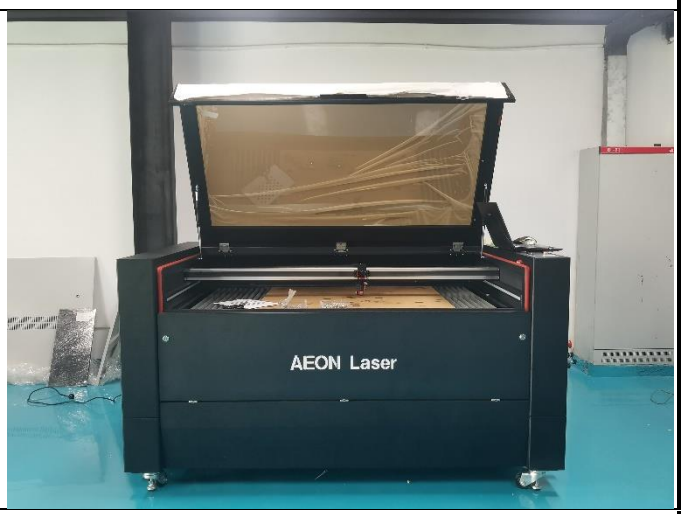
Prüfbericht-Nr.: *Test report no.:*	**CN22V6V2 001 Part I of III**	**Auftrags-Nr.:** *Order no.*:	244446683	Seite 1 von 15 *Page 1 of 15*
Kunden-Referenz-Nr.: *Client reference no.:*	2270712	**Auftragsdatum:** *Order date:*	2022-08-31	
Auftraggeber: *Client:*	SUZHOU AEON LASER TECHNOLOGY CO.,LTD.			
Prüfgegenstand: *Test item:*	Laser Engraving and Cutting Machine			
Bezeichnung / Typ-Nr.: *Identification / Type no.:*	NOVA10, NOVA14, NOVA16			
Auftrags-Inhalt: *Order content*:	Type test			
Prüfgrundlage: *Test specification:*	EN 60204-1:2018 Safety of machinery - Electrical equipment of machines Part 1: General requirements			

Wareneingangsdatum: *Date of sample receipt:*	N/A
Prüfmuster-Nr.: *Test sample no:*	See page 2.
Prüfzeitraum: *Testing period:*	2022-08-11 - 2022-08-11
Ort der Prüfung: *Place of testing:*	As client
Prüflaboratorium: *Testing laboratory:*	TÜV Rheinland (Shanghai) Co., Ltd.
Prüfergebnis*: *Test result*:*	Pass



geprüft von: *tested by:*	Kirk Chen	**genehmigt von:** *authorized by:*	Xinling Liu
Datum: *Date: 2022-10-10*		**Ausstellatum:** *Issue date: 2022-10-10*	
Stellung / *Position:*	Project Engineer	**Stellung** / *Position:*	Technical Certifier

Sonstiges / *Other:* This report is only valid in its full version: Part I of III, Part II of III and Part III of III.
Attachment 1: Measure equipment list (1 page)

Zustand des Prüfgegenstandes bei Anlieferung: Prüfmuster vollständig und unbeschädigt
Condition of the test item at delivery: *Test item complete and undamaged*

* Legende:	1 = sehr gut	2 = gut	3 = befriedigend	4 = ausreichend	5 = mangelhaft
	P(ass) = entspricht o.g. Prüfgrundlage(n)		F(ail) = entspricht nicht o.g. Prüfgrundlage(n)	N/A = nicht anwendbar	N/T = nicht getestet
** Legend:*	*1 = very good*	*2 = good*	*3 = satisfactory*	*4 = sufficient*	*5 = poor*
	P(ass) = passed a.m. test specification(s)		*F(ail) = failed a.m. test specification(s)*	*N/A = not applicable*	*N/T = not tested*

Description of the machine:

The machine is used for engraving and cutting of signs, stamps, etc. A wide variety of materials can be processed, such as rubber, acrylic, coated metal, tin, special steel, anodized aluminum, cork, cardboard, glass, leather, marble, plastics and wood.
The model NOVA10, NOVA14 and NOVA16 are identical completely except the working area size, so full testing is performed on NOVA16, the other models are covered.

Specification:

Type	NOVA10	NOVA14	NOVA16
Power supply	AC 220-240V	AC 220-240V	AC 220-240V
Frequency	50/60Hz	50/60Hz	50/60Hz
Full load current	16A	16A	16A
Power	3300W	3300W	3300W
Weight	450kg	520kg	620kg
Working area	1000mm X 700mm	1400mm X 900mm	1600mm X 1000mm
Serial number	YF220521009W37Q03	XY220816001W37Q03	CJ220822001W37Q03

Note:

The measurement uncertainly of the measurement procedures listed in this test report does not include the compliance of the respective limit values / operating conditions.

Unless otherwise agreed with the customer, a conformity assessment is always carried out based on the applied standards.
At the customer's request, the statement on the conformity of the product tested in this test report is carried out according to the criteria / requirements of the applied standards.
Evaluation conditions deviating from these are documented separately in the respective chapters.

The client address is as "CHANGFU ECONOMIC DEVELOPMENT ZONE, GROUP 30, GUIZHUANG FANSHAN VILLAGE, TAICANG, SUZHOU, 215425 JIANGSU, P.R.CHINA".

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Clause	Requirement	Remarks - Results	Verdict
1	**Scope**	Informative paragraph.	-
2	**Normative references**	Informative paragraph.	-
3	**Definitions**	Informative paragraph.	-
4	**General requirements**	-	-
4.1	**General**	Covered by Machinery Directive	-
4.2	**Selection of equipment**	-	P
4.2.1	**General** (compliance with EN or IEC standards)	Evidence of compliance with relevant EU requirement provided for components: -Circuit breaker (QF1) from Schneider (EN 60947-2); -Safety relay (KF) from Schneider (EN ISO 13849); -Power Supply Switch (Switch disconnector) (QS1) from Schneider (EN 60947-3) -Contactors (KM1, KM2, KM3) from Schneider (EN 60947-4-1); -Coded magnetic switch (SQ1) from Schneider (EN 60947-1); -Switch power supply (UR1, UR2, UR3) from Mean Well (EN 62368-1); -Reset switch (FA1) from Schneider (EN 60947-5-1); -Emergency stop (JTA1) from Schneider (EN 60947-1); -Terminal block from Phoenix All components are checked according to the listed standard and are suitable for use	P
4.2.2	**Switchgear**	Considered	P
4.3	**Electrical supply** (+/-10%, +/-1Hz, harmonics, unbalance, impulses, interruption, dips etc.)	Information regarding electric supply tolerances provided in user manual	P
4.4	**Physical environment and operating conditions**	-	P
4.4.1	**General**	Specifications provided in user manual.	P
4.4.2	Electromagnetic compatibility (EMC) (see EMC directive)	EMC declaration provided.	P
4.4.3	Ambient air temperature (5-40°C)	Information regarding ambient temperature provided in user manual.	P
4.4.4	Humidity (30-90%)	Information regarding humidity provided in user manual.	P

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Clause	Requirement	Remarks - Results	Verdict
4.4.5	Altitude (1000m)	Information regarding installation altitude (max 1000m) provided in user manual.	P
4.4.6	Contaminants (see 11.3 for details)	Considered.	P
4.4.7	Ionizing and non-ionizing radiation	A laser device is used in the machine. The maximum measured value of accessible emission is 18.85W/m^2, which is less than 1000W/m^2 required in EN 60825-1.	P
4.4.8	**Vibration, shock, and bump**	Not required.	N/A
4.5	**Transportation and storage** (-25-55°C/70°C)	Information regarding transport/storage temperature provided in user manual.	P
4.6	**Provisions for handling** (see 13.4.6)	Relevant information provided in user manual. Lift points are provided.	P
5	**Incoming supply conductor terminations and devices for disconnecting and switching off**	-	P
5.1	**Incoming supply conductor terminations** (EN 60445, 5.2, 5.3.1 and 5.3.2d)	Single power supply, no connection between the neutral conductor and the protective bonding circuit inside the electrical equipment.	P
5.2	**Terminal for connection of the external protective conductor** (table 1, 8.2.2 and EN 60445)	Line conductor and PE conductor is with same cross-sectional area. PE marking provided for the incoming earthing terminal, size comply with Table 1	P
5.3	**Supply disconnecting (isolating) device**	-	P
5.3.1	General (for each supply)	See below	P
5.3.2	Type The supply disconnecting device shall be one of the following types: a) switch-disconnector, with or without fuses, in accordance with IEC 60947-3, utilization category AC-23B or DC-23B; b) control and protective switching device suitable for isolation, in accordance with IEC 60947-6-2; 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 and the appropriate utilization category and/or specified endurance requirements defined in the product standard; e) a plug/socket combination for a flexible cable supply.	- The used switch-disconnector (QS1) comply with IEC 60947-3. -N/A -N/A -N/A -N/A	P

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Clause	Requirement	Remarks - Results	Verdict
5.3.3	Requirements (IEC 60417-5007, IEC 60417-5008, red handle for E-stop, padlock, stalled motor, etc.)	Switch-disconnector (QS1) used: 2 positions ON/OFF; Marked with ON /OFF; It is lockable in OFF position; Disconnect all live conductors; Have proper breaking capacity	P
5.3.4	Operating means of the supply disconnecting device	The operating means of the supply disconnecting device is external to the enclosure of the electrical equipment.	P
5.3.5	Excepted circuits (lighting, undervoltage, UPS, etc.)	No such circuits.	N/A
5.4	**Devices for removal of power for prevention of unexpected start-up** (disconnect of 5.3.2, 3.17 and 5.6)	Switch-disconnector (QS1) used	P
5.5	**Devices for isolating electrical equipment** (see 5.3, 5.3.2 and 5.6)	Switch-disconnector (QS1) used	P
5.6	**Protection against unauthorized, inadvertent and/or mistaken connection** (see 5.4, 5.5 and 5.3.2 d)	The means can be secured in the OFF position.	P
6	**Protection against electric shock**	-	P
6.1	**General**	-	P
6.2	**Basic protection**	-	P
6.2.1	General (see 6.2, IEC 60364-4 and EN 60529 IP4X/XXB)	See below	P
6.2.2	Protection by enclosures (general > IP4X; a) opened by tool and without disconnect > IP2X inside; b) disconnect with interlock > IP2X inside; c) without tool and without disconnect > IP2X and interlock for barrier)	IP2X for the enclosure and IP4X for the top surface of the enclosure fulfilled. The enclosure can only be opened with tools.	P
6.2.3	Protection by insulation of live parts (completely covered)	Cables, switches insulated.	P
6.2.4	Protection against residual voltages (60V/5sec or 60μC/1sec or IP2X)	None.	N/A
6.2.5	Protection by barriers (IEC 60364-4-41)	None.	N/A
6.2.6	Protection by placing out of reach or protection by obstacles (IEC 60364-4-41)	None.	N/A
6.3	**Fault protection**	-	P
6.3.1	General	See below.	P
6.3.2	Prevention of the occurrence of a touch voltage	-	P
6.3.2.1	General	See below	P
6.3.2.2	Protection by provision of class II equipment or by equivalent insulation	Class I construction	N/A
6.3.2.3	Protection by electrical separation	None	N/A

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Clause	Requirement	Remarks - Results	Verdict
6.3.3	Protection by automatic disconnection of supply	Earthed and protected	P
6.4	**Protection by the use of PELV**	-	P
6.4.1	General requirements (25/60V and 6/15 etc.)	User accessible interfaces; Elec.-Mag. Valve; control system; are separated by insulation of equivalent level as PELV	P
6.4.2	Sources for PELV	Approved switch power supply provided	P
7	**Protection of equipment**	-	P
7.1	**General**	-	P
7.2	**Overcurrent protection**	-	P
7.2.1	General	See below	P
7.2.2	Supply conductors (data for installation protection device)	Certified supply conductors are provided. Certified Switch-disconnector (QS1) is used.	P
7.2.3	Power circuits (7.2.10, neutral conductor, etc.)	The overcurrent protective devices (QF1, FU1, FU2, FU4) are provided for each power circuit.	P
7.2.4	Control circuits (connection to safety ground)	The overcurrent protective devices (FU3) are provided for the feeding circuit of switch power supply.	P
7.2.5	Socket outlets and their associated conductors (for each socket outlet)	None.	N/A
7.2.6	Lighting circuits (unearthed conductor)	None.	N/A
7.2.7	Transformers (see 7.2.10)	No transformer used.	N/A
7.2.8	Location of overcurrent protective devices (conductor, reduction for less 3m and own duct)	Overcurrent protection provided	P
7.2.9	Overcurrent protective devices (must readily available in country of use)	Circuit breakers comply with relevant EU standard.	P
7.2.10	Rating and setting of overcurrent protective devices (as low as possible)	Rating and setting of overcurrent protective devices are checked OK.	P
7.3	**Protection of motors against overheating**	-	P
7.3.1	General (more than 0.5kW, restart not possible)	Blower motor input is less than 0.5kW.	P
7.3.2	Overload protection	Fuse (FU2) is provide for Overload protection.	P
7.3.3	Over-temperature protection (IEC 60034-11)	Considered.	P
7.4	**Protection against abnormal temperature** (heater protection)	Temperature sensor provided to monitor the heating temperature.	P
7.5	**Protection against the effects of supply interruption or voltage reduction and subsequent restoration**	Supply interruption or a voltage reduction cannot cause a hazardous situation.	P
7.6	**Motor overspeed protection** (see 9.3.2)	Not required.	N/A

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Clause	Requirement	Remarks - Results	Verdict
7.7	**Additional earth fault/residual current protection** (see 6.3)	None.	N/A
7.8	**Phase sequence protection**	Not required.	N/A
7.9	**Protection against overvoltages due to lightning and to switching surges**	None.	N/A
7.10	**Short-circuit current rating**	By application of design rules	P
8	**Equipotential bonding**	-	P
8.1	**General**	-	P
8.2	**Protective bonding circuit**	-	P
8.2.1	General (figure 2, all stress, etc.)	Sizes of earthing conductors comply with table 1. Exposed conductive parts earthed.	P
8.2.2	Protective conductors (13.2.2, size in accordance with Table 1)	Identified according to 13.2.2, copper conductors used.	P
8.2.3	Continuity of the protective bonding circuit (doors, hinges etc. need conductor, except for PELV etc.)	Continuity of the protective bonding circuit ensured and verified by testing.	P
8.2.4	Protective conductor connecting points	Green and yellow conductor properly terminated and labels provided.	P
8.2.5	Mobile machines	Not mobile machine.	N/A
8.2.6	Additional requirements for electrical equipment having earth leakage currents higher than 10 mA	The blower motor is located in the enclosure of the machine.	N/A
8.3	**Measures to restrict the effects of high leakage current**	-	N/A
8.4	**Functional bonding** (insulation failure and EMI, see 4.4.2 and 9.4.3.1)	Control circuit bonding to the protective circuit.	P
9	**Control circuits and control functions**	-	P
9.1	**Control circuits**	Control circuits and control functions provided by the switch power supply (UR2, UR3).	P
9.1.1	**Control circuit supply** (transformer, except for less than two controls etc.)	DC control circuit supplied by switch power supply (UR1).	P
9.1.2	Control circuit voltages (< = 277V)	UR1: Input: AC220V, Output: DC24V switch power; UR2, UR3: Input: AC220V, Output: DC48V switch power	P
9.1.3	Protection (7.2.4 and 7.2.10)	Covered by 7.2.4, 7.2.10	P
9.2	**Control functions**	-	P
9.2.1	General	-	P

Clause	Requirement	Remarks - Results	Verdict
9.2.2	Categories of stop functions (category 0, 1, and 2 etc.)	Cat 0 used for stopping the movement of the blower motor.	P
9.2.3	Operation	-	P
9.2.3.1	General (interlock see 9.3)	Emergency stop switch provided	P
9.2.3.2	Start	Considered	P
9.2.3.3	Stop (category 0, 1, and 2 etc.)	Cat 0 used for stopping the movement of the blower motor, and meet the requirements.	P
9.2.3.4	Emergency operations (emergency stop, emergency switching off)	-	P
9.2.3.4.1	General	See below	P
9.2.3.4.2	Emergency stop	Cat. 0 stop	P
9.2.3.4.3	Emergency switching off	None.	N/A
9.2.3.5	Operating modes	Each position of the selector is clearly identifiable.	P
9.2.3.6	Monitoring of command actions	It keeps working when the machine is connected to supply.	P
9.2.3.7	Hold-to-run controls	None.	N/A
9.2.3.8	Two-hand control	None.	N/A
9.2.3.9	Enabling control	None.	N/A
9.2.3.10	Combined start and stop controls	None.	N/A
9.2.4	Cableless control system (CCS)	None.	N/A
9.2.4.1	General requirements	See above.	N/A
9.2.4.2	Monitoring the ability of a cableless control system to control a machine	See above.	N/A
9.2.4.3	Control limitation	See above.	N/A
9.2.4.4	Use of multiple cableless operator control stations	See above.	N/A
9.2.4.5	Portable cableless operator control stations	See above.	N/A
9.2.4.6	Deliberate disabling of cableless operator control stations	See above.	N/A
9.2.4.7	Emergency stop devices on portable cableless operator control stations	See above.	N/A
9.2.4.8	Emergency stop reset	See above.	N/A
9.3	**Protective interlocks**	Not used	N/A
9.3.1	Reclosing or resetting of an interlocking safeguard	None	N/A
9.3.2	Exceeding operating limits	None	N/A
9.3.3	Operation of auxiliary functions	None	N/A
9.3.4	Interlocks between different operations and for contrary motions (interlock against contrary motion)	None	N/A
9.3.5	Reverse current braking	None	N/A
9.3.6	Suspension of safety functions and/or protective measures	No such suspension of safety functions and/or protective measures	N/A
9.4	Control functions in the event of failure	-	P

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Clause	Requirement	Remarks - Results	Verdict
9.4.1	General requirements (protective device, proven techniques, redundancy, functional tests...)	Use proven circuit techniques and components, redundancy considered. The emergency stop circuit and interlocking switch circuit as below: -Emergency stop button (JTA1) actuation can cause safety relay (KF) to shut off KM2 and KM3, which disconnect the supply to all motors; -Coded magnetic switch (SQ1) actuation can cause safety relay (KF) to shut off KM2 and KM3, which disconnect the supply to all motors.	P
9.4.2	Measures to minimize risk in the event of failure	-	P
9.4.2.1	General	-	P
9.4.2.2	Use of proven circuit techniques and components (one terminal, de-energizing for stop, positive open operation, design...)	Bonding of control circuit to the protective bonding circuits; The circuits are designed to reduce the possibility of failure.	P
9.4.2.3	Provisions of partial or complete redundancy (on-line, off-line...)	Partial redundancy for the safety related circuits.	P
9.4.2.4	Provision of diversity (combination of open and closed contacts, different components, electrical and non-electrical systems...)	The use of combination of open and closed contacts, different components are provided.	P
9.4.2.5	Provision for functional tests (automatic or manually...)	Functional test can be carried out manually.	P
9.4.3	Protection against malfunction of control circuits	-	P
9.4.3.1	Insulation faults	-	P
9.4.3.1.1	General (method a, b, c, d)	-	P
9.4.3.1.2	Method a) – Earthed control circuits fed by transformers	Method a) used for the control circuit.	P
9.4.3.1.3	Method b) – Non-earthed control circuits fed by transformers	-	N/A
9.4.3.1.4	Method c) – Control circuits fed by transformer with an earthed centre-tap winding	-	N/A
9.4.3.1.5	Method d) – Control circuits not fed by a transformer	-	N/A
9.4.3.2	Voltage interruptions (7.5...)	Covered by 7.5	P
9.4.3.3	Loss of circuit continuity	No sliding contact.	N/A
10	Operator interface and machine-mounted control devices	-	P
10.1	General	-	P
10.1.1	General requirements (IEC 61310 and IEC 60447)	Touchscreen used to input	P

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Clause	Requirement	Remarks - Results	Verdict
10.1.2	Location and mounting (>= 0.6m...)	The machine-mounted control devices is readily accessible for service and maintenance. The actuators of hand-operated control devices are 0.6 m above the servicing level, which is easily reached by the user.	P
10.1.3	Protection	IPXXD fulfilled for the control devices.	P
10.1.4	Position sensors (no damage...)	No position sensor used.	N/A
10.1.5	Portable and pendant control stations	None.	N/A
10.2	**Actuators**	-	P
10.2.1	Colours (table 2, red and yellow!...)	Color coding is appropriate.	P
10.2.2	Markings	Ok.	P
10.3	Indicator lights and displays	-	P
10.3.1	General	Comply with the requirement.	P
10.3.2	Colours (EN 50099...)	Comply with the requirement.	P
10.3.3	Flashing lights and displays (immediate action...)	Not used.	N/A
10.4	Illuminated push-buttons (table 2 and 4...)	Not used.	N/A
10.5	Rotary control devices (rotation...)	The rotary control device is with prevention of rotation of the stationary member.	P
10.6	Start devices (inadvertent operation...)	No inadvertent operation is possible for its construction.	P
10.7	Emergency stop devices	-	P
10.7.1	Location of emergency stop devices	Ok.	P
10.7.2	Types of emergency stop device (push-button, pull-cord, and pedal-operated)	Push-button.	P
10.7.3	Operation of the supply disconnecting device to effect emergency stop	None.	N/A
10.8	Emergency switching off devices	None.	N/A
10.8.1	Location of emergency switching off devices	See above.	N/A
10.8.2	Types of emergency switching off device	See above.	N/A
10.8.3	Local operation of the supply disconnecting device to effect emergency switching off	-	N/A
10.9	**Enabling control device**	None	N/A
11	**Controlgear: location, mounting, and enclosures**	-	P
11.1	**General requirements**	-	P
11.2	Location and mounting	-	P
11.2.1	Accessibility and maintenance (0.4-2.0m, see 13.4.5)	The machine is stationary type, the actuators of hand-operated control devices are about 0.6 m above the servicing level, which is easily reached by the user.	N/A

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Clause	Requirement	Remarks - Results	Verdict
11.2.2	Physical separation or grouping (power circuits, associated control circuits, other)	Wires for different circuits are fixed separately.	P
11.2.3	Heating effects (limits...)	Sufficient space and ventilation.	P
11.3	Degrees of protection (at least IP22 for enclosures of controlgear, see EN 60529...)	IP22 fulfilled for the enclosure.	P
11.4	Enclosures, doors and openings (doors <= 0.9m, no openings between liquids and electrical devices, fasteners of captive type...)	No openings between liquids and electrical devices	P
11.5	Access to electrical equipment (see 481.2.4 of IEC 60364-4-81, 0.7m x 2.0m...)	Small machine, the electrical equipment is easily access.	N/A
12	Conductors and cables	-	P
12.1	General requirements (EN 60439-1...)	See below.	P
12.2	Conductors (table 5)	PVC insulated conductors adequately dimensioned (according to Table 5)	P
12.3	Insulation (PVC, 2000V test voltage, 500V for PELV, see IEC 60364-4-41, class III equipment...)	For the three tested models: Ok, 2000V, 5min; Ok, 500V, 5min	P
12.4	Current-carrying capacity in normal service (table 5, table 6, and D2...)	Wire sizes Ok.	P
12.5	Conductor and cable voltage drop (<= 5%...)	Small machine fulfilled the requirements.	P
12.6	Flexible cables	Not used.	N/A
12.6.1	General (table D.4...)	See above.	N/A
12.6.2	Mechanical rating (15 N/mm^2...)	See above.	N/A
12.6.3	Current-carrying capacity of cables wound on drums	See above.	N/A
12.7	Conductor wires, conductor bars and slip-ring assemblies	-	P
12.7.1	Basic protection	Conduct wires are protected against direct contact.	P
12.7.2	Protective conductors	Protective bonding circuit does not carry current in normal operation, protective conductor and neutral conductor use separate conductor wire.	P
12.7.3	Protective conductor current collectors	None.	N/A
12.7.4	Removable current collectors with a disconnector function	None.	N/A
12.7.5	Clearances in air	Considered.	P
12.7.6	Creepage distances	Considered.	P
12.7.7	Conductor system sectioning	None.	N/A
12.7.8	Construction and installation of conductor wire, conductor bar systems and slip-ring assemblies	Power circuit grouped and fixed separately from control circuit.	P
13	Wiring practices	-	P
13.1	Connections and routing	-	P

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Clause	Requirement	Remarks - Results	Verdict
13.1.1	General requirements (loosening, one terminal, correspond with schematics, no solder, EN 60947-7-1, no cross overs...)	-Connections against loosening. -No soldering used. -No wiring crosses over the terminals. -Clamp used for retaining conductor strands.	P
13.1.2	Conductor and cable runs (from terminal to terminal, no strain to termination, ...)	-No splices or joints for the conductors and cables.	P
13.1.3	Conductors of different circuits (insulation for highest voltage, separation of live conductors before disconnect or marked with different color...)	Conductors of different circuits are grouped and fixed separately.	P
13.1.4	AC circuits – Electromagnetic effects (prevention of eddy currents)	No conductors are individually surrounded by ferromagnetic material. No single-core cables armored with steel wire used in AC circuits.	P
13.1.5	Connection between pick-up and pick-up converter of an inductive power supply system (as short as possible…)	None.	N/A
13.2	Identification of conductors	-	P
13.2.1	General requirements	Marking applied via numbering and color coding.	P
13.2.2	Identification of the protective conductor / protective bonding conductor (60417-IEC-5019 symbol or green-and-yellow...)	Green-and-yellow.	P
13.2.3	Identification of the neutral conductor (light blue (3.2.2 of IEC 60446)...)	Light blue color provided for neutral conductor; the circuit is not only identified by color alone.	P
13.2.4	Identification by color (black > power, red > control, orange > interlock...)	By numbering and color coding	P
13.3	Wiring inside enclosures (IEC 60332, 11.2.1, 8.2.3...)	Wires are fixed appropriately.	P
13.4	Wiring outside enclosures	-	P
13.4.1	General requirements (individual glands, bushings, ...)	Wiring bushing is used at cable entrance to ensure degree of protection.	P
13.4.2	External ducts (13.5, ...)	Conductors outside of the enclosure are in the external ducts. No sharp edges, burrs or the like in ducts.	P
13.4.3	Connection to moving elements of the machine (12.2, 12.6, flexible conduit, 25mm, no metallic conduits, ...)	No such connection.	N/A
13.4.4	Interconnection of devices on the machine (no in series connection of devices...)	None	N/A
13.4.5	Plug/socket combinations (safety ground first, > 16A must be locked, identification, see 6.2.4 and IEC 60309-1...)	None	N/A

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Clause	Requirement	Remarks - Results	Verdict
13.4.6	Dismantling for shipment (protected, ...)	None	N/A
13.4.7	Additional conductors (spare conductors)	Spare conductors are connected to spare terminals.	P
13.5	Ducts, connection boxes and other boxes	-	P
13.5.1	General requirements (no edges, separation from liquids...)	No sharp edge, separation from liquids	P
13.5.2	Rigid metal conduit and fittings	None	N/A
13.5.3	Flexible metal conduit and fittings (corrosion...)	None	N/A
13.5.4	Flexible non-metallic conduit and fittings	The conduit is resistant to kinking.	P
13.5.5	Cable trunking systems	None	N/A
13.5.6	Machine compartments and cable trunking systems	None	N/A
13.5.7	Connection boxes and other boxes	None	N/A
13.5.8	Motor connection boxes	See below.	P
	Motor connection boxes shall enclose only connections to the motor and motor-mounted devices (for example brakes, temperature sensors, plugging switches, tachometer generators).	Only connection to the motor	P
14	Electric motors and associated equipment	-	P
14.1	General requirements (EN 60034-1, 7.3, 7.6, 7.2, 5.3, 5.4, 5.5, 7.5, 7.6, 9.4, 11...)	Motor used in a blower, the protection provided by the motor controller.	P
14.2	Motor enclosures (EN 60034-5, IP23...)	Suitable for operation	P
14.3	Motor dimensions (IEC 60072-1, IEC 60072-2...)	Not safety relevant	N/A
14.4	Motor mounting and compartments (EN 60034-1, guarding...)	Motor is adequately protected.	P
14.5	Criteria for motor selection (EN 60034-1, IEC 60146, ...)	Motor is suitable for operation.	P
15	Socket-outlets and lighting	None.	N/A
15.1	Socket-outlets for accessories (socket-outlets based on EN 60309-1, see 6.4, 7.2, 7.3, 5.3.5...)	None.	N/A
15.2	Local lighting of the machine and of the equipment	None.	N/A
15.2.1	General (see 8.2.2, 4.4.2...)	None.	N/A
15.2.2	Supply (<= 50V, 250V, one source like transformer, separate overcurrent protection, factory lighting, 7.2.6...)	None.	N/A
15.2.3	Protection (7.2.6...)	None.	N/A
15.2.4	Fittings (lampholders based on IEC, ...)	None	N/A
16	Marking, warning signs and reference designations	-	P
16.1	General	Meet the requirements.	P
16.2	Warning signs (IEC 60417-5036, no disconnect, ...)	-	P
16.2.1	Electric shock hazard	Power supply marked on the enclosure of the machine.	P
16.2.2	Hot surfaces hazard	No such hazard	N/A

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Clause	Requirement	Remarks - Results	Verdict
16.3	Functional identification (IEC 60417, ISO 7000...)	Controls marked.	P
16.4	Marking of enclosures of electrical equipment (name, mark, ratings, IEC 62023...)	Information provided on nameplate.	P
16.5	Reference designations	Control devices and components are identified as in the technical drawing.	P
17	Technical documentation	-	P
17.1	General (see annex I)	See below.	P
17.2	Information related to the electrical equipment (description, supply requirements, environment, block diagram, schematics, sequence of operation, inspection, functional tests, maintenance, part lists...)	Relevant information contained in user manual.	P
18	Verification	-	P
18.1	General	-	P
18.2	Verification of conditions for protection by automatic disconnection of supply	See below.	P
18.2.1	General	TN system.	P
18.2.2	Test 1 – Verification of the continuity of the protective bonding circuit	Test 1 performed to verify continuity of the protective bonding circuit.	P
18.2.3	Test 2 – Fault loop impedance verification and suitability of the associated overcurrent protective device	Test 2 is not necessary according to table 10.	N/A
18.2.4	Application of the test methods for TN-systems	See above.	P
18.3	Insulation resistance tests	For the three tested models: Ok	P
18.4	Voltage tests	For the three tested models: Ok	P
18.5	Protection against residual voltages	Not necessary.	N/A
18.6	Functional tests	Ok.	P
18.7	Retesting	None	N/A
Annex A (normative)	Fault protection by automatic disconnection of supply	Considered	P
Annex B (informative)	Enquiry form for the electrical equipment of machines	Not applied, however it is recommended to use this form with end user.	-
Annex C (informative)	Examples of machines covered by this part of IEC 60204	Informative.	-
Annex D (informative)	Current-carrying capacity and overcurrent protection of conductors and cables in the electrical equipment of machines	Informative.	-
Annex E (informative)	Explanation of emergency operation functions	Informative.	-
Annex F (informative)	Guide for the use of this part of IEC 60204	Informative.	-

Clause	Requirement	Remarks - Results	Verdict
Annex G (informative)	Comparison of typical conductor cross-sectional areas	Informative.	-
Annex H (informative)	Measures to reduce the effects of electromagnetic influences	Informative.	-
Annex I (informative)	Documentation / Information	Informative.	-

End of Test Report

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Measurement Equipment List

Service Start Date 11.08.2022
Service End Date 11.08.2022

Deliverable/Report Number CN22V6V2 001
AMEL ID P00812102AA

Client Suzhou AEON Laser Technology Co.,Lt
Product Laser Engraving and Cutting Machine
Comment N/A

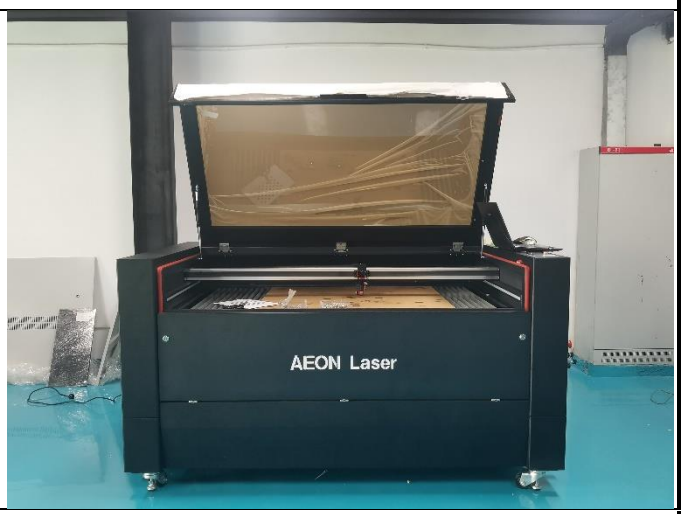
Equip.	Description	Model	Manufacturer	Last Date DD.MM.YYYY	Due Date DD.MM.YYYY
G1825776	Safety Comprehensive Tester	3394	metrel	07.07.2022	07.07.2023
G1811957	Steel Tape	5M	Shanghai Tiandao Tools Company	12.07.2022	12.07.2027
G1811626	Noncontact Thermometer	RAYST30XXAP	Raytek China Company	30.12.2021	30.12.2022
9039021	Optical radiation tester	StarBright	OPHIR	20.08.2021	20.08.2022
G1825481	Digital work dynamometer	DS2-200	motive	15.11.2021	15.11.2022

* No entry for devices that are not subject to regular calibration or require initial verification/calibration only.

where required, Signature: _____

Prüfbericht-Nr.: *Test report no.:*	**CN22V6V2 001 Part II of III**	**Auftrags-Nr.:** *Order no.*:	244446683	Seite 1 von 50 *Page 1 of 50*
Kunden-Referenz-Nr.: *Client reference no.:*	2270712	**Auftragsdatum:** *Order date:*	2022-08-31	
Auftraggeber: *Client:*	SUZHOU AEON LASER TECHNOLOGY CO.,LTD.			
Prüfgegenstand: *Test item:*	Laser Engraving and Cutting Machine			
Bezeichnung / Typ-Nr.: *Identification / Type no.:*	NOVA10, NOVA14, NOVA16			
Auftrags-Inhalt: *Order content*:	Type test			
Prüfgrundlage: *Test specification:*	EN ISO 12100:2010 Safety of machinery – General principles for design – Risk assessment and risk reduction			

Wareneingangsdatum: *Date of sample receipt:*	N/A
Prüfmuster-Nr.: *Test sample no:*	See page 2.
Prüfzeitraum: *Testing period:*	2022-08-11 - 2022-08-11
Ort der Prüfung: *Place of testing:*	As client
Prüflaboratorium: *Testing laboratory:*	TÜV Rheinland (Shanghai) Co., Ltd.
Prüfergebnis*: *Test result*:*	Pass



geprüft von: *tested by:*	Kirk Chen	**genehmigt von:** *authorized by:*	Xinling Liu
Datum: *Date: 2022-10-10*		**Ausstellatum:** *Issue date: 2022-10-10*	
Stellung / *Position:*	Project Engineer	**Stellung** / *Position:*	Technical Certifier

Sonstiges / *Other:* This report is only valid in its full version: Part I of III, Part II of III and Part III of III.

Zustand des Prüfgegenstandes bei Anlieferung: Prüfmuster vollständig und unbeschädigt
Condition of the test item at delivery: *Test item complete and undamaged*

* Legende:	1 = sehr gut	2 = gut	3 = befriedigend	4 = ausreichend	5 = mangelhaft
	P(ass) = entspricht o.g. Prüfgrundlage(n)		F(ail) = entspricht nicht o.g. Prüfgrundlage(n)	N/A = nicht anwendbar	N/T = nicht getestet
** Legend:*	*1 = very good*	*2 = good*	*3 = satisfactory*	*4 = sufficient*	*5 = poor*
	P(ass) = passed a.m. test specification(s)		*F(ail) = failed a.m. test specification(s)*	*N/A = not applicable*	*N/T = not tested*

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Clause	Requirement	Remarks - Results	Verdict
4	**Strategy for risk assessment and risk reduction**	**Considered.**	**P**
5	**Risk assessment**	**See below**	**P**
5.1	General	See below	**P**
	Risk assessment comprises (see Figure 1) – risk analysis, comprising 1) determination of the limits of the machinery (see 5.3), 2) hazard identification (5.4 and Annex B), and 3) risk estimation (see 5.5), and – risk evaluation (see 5.6). Risk analysis provides information required for the risk evaluation, which in turn allows judgments to be made about whether or not risk reduction is required. These judgments shall be supported by a qualitative or, where appropriate, quantitative estimate of the risk associated with the hazards present on the machinery. NOTE A quantitative approach can be appropriate when useful data is available. However, a quantitative approach is restricted by the useful data that are available and/or the limited resources of those conducting the risk assessment. Therefore, in many applications only qualitative risk estimation will be possible. The risk assessment shall be documented according to Clause 7.	Considered. It is included in the analysis that the determination of the limits of the machinery, hazard identification and risk estimation.	**P**
5.2	Information for risk assessment	See below	**P**
	The information for risk assessment should include the following. a) Related to machinery description: 1) user specifications; 2) anticipated machinery specifications, including i) a description of the various phases of the whole life cycle of the machinery, ii) design drawings or other means of establishing the nature of the machinery, and iii) required energy sources and how they are supplied; 3) documentation on previous designs of similar machinery, if relevant; 4) Information for use of the machinery, as available. b) Related to regulations, standards and other applicable documents: 1) applicable regulations; 2) relevant standards; 3) relevant technical specifications; 4) relevant safety data sheets	Intended use and relevant description provided in the rating label and user manual.	**P**

Clause	Requirement	Remarks - Results	Verdict
	c) Related to experience of use: 1) any accident, incident or malfunction history of the actual or similar machinery; 2) the history of damage to health resulting, for example, from emissions (noise, vibration, dust, fumes, etc.), chemicals used or materials processed by the machinery; 3) the experience of users of similar machines and, whenever practicable, an exchange of information with the potential users. NOTE An incident that has occurred and resulted in harm can be referred to as an “accident”, whereas an incident that has occurred and that did not result in harm can be referred to as a “near miss” or “dangerous occurrence”	Relevant information provided in user manual	**P**
	d) Relevant ergonomic principles. The information shall be updated as the design develops or when modifications to the machine are required. Comparisons between similar hazardous situations associated with different types of machinery are often possible, provided that sufficient information about hazards and accident circumstances in those situations is available. NOTE The absence of an accident history, a small number of accidents or low severity of accidents ought not to be taken as a presumption of a low risk. For quantitative analysis, data from databases, handbooks, laboratories or manufacturers' specifications may be used, provided that there is confidence in the suitability of the data. Uncertainty associated with these data shall be indicated in the documentation (see Clause 7).	Considered.	**P**
5.3	Determination of limits of machinery	See below	**P**
5.3.1	General	See below	**P**
	Risk assessment begins with the determination of the limits of the machinery, taking into account all the phases of the machinery life. This means that the characteristics and performances of the machine or a series of machines in an integrated process, and the related people, environment and products, should be identified in terms of the limits of machinery as given in 5.3.2 to 5.3.5.	Intended use provided in user manual.	**P**
5.3.2	Use limits	See below	**P**

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Clause	Requirement	Remarks - Results	Verdict
	Use limits include the intended use and the reasonably foreseeable misuse. Aspects to be taken into account include the following: a) the different machine operating modes and different intervention procedures for the users, including interventions required by malfunctions of the machine; b) the use of the machinery (for example, industrial, non-industrial and domestic) by persons identified by sex, age, dominant hand usage, or limiting physical abilities (visual or hearing impairment, size, strength, etc.); c) the anticipated levels of training, experience or ability of users including 1) operators, 2) maintenance personnel or technicians, 3) trainees and apprentices, and 4) the general public	Relevant information provided in user manual, refer to intended use.	**P**
	d) exposure of other persons to the hazards associated with the machinery where it can be reasonably foreseen: 1) persons likely to have a good awareness of the specific hazards, such as operators of adjacent machinery; 2) persons with little awareness of the specific hazards but likely to have a good awareness of site safety procedures, authorized routes, etc., such as administration staff; 3) persons likely to have very little awareness of the machine hazards or the site safety procedures, such as visitors or members of the general public, including children. If specific information is not available in relation to b), above, the manufacturer should take into account general information on the intended user population (for example, appropriate anthropometric data).	Considered and refer to General precautions of user manual.	**P**
5.3.3	Space limits	See below	**P**
	Aspects of space limits to be taken into account include a) the range of movement, b) space requirements for persons interacting with the machine, such as during operation and maintenance, c) human interaction such as the operator–machine interface, and d) the machine–power supply interface	Considered Dimension of machine and ambience conditions for installation provided in user manual.	**P**
5.3.4	Time limits	See below	**P**
	Aspects of time limits to be taken into account include a) the life limit of the machinery and/or of some of its components (tooling, parts that can wear, electromechanical components, etc.), taking into account its intended use and reasonably foreseeable misuse, and b) recommended service intervals.	Considered. Related information mentioned in the manual.	**P**
5.3.5	Other limits	See below	**P**

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Clause	Requirement	Remarks - Results	Verdict
	Examples of other limits include a) properties of the material(s) to be processed, b) housekeeping — the level of cleanliness required, and c) environmental — the recommended minimum and maximum temperatures, whether the machine can be operated indoors or outdoors, in dry or wet weather, in direct sunlight, tolerance to dust and wet, etc.	Considered. Related information mentioned in the manual as temperature, humidity etc.	**P**
5.4	Hazard identification	See below	**P**
	After determination of the limits of the machinery, the essential step in any risk assessment of the machinery is the systematic identification of reasonably foreseeable hazards (permanent hazards and those which can appear unexpectedly), hazardous situations and/or hazardous events during all phases of the machine life cycle, i.e.: – transport, assembly and installation; – commissioning; – use; – dismantling, disabling and scrapping	Considered. Stated in the manual	**P**
	Only when hazards have been identified can steps be taken to eliminate them or to reduce risks. To accomplish this hazard identification, it is necessary to identify the operations to be performed by the machinery and the tasks to be performed by persons who interact with it, taking into account the different parts, mechanisms or functions of the machine, the materials to be processed, if any, and the environment in which the machine can be used. The designer shall identify hazards taking into account the following. a) Human interaction during the whole life cycle of the machine Task identification should consider all tasks associated with every phase of the machine life cycle as given above. Task identification should also take into account, but not be limited to, the following task categories: – setting; – testing; – teaching/programming; – process/tool changeover; – start-up;	Considered.	**P**
	– all modes of operation; – feeding the machine; – removal of product from machine; – stopping the machine; – stopping the machine in case of emergency; – recovery of operation from jam or blockage; – restart after unscheduled stop; – fault-finding/trouble-shooting (operator intervention); – cleaning and housekeeping; – preventive maintenance; – corrective maintenance.	Considered.	**P**

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Clause	Requirement	Remarks - Results	Verdict
	All reasonably foreseeable hazards, hazardous situations or hazardous events associated with the various tasks shall then be identified. Annex B gives examples of hazards, hazardous situations and hazardous events to assist in this process. Several methods are available for the systematic identification of hazards. See also ISO/TR 14121-2. In addition, reasonably foreseeable hazards, hazardous situations or hazardous events not directly related to tasks shall be identified. EXAMPLE Seismic events, lightning, excessive snow loads, noise, break-up of machinery, hydraulic hose burst.	Considered.	**P**
	b) Possible states of the machine These are as follows: 1) the machine performs the intended function (the machine operates normally); 2) the machine does not perform the intended function (i.e. it malfunctions) due to a variety of reasons, including – variation of a property or of a dimension of the processed material or of the workpiece, – failure of one or more of its component parts or services, – external disturbances (for example, shocks, vibration, electromagnetic interference), – design error or deficiency (for example, software errors), – disturbance of its power supply, and – surrounding conditions (for example, damaged floor surfaces).	Considered.	**P**
	c) Unintended behaviour of the operator or reasonably foreseeable misuse of the machine Examples include – loss of control of the machine by the operator (especially for hand-held or mobile machines), – reflex behaviour of a person in case of malfunction, incident or failure during the use of the machine, – behaviour resulting from lack of concentration or carelessness, – behaviour resulting from taking the “line of least resistance” in carrying out a task, – behaviour resulting from pressures to keep the machine running in all circumstances, and – behaviour of certain persons (for example, children, disabled persons). NOTE Examination of the available design documentation can be a useful means of identifying hazards related to the machinery, particularly those associated with moving elements such as motors or hydraulic cylinders	Considered.	**P**
5.5	Risk estimation	See below	**P**
5.5.1	General	See below	**P**

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Clause	Requirement	Remarks - Results	Verdict
	After hazard identification, risk estimation shall be carried out for each hazardous situation by determining the elements of risk given in 5.5.2. When determining these elements, it is necessary to take into account the aspects given in 5.5.3. If standardized (or other suitable) measurement methods exist for an emission, they should be used, in conjunction with existing machinery or prototypes, to determine emission values and comparative emission data. This makes it possible for the designer to – estimate the risk associated with the emissions, – evaluate the effectiveness of the protective measures implemented at the design stage, – provide potential buyers with quantitative information on emissions in the technical documentation, and – provide users with quantitative information on emissions in the information for use. Hazards other than emissions that are described by measurable parameters can be dealt with in a similar manner.	Considered. All electric risk estimation is carried out and the machine is complied with EN 60204-1	**P**
5.5.2	Elements of risk	See below	**P**
5.5.2.1	General	See below	**P**
	The risk associated with a particular hazardous situation depends on the following elements: a) the severity of harm; b) the probability of occurrence of that harm, which is a function of 1) the exposure of person(s) to the hazard, 2) the occurrence of a hazardous event, and 3) the technical and human possibilities to avoid or limit the harm. The elements of risk are shown in Figure 3. Additional details are given in 5.5.2.2, 5.5.2.3 and 5.5.3.	Considered.	**P**
5.5.2.2	Severity of harm	See below	**P**
	The severity can be estimated by taking into account the following: a) the severity of injuries or damage to health, for example, – slight, – serious, – death. b) the extent of harm, for example, to – one person, – several persons. When carrying out a risk assessment, the risk from the most likely severity of the harm that is likely to occur from each identified hazard shall be considered, but the highest foreseeable severity shall also be taken into account, even if the probability of such an occurrence is not high.	Considered. Slight Several persons	**P**
5.5.2.3	Probability of occurrence of harm	See below	**P**
5.5.2.3.1	Exposure of persons to the hazard	See below	**P**

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Clause	Requirement	Remarks - Results	Verdict
	The exposure of a person to the hazard influences the probability of the occurrence of harm. Factors to be taken into account when estimating the exposure are, among others, a) the need for access to the hazard zone (for normal operation, correction of malfunction, maintenance or repair, etc.), b) the nature of access (for example, manual feeding of materials), c) the time spent in the hazard zone, d) the number of persons requiring access, and e) the frequency of access.	Considered.	**P**
5.5.2.3.2	Occurrence of a hazardous event	See below	**P**
	The occurrence of a hazardous event influences the probability of occurrence of harm. Factors to be taken into account when estimating the occurrence of a hazardous event are, among others, a) reliability and other statistical data, b) accident history, c) history of damage to health, and d) comparison of risks (see 5.6.3). NOTE The occurrence of a hazardous event can be of a technical or human origin	Considered.	**P**
5.5.2.3.3	Possibility of avoiding or limiting harm	See below	**P**
	The possibility of avoiding or limiting harm influences the probability of occurrence of harm. Factors to be taken into account when estimating the possibility of avoiding or limiting harm are, among others, the following: a) different persons who can be exposed to the hazard(s), for example, – skilled, – unskilled; b) how quickly the hazardous situation could lead to harm, for example, – suddenly, – quickly, – slowly; c) any awareness of risk, for example, – by general information, in particular, information for use, – by direct observation, – through warning signs and indicating devices, in particular, on the machinery; d) the human ability to avoid or limit harm (for example, reflex, agility, possibility of escape); e) practical experience and knowledge, for example, – of the machinery, – of similar machinery, – no experience.	Considered.	**P**
5.5.3	Aspects to be considered during risk estimation	See below	**P**
5.5.3.1	Persons exposed	See below	**P**
	Risk estimation shall take into account all persons (operators and others) for whom exposure to the hazard is reasonably foreseeable.	Considered.	**P**

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Clause	Requirement	Remarks - Results	Verdict
5.5.3.2	Type, frequency and duration of exposure	See below	**P**
	The estimation of the exposure to the hazard under consideration (including long-term damage to health) requires analysis of, and shall account for, all modes of operation of the machinery and methods of working. In particular, the analysis shall account for the needs for access during loading/unloading, setting, teaching, process changeover or correction, cleaning, fault-finding and maintenance. The risk estimation shall also take into account tasks, for which it is necessary to suspend protective measures.	Considered.	**P**
5.5.3.3	Relationship between exposure and effects	See below	**P**
	The relationship between an exposure to a hazard and its effects shall be taken into account for each hazardous situation considered. The effects of accumulated exposure and combinations of hazards shall also be considered. When considering these effects, risk estimation shall, as far as practicable, be based on appropriate recognized data. NOTE 1 Accident data can assist in establishing the probability and severity of injury associated with the use of a particular type of machinery with a particular type of protective measure. NOTE 2 Zero accident data is, however, no guarantee of the low probability and severity of an injury	Considered.	**P**
5.5.3.4	Human factors	See below	**P**
	Human factors can affect risk and shall be taken into account in the risk estimation, including, for example, a) the interaction of person(s) with the machinery, including correction of malfunction, b) interaction between persons, c) stress-related aspects, d) ergonomic aspects, e) the capacity of persons to be aware of risks in a given situation depending on their training, experience and ability, f) fatigue aspects, and g) aspects of limited abilities (due to disability, age, etc.).	Considered.	**P**
	Training, experience and ability can affect risk; nevertheless, none of these factors shall be used as a substitute for hazard elimination, risk reduction by inherently safe design measure or safeguarding, wherever these protective measures can be practicably implemented	Considered. Appropriate information provided in the user manual	**P**
5.5.3.5	Suitability of protective measures	See below	**P**

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Clause	Requirement	Remarks - Results	Verdict
	Risk estimation shall take into account the suitability of protective measures and shall a) identify the circumstances which can result in harm, b) whenever appropriate, be carried out using quantitative methods to compare alternative protective measures (see ISO/TR 14121-2), and c) provide information that can assist with the selection of appropriate protective measures. When estimating risk, those components and systems identified as immediately increasing the risk in case of failure need special attention. When protective measures include work organization, correct behaviour, attention, application of personal protective equipment (PPE), skill or training, the relatively low reliability of such measures compared with proven technical protective measures shall be taken into account in the risk estimation.	Considered. Related information is stated in user manual.	**P**
5.5.3.6	Possibility of defeating or circumventing protective measures	See below	**P**
	For the continued safe operation of a machine, it is important that the protective measures allow its easy use and do not hinder its intended use. Otherwise, there is a possibility that protective measures might be bypassed in order for maximum utility of the machine to be achieved. Risk estimation shall take account of the possibility of defeating or circumventing protective measures. It shall also take account of the incentive to defeat or circumvent protective measures when, for example, a) the protective measure slows down production or interferes with another activity or preference of the user, b) the protective measure is difficult to use, c) persons other than the operator are involved, or d) the protective measure is not recognized by the user or not accepted as being suitable for its function. Whether or not a protective measure can be defeated depends on both the type of protective measure, such as an adjustable guard or programmable trip device, and its design details.	Considered. Easy use is allowed as designation. The intended use cannot be hindered as designation.	**P**
	Protective measures that use programmable electronic systems introduce additional possibilities of defeat or circumvention if access to safety-related software is not appropriately restricted by design and monitoring methods. Risk estimation shall identify where safety-related functions are not separated from other machine functions and shall determine the extent to which access is possible. This is particularly important when remote access for diagnostic or process correction purposes is required.	Safety measures provided and the equipment can only be operated in safe condition.	**P**
5.5.3.7	Ability to maintain protective measures	See below	**P**

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Clause	Requirement	Remarks - Results	Verdict
	Risk estimation shall consider whether the protective measures can be maintained in the condition necessary to provide the required level of protection. NOTE If the protective measure cannot easily be maintained in correct working order, this can encourage the defeat or circumvention of the protective measure in order to allow continued use of the machinery.	The protective measure (emergency stop) can be maintained.	**P**
5.5.3.8	Information for use	See below	**P**
	Risk estimation shall take into account the information for use, as available. See also 6.4.	Considered.	**P**
5.6	Risk evaluation	See below	**P**
5.6.1	General	See below	**P**
	After risk estimation has been completed, risk evaluation shall be carried out to determine if risk reduction is required. If risk reduction is required, then appropriate protective measures shall be selected and applied (see Clause 6). As shown in Figure 1, the adequacy of the risk reduction shall be determined after applying each of the three steps of risk reduction described in Clause 6. As part of this iterative process, the designer shall also check whether additional hazards are introduced or other risks increased when new protective measures are applied. If additional hazards do occur, they shall be added to the list of identified hazards and appropriate protective measures will be required to address them. Achieving the objectives of risk reduction and a favourable outcome of risk comparison applied when practicable gives confidence that risk has been adequately reduced.	Considered.	**P**
5.6.2	Adequate risk reduction	See below	**P**
	Application of the three-step method described in 6.1 is essential in achieving adequate risk reduction. Following the application of the three-step method, adequate risk reduction is achieved when – all operating conditions and all intervention procedures have been considered, – the hazards have been eliminated or risks reduced to the lowest practicable level, – any new hazards introduced by the protective measures have been properly addressed, – users are sufficiently informed and warned about the residual risks (see 6.1, step 3), – protective measures are compatible with one another, – sufficient consideration has been given to the consequences that can arise from the use in a nonprofessional/ non-industrial context of a machine designed for professional/industrial use, and – the protective measures do not adversely affect the operator's working conditions or the usability of the machine	Three-step method used for risk reduction.	**P**
5.6.3	Comparison of risks	See below	**P**

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Clause	Requirement	Remarks - Results	Verdict
	As part of the process of risk evaluation, the risks associated with the machinery or parts of machinery can be compared with those of similar machinery or parts of machinery, provided the following criteria apply: – the similar machinery is in accordance with the relevant type-C standard(s); – the intended use, reasonably foreseeable misuse and the way both machines are designed and constructed are comparable; – the hazards and the elements of risk are comparable; – the technical specifications are comparable; – the conditions for use are comparable. The use of this comparison method does not eliminate the need to follow the risk assessment process as described in this International Standard for the specific conditions of use. For example, when a band saw used for cutting meat is compared with a band saw used for cutting wood, the risks associated with the different material shall be assessed	Considered.	**P**
6	**Risk reduction**	See below	**P**
6.1	General	See below	**P**
	The objective of risk reduction can be achieved by the elimination of hazards, or by separately or simultaneously reducing each of the two elements that determine the associated risk: – severity of harm from the hazard under consideration; – probability of occurrence of that harm. All protective measures intended for reaching this objective shall be applied in the following sequence, referred to as the three-step method (see also Figures 1 and 2). Step 1: Inherently safe design measures Inherently safe design measures eliminate hazards or reduce the associated risks by a suitable choice of design features of the machine itself and/or interaction between the exposed persons and the machine. See 6.2. NOTE 1 This stage is the only one at which hazards can be eliminated, thus avoiding the need for additional protective measures such as safeguarding or complementary protective measures.	Considered.	**P**

Clause	Requirement	Remarks - Results	Verdict
	Step 2: Safeguarding and/or complementary protective measures Taking into account the intended use and the reasonably foreseeable misuse, appropriately selected safeguarding and complementary protective measures can be used to reduce risk when it is not practicable to eliminate a hazard, or reduce its associated risk sufficiently, using inherently safe design measures. See 6.3. Step 3: Information for use Where risks remain despite inherently safe design measures, safeguarding and the adoption of complementary protective measures, the residual risks shall be identified in the information for use. The information for use shall include, but not be limited to, the following: – operating procedures for the use of the machinery consistent with the expected ability of personnel who use the machinery or other persons who can be exposed to the hazards associated with the machinery; – the recommended safe working practices for the use of the machinery and the related training requirements adequately described; – sufficient information, including warning of residual risks for the different phases of the life of the machinery;	3-step protective measures considered.	**P**
	– the description of any recommended personal protective equipment, including detail as to its need as well as to training needed for its use. Information for use shall not be a substitute for the correct application of inherently safe design measures, safeguarding or complementary protective measures. NOTE 2 Adequate protective measures associated with each of the operating modes and intervention procedures reduce the possibility of operators being induced to use hazardous intervention techniques in case of technical difficulties	Considered.	**P**
6.2	Inherently safe design measures	See below	**P**
6.2.1	General	See below	**P**

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Clause	Requirement	Remarks - Results	Verdict
	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. NOTE See 6.3 for safeguarding and complementary measures that can be used to achieve the risk reduction objectives in the case where inherently safe design measures are not sufficient (see 6.1 for the three-step method).	Considered.	**P**
6.2.2	Consideration of geometrical factors and physical aspects	See below	**P**
6.2.2.1	Geometrical factors	See below	**P**
	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.	Considered.	**P**

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Clause	Requirement	Remarks - Results	Verdict
	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 accessible manual controls (actuators).	Considered.	**P**
6.2.2.2	Physical aspects	See below	**P**
	Such aspects include the following: a) limiting the actuating force to a sufficiently low value so that the actuated part does not generate a mechanical hazard; b) limiting the mass and/or velocity of the movable elements, and hence their kinetic energy	Considered.	**P**
	c) limiting the emissions by acting on the characteristics of the source using measures for reducing 1) noise emission at source (see ISO/TR 11688-1), 2) the emission of vibration at source, such as redistribution or addition of mass and changes of process parameters [for example, frequency and/or amplitude of movements (for hand-held and hand-guided machinery, see CR 1030-1)], 3) the emission of hazardous substances, including the use of less hazardous substances or dust-reducing processes (granules instead of powders, milling instead of grinding), and 4) radiation emissions, including, for example, avoiding the use of hazardous radiation sources, limiting the power of radiation to the lowest level sufficient for the proper functioning of the machine, designing the source so that the beam is concentrated on the target, increasing the distance between the source and the operator or providing for remote operation of the machinery [measures for reducing emission of non-ionizing radiation are given in 6.3.4.5 (see also EN 12198-1 and EN 12198-3)].	Considered.	**P**
6.2.3	Taking into account general technical knowledge of machine design	Considered.	**P**

Clause	Requirement	Remarks - Results	Verdict
	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	Considered.	**P**
	c) emission values for – noise, – vibration, – hazardous substances, and – radiation. When the reliability of particular components or assemblies is critical for safety (for example, ropes, chains, lifting accessories for lifting loads or persons), stress limits shall be multiplied by appropriate working coefficients	Considered.	**P**
6.2.4	Choice of appropriate technology	See below	**P**
	One or more hazards can be eliminated or risks reduced by the choice of the technology to be used in certain applications such as the following: a) on machines intended for use in explosive atmospheres, using – appropriately selected pneumatic or hydraulic control system and machine actuators, – intrinsically safe electrical equipment (see IEC 60079-11); b) for particular products to be processed (for example, by a solvent), by using equipment that ensures the temperature will remain far below the flash point; c) the use of alternative equipment to avoid high noise levels, such as – electrical instead of pneumatic equipment, – in certain conditions, water-cutting instead of mechanical equipment	Not used in explosive atmospheres. Considered	**P**
6.2.5	Applying principle of positive mechanical action	See below	**P**

Clause	Requirement	Remarks - Results	Verdict
	Positive mechanical action is achieved when a moving mechanical component inevitably moves another component along with it, either by direct contact or via rigid elements. An example of this is positive opening operation of switching devices in an electrical circuit (see IEC 60947-5-1 and ISO 14119). NOTE Where a mechanical component moves and thus allows a second component to move freely (for example, by gravity or spring force), there is no positive mechanical action of the first component on the second	See 6.1.	**P**
6.2.6	Provisions for stability	See below	**P**
	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.	Considered and relevant information provided in user manual and the stability will be ensured by end user.	**P**
6.2.7	Provisions for maintainability	See below	**P**
	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	Considered.	**P**
6.2.8	Observing ergonomic principles	See below	**P**

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Clause	Requirement	Remarks - Results	Verdict
	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. 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.	Considered.	**P**
	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	Considered and relevant information provided in user manual, refer to general safety precautions.	**P**

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Clause	Requirement	Remarks - Results	Verdict
	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.	Considered, and the control switch are all located at operator's reach area.	**P**
	Where a control is designed and constructed to perform several different actions — namely, where there is no one-to-one correspondence (for example, keyboards) — the action to be performed shall be clearly displayed and subject to confirmation where necessary. Controls shall be so arranged that their layout, travel and resistance to operation are compatible with the action to be performed, taking account of ergonomic principles. Constraints due to the necessary or foreseeable use of personal protective equipment (such as footwear, gloves) shall be taken into account. g) Select, design and locate indicators, dials and visual display units so that – they fit within the parameters and characteristics of human perception, – information displayed can be detected, identified and interpreted conveniently, i.e. long-lasting, distinct, unambiguous and understandable with respect to the operator's requirements and the intended use, and – the operator is able to perceive them from the control position	No control used for several different actions.	**N/A**
6.2.9	Electrical hazards	See below	**P**
	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).	Refer to part I of this report.	**P**
6.2.10	Pneumatic and hydraulic hazards	See below	**P**

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Clause	Requirement	Remarks - Results	Verdict
	Pneumatic and hydraulic equipment of machinery shall be designed so that – the maximum rated pressure cannot be exceeded in the circuits (using, for example, pressure-limiting devices), – no hazard results from pressure fluctuations or increases, or from loss of pressure or vacuum, – no hazardous fluid jet or sudden hazardous movement of the hose (whiplash) results from leakage or component failures, – air receivers, air reservoirs or similar vessels (such as in gas-loaded accumulators) comply with the applicable design standard codes or regulations for these elements, – all elements of the equipment, especially pipes and hoses, are protected against harmful external effects, – as far as possible, reservoirs and similar vessels (for example, gas-loaded accumulators) are automatically depressurized when isolating the machine from its power supply (see 6.3.5.4) and, if not possible, means are provided for their isolation, local depressurizing and pressure indication (see also ISO 14118:2000, Clause 5), and – all elements which remain under pressure after isolation of the machine from its power supply are provided with clearly identified exhaust devices, and there is a warning label drawing attention to the necessity of depressurizing those elements before any setting or maintenance activity on the machine. NOTE See also ISO 4413 and ISO 4414.	Considered and meet this requirement.	**P**
6.2.11	Applying inherently safe design measures to control systems	See below	**P**
6.2.11.1	General	See below	**P**
	The design measures of the control system shall be chosen so that their safety-related performance provides a sufficient amount of risk reduction (see ISO 13849-1 or IEC 62061). 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 behavior are – unexpected start-up (see ISO 14118), – uncontrolled speed change, – failure to stop moving parts,	Hardwire circuit (emergency stop circuit) used for safety related control system. Meet the requirements.	**P**

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Clause	Requirement	Remarks - Results	Verdict
	– 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 behavior and to achieve safety functions, the design of control systems shall comply with the principles and methods presented in this sub-clause (6.2.11) and in 6.2.12. These principles and methods shall be applied singly or in combination as appropriate to the circumstances (see ISO 13849-1, IEC 60204-1 and IEC 62061). Control systems shall be designed to enable the operator to interact with the machine safely and easily. This requires one or several of the following solutions: – systematic analysis of start and stop conditions; – provision for specific operating modes (for example, start-up after normal stop, restart after cycle interruption or after emergency stop, removal of the workpieces contained in the machine, operation of a part of the machine in case of a failure of a machine element); – clear display of the faults; – measures to prevent accidental generation of unexpected start commands (for example, shrouded start device) likely to cause dangerous machine behaviour (see ISO 14118:2000, Figure 1); – maintained stop commands (for example, interlock) to prevent restarting that could result in dangerous machine behaviour (see ISO 14118:2000, Figure 1).	Considered.	**P**
	An assembly of machines may be divided into several zones for emergency stopping, for stopping as a result of protective devices and/or for isolation and energy dissipation. The different zones shall be clearly defined and it shall be obvious which parts of the machine belong to which zone. Likewise, it shall be obvious which control devices (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	Emergency stop provided.	**P**

Clause	Requirement	Remarks - Results	Verdict
	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).	Considered.	**P**
6.2.11.2	Starting of an internal power source/switching on an external power supply	See below	**P**
	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).	Meet the requirements of EN 60204-1.	**P**
6.2.11.3	Starting/stopping of a mechanism	See below	**P**

Clause	Requirement	Remarks - Results	Verdict
	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. 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	Considered.	**P**
6.2.11.4	Restart after power interruption	See below	**P**
	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).	Considered.	**P**
6.2.11.5	Interruption of power supply	See below	**P**
	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.	Stopping function provided.	**P**
6.2.11.6	Use of automatic monitoring 6.2.11.6 Use of automatic monitoring	See below.	**N/A**

Clause	Requirement	Remarks - Results	Verdict
	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.	Small machine and operator can monitor the control function.	**N/A**
6.2.11.7	Safety functions implemented by programmable electronic control systems	No such safety function.	**N/A**
6.2.11.7.1	General	None	**N/A**
	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 behaviour 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. 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	None	**N/A**
6.2.11.7.2	Hardware aspects	None	**N/A**

Clause	Requirement	Remarks - Results	Verdict
	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.	None	**N/A**
6.2.11.7.3	Software aspects	None	**N/A**
	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).	None	**N/A**
6.2.11.8	Principles relating to manual control	See below	**P**
	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.	Meet the requirements.	**P**

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Clause	Requirement	Remarks - Results	Verdict
	1) The driver of a ride-on mobile machine shall be able to actuate all control devices required to operate the machine from the driving position, except for functions which can be controlled more safely from other positions. 2) On machinery intended for lifting persons, controls for lifting and lowering and, if appropriate, for moving the carrier shall generally be located in the carrier. If safe operation requires controls to be situated outside the carrier, the operator in the carrier shall be provided with the means of preventing hazardous movements.	Not such machine.	**N/A**
	e) If it is possible to start the same hazardous element by means of several controls, the control circuit shall be so arranged that only one control is effective at a given time. This applies especially to machines which can be manually controlled 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).	No such control function.	**N/A**
	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).	No such control function.	**N/A**
6.2.11.9	Control mode for setting, teaching, process changeover, fault-finding, cleaning or Maintenance	See below	**P**

Clause	Requirement	Remarks - Results	Verdict
	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	All modes are protected by emergency stop. The safety of user is achieved by disabling all other control modes No hazard.	**P**
	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.	No this hazard.	**N/A**
6.2.11.10	Selection of control and operating modes	Only one operating mode.	**N/A**
	If machinery has been designed and built to allow for its use in several control or operating modes requiring different protective measures and/or work procedures (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).	See above.	**N/A**
6.2.11.11	Applying measures to achieve electromagnetic compatibility (EMC)	Covered by EMC directive.	**N/A**
	For guidance on electromagnetic compatibility, see IEC 60204-1 and IEC 61000-6.	See above.	**N/A**
6.2.11.12	Provision of diagnostic systems to aid fault-finding	See below	**N/A**

Clause	Requirement	Remarks - Results	Verdict
	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.	No diagnostic system needed. Appropriate protective measure used.	**N/A**
6.2.12	Minimizing probability of failure of safety functions	See below	**P**
6.2.12.1	General	See below	**P**
	Safety of machinery is not only dependent on the reliability of the control systems but also on the reliability of all parts of the machine. The continued operation of the safety functions is essential for the safe use of the machine. This can be achieved by the measures given in 6.2.12.2 to 6.2.12.4	Considered.	**P**
6.2.12.2	Use of reliable components	See below	**P**
	"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.	Reliable components are used for the machine. All components belong to low voltage directive comply with relevant EU standards.	**P**
6.2.12.3	Use of "oriented failure mode" components	No this kind of components used.	**N/A**
	"Oriented failure mode" components or systems are those in which the predominant failure mode is known in advance and which can be used so that 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.	See above.	**N/A**
6.2.12.4	Duplication (or redundancy) of components or subsystems	See below.	**N/A**

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Clause	Requirement	Remarks - Results	Verdict
	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.	Simple machine, no redundancy requirements.	**N/A**
6.2.13	Limiting exposure to hazards through reliability of equipment	See below	**P**
	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	Considered.	**P**
6.2.14	Limiting exposure to hazards through mechanization or automation of loading (feeding)/ unloading (removal) operations	No this hazard.	**N/A**
	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.	See above.	**N/A**

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Clause	Requirement	Remarks - Results	Verdict
	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	See above.	**N/A**
6.2.15	Limiting exposure to hazards through location of setting and maintenance points outside danger zones	Considered.	**P**
	The need for access to danger zones shall be minimized by locating maintenance, lubrication and setting points outside these zones.	Considered.	**P**
6.3	Safeguarding and complementary protective measures	See below	**P**
6.3.1	General	See below	**P**
	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.	Emergency stop provided to stop all hazardous movements.	**P**
6.3.2	Selection and implementation of guards and protective devices	See below	**P**
6.3.2.1	General	See below	**P**
	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 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).	Movable guard provided for the cutter. See 6.1.	**P**

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Clause	Requirement	Remarks - Results	Verdict
	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.	See above.	**P**
	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	All dangerous parts and materials are all located and protected by safety guard and machine enclosure.	**P**
6.3.2.2	Where access to the hazard zone is not required during normal operation	See below	**P**
	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).	Movable guard provided for the cutter.	**P**
6.3.2.3	Where access to the hazard zone is required during normal operation	See below	**N/A**

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Clause	Requirement	Remarks - Results	Verdict
	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).	No this hazard.	**N/A**
6.3.2.4	Where access to the hazard zone is required for machine setting, teaching, process changeover, fault-finding, cleaning or maintenance	See below	**P**
	As far as possible, machines shall be designed so that the safeguards provided for the protection of the production operator also ensure the protection of personnel carrying out setting, teaching, process changeover, fault-finding, cleaning or maintenance, without hindering them in the performance of their task. Such tasks shall be identified and considered in the risk assessment as parts of the use of the machine (see 5.2). 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.	Considered	**P**
6.3.2.5	Selection and implementation of sensitive protective equipment[1)]	See below	**P**
6.3.2.5.1	Selection	-	**P**
	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	Considered	**P**

Clause	Requirement	Remarks - Results	Verdict
	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 protective equipment: – tendency for the machinery to eject materials or component parts; – necessity to guard against emissions (noise, radiation, dust, etc.); – erratic or excessive machine stopping time; – inability of a machine to stop part-way through a cycle.	Considered	**P**
6.3.2.5.2	Implementation	See below	**P**
	Consideration should be given to a) the size, characteristics and positioning of the detection zone (see ISO 13855, which deals with the positioning of some types of sensitive protective equipment), b) the reaction of the device to fault conditions (see IEC 61496 for electrosensitive protective equipment), c) the possibility of circumvention, and d) detection capability and its variation over the course of time (as a result, for example, of its susceptibility to different environmental conditions such as the presence of reflecting surfaces, other artificial light sources and sunlight or impurities in the air). 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 is maintained by the control system until a new command is given	Considered	**P**

Clause	Requirement	Remarks - Results	Verdict
	– 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.	Considered	**P**
6.3.2.5.3	Additional requirements for sensitive protective equipment when used for cycle initiation	No such cycle initiation	**N/A**
	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.	None.	**N/A**

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Clause	Requirement	Remarks - Results	Verdict
	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 (including ancillary equipment and transmission elements) is initiated by clearing of the sensing field. NOTE 2 See also IEC/TS 62046	None.	**N/A**
6.3.2.6	Protective measures for stability	See below	**P**
	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	Considered	**P**
6.3.2.7	Other protective devices	See below	**P**
	When a machine requires continuous control by the operator (for example, mobile machines, cranes) and an error of the operator can generate a hazardous situation, this machine shall be equipped with the necessary devices to enable the operation to remain within specified limits, in particular – when the operator has insufficient visibility of the hazard zone, – when the operator lacks knowledge of the actual value of a safety-related parameter (distance, speed, mass, angle, etc.), and – when hazards can result from operations other than those controlled by the operator.	No need for continuous control for this machine.	**N/A**

Clause	Requirement	Remarks - Results	Verdict
	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	See above.	**N/A**
	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).	See above.	**N/A**
6.3.3	Requirements for design of guards and protective devices	See below	**P**
6.3.3.1	General requirements	See below	**P**
	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.	All guards are well fixed and have enough strength. Guards are fixed reliable.	**P**

Clause	Requirement	Remarks - Results	Verdict
	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	The safety distances are in accordance with Table 4 of EN ISO 13857.	**P**
6.3.3.2	Requirements for guards	See below	**P**
6.3.3.2.1	Functions of guards	See below	**P**
	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).	Considered.	**P**
6.3.3.2.2	Requirements for fixed guards	Considered.	**P**
	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.	Moving parts are located in the enclosure of the machine	**P**
6.3.3.2.3	Requirements for movable guards	See below	**P**

Clause	Requirement	Remarks - Results	Verdict
	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	Considered.	**P**
6.3.3.2.4	Requirements for adjustable guards	See below	**N/A**
	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	No control guard used.	**N/A**
6.3.3.2.5	Requirements for interlocking guards with a start function (control guards)	See below	**N/A**
	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,	No control guard used.	**N/A**

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Clause	Requirement	Remarks - Results	Verdict
	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.	See above.	**N/A**
6.3.3.2.6	Hazards from guards	See below	**P**
	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).	Considered.	**P**
6.3.3.3	Technical characteristics of protective devices	See below	**P**
	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.	Considered.	**P**
6.3.3.4	Provisions for alternative types of safeguards6.3.3.4 Provisions for alternative types of safeguards	Not required.	**N/A**
	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.	See above.	**N/A**
6.3.4	Safeguarding to reduce emissions	See below	**P**
6.3.4.1	General	See below	**P**
	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).	Considered.	**P**
6.3.4.2	Noise	See below	**P**
	Additional protective measures against noise include – enclosures (see ISO 15667), – screens fitted to the machine, and – silencers (see ISO 14163).	Considered.	**P**
6.3.4.3	Vibration	See below	**P**

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Clause	Requirement	Remarks - Results	Verdict
	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.	Not handhold machine and can be fixed on ground. Vibration considered.	**P**
6.3.4.4	Hazardous substances	See below	**P**
	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.	Considered.	**P**
6.3.4.5	Radiation	See below	**N/A**
	Additional protective measures against radiation include – use of filtering and absorption, and – use of attenuating screens or guards	No radiation generated.	**N/A**
6.3.5	Complementary protective measures	See below	**P**
6.3.5.1	General	See below	**P**
	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.	Considered.	**P**
6.3.5.2	Components and elements to achieve emergency stop function	See below	**P**
	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.	The Emergency stop button is clearly marked; It can stop all hazardous movements.	**P**

Clause	Requirement	Remarks - Results	Verdict
	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. More details for the design and selection of electrical components and elements to achieve the emergency stop function are provided in IEC 60204	Meet this requirement.	**P**
6.3.5.3	Measures for the escape and rescue of trapped persons	Small machine and no such hazard.	**N/A**
	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.	None.	**N/A**
6.3.5.4	Measures for isolation and energy dissipation	See below	**P**
	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	Meet requirement of EN 60204-1, refer to part I of this report.	**P**
	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.	Meet requirement of EN 60204-1, refer to part I of this report.	**P**
6.3.5.5	Provisions for easy and safe handling of machines and their heavy component parts	See below	**P**

Clause	Requirement	Remarks - Results	Verdict
	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).	Lifting and fixing point are clearly marked.	**P**
6.3.5.6	Measures for safe access to machinery	See below	**P**
	Machinery shall be so designed as to enable operation and all routine tasks relating to setting and/or maintenance to be carried out as far as possible by a person remaining at ground level. 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 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	All operation, maintenance and setting can be done by a person remaining at ground level. No stairs, fixed ladder and guard-rail used.	**P**

Clause	Requirement	Remarks - Results	Verdict
	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.	See above.	**N/A**
6.4	Information for use	See below	**P**
6.4.1	General requirements6.4.1 General requirements	See below	**P**
6.4.1.1	Drafting information for use is an integral part of the design of a machine (see Figure 2). Information for use consists of communication links, such as texts, words, signs, signals, symbols or diagrams, used separately or in combination to convey information to the user. Information for use is intended for professional and/or non-professional users. NOTE See also IEC 62079 for structuring and presentation of information for use	Considered.	**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.	Relevant information provided in user manual.	**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.	Relevant information provided in user manual.	**P**
6.4.2	Location and nature of information for use	See below	**P**

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Clause	Requirement	Remarks - Results	Verdict
	Depending on the risk, the time when the information is needed by the user and the machine design, it shall be decided whether the information — or parts thereof — are to be given a) in/on the machine itself (see 6.4.3 and 6.4.4), b) in accompanying documents (in particular instruction handbook, see 6.4.5), c) on the packaging, d) by other means such as signals and warnings outside the machine. Standardized phrases shall be considered where important messages such as warnings are given (see also IEC 62079).	Considered.	**P**
6.4.3	Signals and warning devices	See below	**P**
	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,	Considered.	**P**
	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	Considered.	**P**
6.4.4	Markings, signs (pictograms) and written warnings	See below	**P**
	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),	Considered.	**P**

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Clause	Requirement	Remarks - Results	Verdict
	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	Considered.	**P**
	Markings, signs and written warnings shall be readily understandable and unambiguous, especially as regards the part of the function(s) of the machine to which they are related. Readily understandable signs (pictograms) should be used in preference to written warnings. Signs and pictograms should only be used if they are understood in the culture in which the machinery is to be used.	Considered.	**P**
	Written warnings shall be drawn up in the language(s) of the country in which the machine will be used for the first time and, on request, in the language(s) understood by operators. 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	User manual with local language declaration provided by the manufacturer.	**P**
6.4.5	Accompanying documents (in particular — instruction handbook)	See below	**P**
6.4.5.1	Contents	See below	**P**
	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	Considered.	**P**

EN ISO 12100:2010

Clause	Requirement	Remarks - Results	Verdict
	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),	Considered.	**P**
	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	Considered.	**P**
	d) information relating to the use of the machine, such as that related to or describing 1) intended use, 2) manual controls (actuators), 3) setting and adjustment, 4) modes and means for stopping (especially emergency stop), 5) risks which could not be eliminated by the protective measures implemented by the designer, 6) particular risks which can be generated by certain applications, by the use of certain fittings, and about specific safeguards necessary for such applications, 7) reasonably foreseeable misuse and prohibited applications, 8) fault identification and location, for repair and for restarting after an intervention, and 9) personal protective equipment needed to be used and the training that is required;	Considered.	**P**

Clause	Requirement	Remarks - Results	Verdict
	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;	Considered.	**P**
	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	Considered.	**P**
6.4.5.2	Production of instruction handbook	See below	**P**
	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.	Considered.	**P**

Clause	Requirement	Remarks - Results	Verdict
	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	Considered.	**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.	Considered.	**P**
6.4.5.3	Drafting and editing information for use	See below	**P**
	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.	Considered.	**P**

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Clause	Requirement	Remarks - Results	Verdict
	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.	Not for non-professional use.	**N/A**
7	**Documentation of risk assessment and risk reduction**	See below	**P**
	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;	Considered.	**P**
	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 documentation.	Considered.	**P**
Annex A (informative)	**Schematic representation of a machine**	Considered.	**P**

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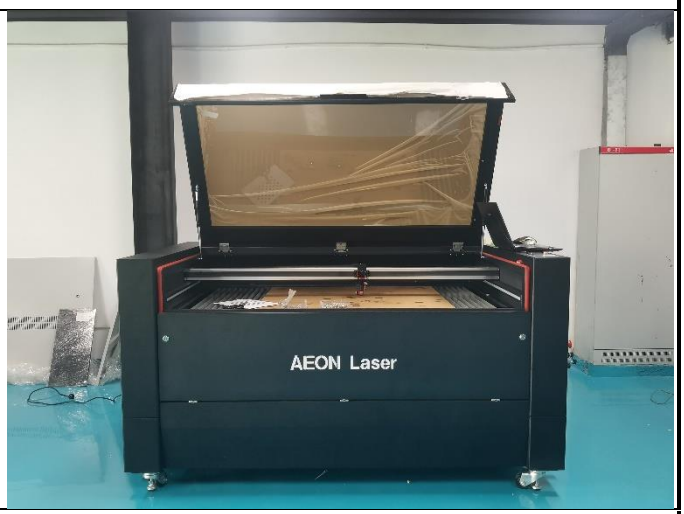
Clause	Requirement	Remarks - Results	Verdict
Annex B (informative)	**Examples of hazards, hazardous situations and hazardous events**	Considered.	**P**
Annex C (informative)	**Trilingual lookup and index of specific terms and expressions used in ISO 12100**	Considered.	**P**

End of Part II Test Report

Prüfbericht-Nr.: *Test report no.:*	**CN22V6V2 001 Part III of III**	**Auftrags-Nr.:** *Order no.*:	244446683	Seite 1 von 13 *Page 1 of 13*
Kunden-Referenz-Nr.: *Client reference no.:*	2270712	**Auftragsdatum:** *Order date:*	2022-08-31	
Auftraggeber: *Client:*	SUZHOU AEON LASER TECHNOLOGY CO.,LTD.			
Prüfgegenstand: *Test item:*	Laser Engraving and Cutting Machine			
Bezeichnung / Typ-Nr.: *Identification / Type no.:*	NOVA10, NOVA14, NOVA16			
Auftrags-Inhalt: *Order content*:	Type test			
Prüfgrundlage: *Test specification:*	EN ISO 11553-1:2020 EN ISO 11553-1:2020/A11:2020 Safety of machinery - Laser processing machines Part 1: Laser safety requirements			

Wareneingangsdatum: *Date of sample receipt:*	N/A
Prüfmuster-Nr.: *Test sample no:*	See page 2.
Prüfzeitraum: *Testing period:*	2022-08-11 - 2022-08-11
Ort der Prüfung: *Place of testing:*	As client
Prüflaboratorium: *Testing laboratory:*	TÜV Rheinland (Shanghai) Co., Ltd.
Prüfergebnis*: *Test result*:*	Pass



geprüft von: *tested by:*	Kirk Chen	**genehmigt von:** *authorized by:*	Xinling Liu
Datum: *Date: 2022-10-10*		**Ausstellatum:** *Issue date: 2022-10-10*	
Stellung / *Position:*	Project Engineer	**Stellung** / *Position:*	Technical Certifier

Sonstiges / *Other:* This report is only valid in its full version: Part I of III, Part II of III and Part III of III.

Zustand des Prüfgegenstandes bei Anlieferung: Prüfmuster vollständig und unbeschädigt
Condition of the test item at delivery: *Test item complete and undamaged*

* Legende:	1 = sehr gut	2 = gut	3 = befriedigend	4 = ausreichend	5 = mangelhaft
	P(ass) = entspricht o.g. Prüfgrundlage(n)		F(ail) = entspricht nicht o.g. Prüfgrundlage(n)	N/A = nicht anwendbar	N/T = nicht getestet
** Legend:*	*1 = very good*	*2 = good*	*3 = satisfactory*	*4 = sufficient*	*5 = poor*
	P(ass) = passed a.m. test specification(s)		*F(ail) = failed a.m. test specification(s)*	*N/A = not applicable*	*N/T = not tested*

EN ISO 11553-1:2020+A11:2020

Clause	Requirement	Remarks - Results	Verdict
5	**Safety requirements and measures**	See below	P
5.1	General requirements	See below	P
	The extent to which hazards are covered is indicated in the Scope. Manufacturers shall ensure the safety of laser processing machines by a) hazard identification and analysis, b) implementation of safety measures, c) certification and verification of the safety measures, and d) provision of appropriate information for the user. Based on the hazard identification (see 5.2), appropriate safety measures shall be incorporated into the laser processing machine by design and manufacture.	Considered.	P
5.2	Risk assessment with regard to laser radiation hazards	See below	P
	The accessibility to hazardous laser radiation decisively depends on the status of a laser machine. Therefore, a risk assessment with regard to laser radiation hazard shall be performed: -for the whole life cycle of the machine, as applicable, (for examples see ISO 12100:2010); -for all operating modes (The operating modes described in Clause 3 are only examples. The operating modes of the machine incl. terminology and content should be defined by the risk assessment of the manufacturer.); -after each modification of the machine by the person or organization responsible for the modification; and -for each reasonably foreseeable misuse/operation not included by the intended use.	Considered.	P
	A risk assessment includes but is not limited to: a) hazards caused by the direct or reflected laser beam; b) hazard zones, particularly those associated with 1) the laser or the laser system, 2) the laser beam path/beam delivery system, 3) the process zone, 4) the laser hazard area, and 5) the area in which laser radiation can dazzle people; c) "interferences"" listed in 4.3. The results of the risk assessment shall be duly documented. See ISO 12100:2010 for principle for risk assessment.	Risk assessment provided.	P
5.3	Implementation of corrective measures	See below	P
5.3.1	General	See below	P
	Safety measures against laser radiation hazards shall be incorporated in the machine by design and manufacture as specified in 5.3.2 to 5.3.4. Safety measures against laser hazards shall follow the priority principle according to ISO 12100:2010.	Refer to 5.3.2 to 5.3.4	P

EN ISO 11553-1:2020+A11:2020

Clause	Requirement	Remarks - Results	Verdict
5.3.2	Safety measures against laser radiation hazards in dependence of the locations Note: in the following, requirements for safety measures against laser radiation hazards are given in dependence of the location, where the laser processing machine operates.	See below	P
5.3.2.1	Safety measures at locations with unrestricted and uncontrolled access	No unrestricted and uncontrolled access for this machine.	N/A
	For laser processing machines operating in locations with unrestricted and uncontrolled access, the possibility of people being exposed to hazardous levels of laser radiation exceeding the accessible emission limit (AEL) for Class 1 according to IEC 60825-1:2014 shall be eliminated during all operating modes (production and any other operating mode). To satisfy these requirements, the following conditions shall be met. -Unauthorized human access to a hazard zone shall be prevented solely by engineering safety measures as stipulated in IEC 60825-1 and ISO 12100:2010. - Guarding shall be applied to protect against laser radiation. - SRP/CS shall be used to safety isolate the laser radiation, the requirements of ISO 13849-1:2015 shall be met. Note: most commonly by means of an enclosure or guards/screens as described in IEC60825-4:2006. Example: typically, these machines are exhibited or demonstrated on fairs and exhibitions. Since the public can have access to the location, no hazards may emanate from the laser processing machine.	As above	N/A
5.3.2.2	Safety measures at locations with restricted access	See below	P

EN ISO 11553-1:2020+A11:2020

Clause	Requirement	Remarks - Results	Verdict
	For laser processing machines operating in locations with restricted access, predominantly engineering safety measures specified in IEC 60825-1:2014 and ISO 12100:2010 shall be taken to prevent human access to a laser hazard area (NOHA). To satisfy these requirements, the following conditions shall be met: a) Engineering safety measures for guarding and for shielding of laser radiation shall reduce the irradiance below the MPE of eye and skin. SRP/CS for the safe isolation of the laser radiation shall comply with ISO 13849-1:2015. b) In addition to engineering measures organizational measures might be necessary (e.g. for operating mode "service") to prevent human access to hazardous laser radiation. Exposure above the MPE shall be eliminated by additional use of administrative / organizational safety measures. Organizational safety measures shall be carried out with secondary priority in accordance with ISO 12100:2010 and IEC 60825-1:2014. The manufactures shall inform the user, how to carry out the organizational measures in order to avoid risks (exceed MPE) by laser radiation. If the laser hazard area is shielded or partially shielded by laser guards the manufacturer shall inform the user how to determine the FEL and provide adequate laser guards (with sufficient PEL according to IEC 60825-1:2014). If the laser safety is provided by distance the manufacturer shall inform the user how to determine the NOHA. The manufacturer shall inform the user, how to install barriers (e.g. with barrier tapes) at the respective Nominal Ocular Hazard Distances. He shall provide information how to implement the organizational measures in training/education and safety instructions. EXAMPLE Performing service at a laser processing machine located in a shop floor, which is the restricted area. The laser hazard area is screened by means of vertical mobile laser guards/walls, which are labelled with safety signs respectively. Reflected laser radiation can propagate to upper floors or scaffold platforms. Personnel having access to the shop floor is trained in organizational measures, to follow the organizational safety measures (prohibitions/warnings). By this, the residual risk by laser radiation can be eliminated by organizational measures; here e.g. prohibition of entry to upper floors.	Risk assessment performed. The access to radiation is protected by guard with interlocking switch. Unauthorized human access to a danger zone is prohibited and when guard is open, the interlocking switch will power off the lasing. The maximum values of measured accessible emission are less than 1000W/m^{-2} required in EN 60825-1 table 3 (λ: 10,600 nm; Time base: 100s). Max. measured value: 18.85W/m^{-2}; Meet requirement of EN 60825-1. During all operating modes, the hazardous levels of laser radiation does not exceed the accessible emission limit (AEL) for Class 1. The appropriate warning label is attached to the machine.	P
5.3.2.3	Safety measured at locations with controlled access	No controlled access for this machine.	N/A

EN ISO 11553-1:2020+A11:2020

Clause	Requirement	Remarks - Results	Verdict
	For laser processing machines operating in locations with controlled access, the possibility of people being expose to levels of laser radiation exceeding the maximum permissible exposure (MPEeye and MPEskin) shall be eliminated. To satisfy this requirement, the following conditions shall be met in addition to all safety measures related to operating modes, where 5.3.3.2 to 5.3.3.5 apply. a) Unauthorized human access to the laser hazard zone shall be prevented predominantly by engineering safety measures as specified in IEC 60825-1:2014 and ISO 12100:2010. The manufacturer shall specify the kind of authorization control enabling/preventing access to the laser hazard zone (e.g. door with key, password/transponder). b) If authorized access (e.g. by key or password/transponder) is necessary for laser processing machines operating in locations with controlled access (e.g. for service mode, see also 5.3.3.4) the manufacturer shall provide information on how to work safely in a laser hazard area (see IEC 60825-1:2014). Exposure above the MPE in the controlled area shall be eliminated by use of engineering and administrative controls, including Personal Protective Equipment (PPE). The manufacturer shall provide the following information to the user: — Engineering measures: Emergency stop in the laser hazard area. — Organizational measures: The qualification of personnel authorized to access the laser hazard zone, which means level of training and education of the personnel and on safety instructions given to the personnel. — PPE: The required personal protective equipment (type, level of protection). EXAMPLE Service engineers that need to work in a guarded laser hazard area, or in excess of the MPE respectively. Protective measures include, besides technical and administrative means, adequate personal protective equipment (laser protective eyewear, protective clothing).	As above	N/A
5.3.3	Safety measures against laser radiation hazards NOTE In the following, design requirements for safety measures against laser radiation hazards are given.	See below	P
5.3.3.1	Design requirements for safety measures	See below	P

EN ISO 11553-1:2020+A11:2020

Clause	Requirement	Remarks - Results	Verdict
	For all laser processing machines, without regard to restricted or controlled access, the following shall apply. a) The laser machine shall be equipped with protective devices to ensure a safe isolation of the laser beam (e.g. by a safety shutter or deactivation by shutting off the power to the pumping diodes). b) If human presence in a hazard zone is unavoidable while the machine is functioning (e.g. during service), the machine shall be equipped with an enabling switch of machine motion, laser beam direction and laser beam isolation. See 5.3.3.5. c) The design of protective devices, such as switches, shutters, beam dissipation devices and deterring/impeding devices, shall meet the requirements specified in IEC 60825-1:2014 and ISO 12100:2010. A single protective device may be used to provide simultaneous protection against more than one hazard. d) Protective housings (enclosures) are not subject to IEC 60825-4:2006, Annex D, but shall otherwise conform to IEC 60825-4:2006 or IEC 60825-1:2014. Laser guards (not part of a protective housing) shall comply with requirements specified in IEC 60825-4:2006, Annex D. e) If active guards (e.g. equipped with sensors) are used within the enclosure or guarding the component shall be integrated in the safety control (SRP/CS) of the laser processing machine. Requirements on active guards are specified in IEC 60825-4:2006, Annex D. The manufacturer shall indicate the achieved PL (according to ISO 13849-1:2015) or SIL (according to IEC 62061:2005) and the system reaction time for isolating the laser beam and shall ensure that the passive laser resistance (time) of guard/windows is sufficient (longer) than the system reaction time. NOTE 1 Passive laser guards: Laser guard which relies for its operation on its physical properties only. They are used, when the physical laser resistance of the material is sufficient for the given inspection time and FEL (see IEC 60825-4:2006). NOTE 2 Active laser guards: If the FEL cannot be reduced to a value where common guarding materials provide adequate protection in the form of a passive laser guard, an active laser guard can be used (see IEC 60825-4:2006) NOTE 3 IEC 60825-4:2006, Annex E provides informative guidelines on the arrangement and installation of laser guards, Annex F provides information for assessing the suitability of laser guards. f) The beam delivery system or parts of a beam delivery system shall comply with the requirements specified in IEC 60825-4:2006, Annex G. g) Whenever and wherever there are multiple laser sources [e.g. from a back-up laser, energy share multiplex (beam split) or time share multiplex (beam switch)] the safety controls for each respective work	Considered.	P

EN ISO 11553-1:2020+A11:2020

Clause	Requirement	Remarks - Results	Verdict
	station, process zone or laser hazard zone shall be automatically connected or associated with each respective laser source, such that when that station's interlocks or emergency stops or other protective device sensors are activated, no hazardous laser energy can be directed to that station or zone. NOTE 4 The laser machine can be operated in manual intervention mode under the conditions described under the modes for production, service or setting.		
5.3.3.2	Protection against laser radiation hazards during production	See below	P
	The principal hazard zone is usually the process zone but the hazard zone shall be defined as a result of the risk assessment. The risk assessment shall indicate which type of guarding (local protection or peripheral protection) is to be used. The applicable type of guarding depends on the design of the machine and the guards respectively (see also IEC 60825-4:2006, Annex F: Guideline for assessing the suitability of laser guards). Local protection is a method of guarding to reduce laser radiation and associated optical radiation to a safe level based on a risk assessment (e.g. by means of a nozzle or a small guard fitted close to the beam focus at the work piece) without totally enclosing the work piece, the work piece support and/or machine motion system. EXAMPLE 1 Applied for laser marking systems being integrated in a complex packaging machine or bottling line. Peripheral protection is a method of guarding to reduce laser radiation and associated optical radiation to a safe level based on a risk assessment by means of one or more distant guards (e.g. a protective enclosure or a laser cabin) that enclose the work piece, work piece support and, usually, most of the machine motion system. EXAMPLE 2 Applied for laser cutting machines, micromachining laser machines, laser additive manufacturing. The type of protection and the requirements on the guarding will depend on several factors, for instance (see also IEC 60825-4:2006, Annex F): a) the power determining laser parameters, (e.g. laser power, pulse duration, pulse energy, repetition rate, wavelength); b) the optical elements (for example, focal length), resulting in irradiance or radiant exposure at the work piece or guard; c) the direction (fixed or variable) of beam propagation with regard to the work piece, (working with static optical elements or scanner optics); d) the type of machining operation to be realized (cutting, welding, etc.), (e.g. handling or robot system: dimensions, number of axis, laser head);	Considered	P

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Clause	Requirement	Remarks - Results	Verdict
	e) the material and shape of the work piece to be processed, (e.g. size of the work piece, shape); f) the work piece support, (e.g. manually/automatically, continuous support for e.g. tubes/hoses, discontinuous support); g) the visibility of the process zone (e.g. type of laser window: active/passive, process viewing by camera and monitor systems).	As above	P
5.3.3.3	Protection against laser radiation hazards during setting mode (teaching, path programming and programme verification without processing)	See below	P
	During setting mode, human access to laser radiation exceeding the AEL for Class 1 shall be prevented except for laser radiation emitted in the wavelength range of 400 nm to 700 nm when human access to laser radiation shall not exceed the AEL for Class 3R. NOTE Exposure limits for the eye and the skin of employees in the workplace and the general public are in many countries specified in national laws. The legally binding national exposure limits might differ from the MPEs used in this standard. Therefore, radiation emitted in the wavelength range of 400 nm to 700 nm when human access to laser radiation might be limited to the AEL for Class 2.	Mode setting cannot be performed in using and maintenance.	P
5.3.3.4	Protection against laser radiation hazards during service mode	The laser radiation is less than AEL for class 1, the measured value is as clause 5.3.2.2.	N/A
	During service mode, human access to laser radiation exceeding the AEL for Class 1 is sometimes unavoidable. Machines shall therefore be designed, and appropriate safety measures provided, with respect to the following four situations (listed in order of preference): a) servicing takes place outside the laser hazard area (according to IEC 60825-1:2014); no further protection is necessary. b) servicing takes place in a laser hazard area to which access is controlled in the same manner as during production; protective measures in c) apply.	As above	N/A

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Clause	Requirement	Remarks - Results	Verdict
	c) servicing takes place in a laser hazard area (e.g. with open guards that are normally closed during production) but accessible laser radiation does not exceed the AEL for Class 1. Exposure above AEL for class 1 shall be predominantly prevented by engineering safety measures described in IEC 60825-1:2014, e.g. protective equipment to detect the presence of persons e. g. opto-electronic protective devices (Laserscanner). If parts are integrated in a safety control, requirements specified in ISO 13849-1:2015 and/or ISO 62061:2005 shall be met. Administrative safety measures (lock-out/tagout: LOTO), e.g. to lock-out (e.g. with a padlock) a laser cabin door so that the door/interlock is open and therefore exposure above AEL for class 1 is prevented by SRP/CS, shall be used as subordinated measure. d) servicing takes place in hazard zones, for example because opening of guards (normally closed during production) is necessary. In this case accessible laser radiation exceeds the AEL for Class 1. If servicing takes place in the laser hazard area the requirements of 5.3.2.3 shall be met. The manufacturer shall indicate the effective class of accessible laser radiation as indicated by the AEL when in the service mode and recommended safety procedures for each of these situations.	As above	N/A
5.3.3.5	Protection against laser radiation hazard by operating mode selector switch	See below	P
	The operating mode selector switch enables the selection of machine functions characterized by different risk levels with regard to laser radiation hazards; e.g. normal use/automatic mode vs. service mode. On the basis of the risk assessment the manufacturer shall define requirements on the operating mode selector switch and the authorization control for the operating mode selector switch. If the mode selection can give rise to unsafe operation of the machine (e.g. by unauthorized or wrong selection of service mode resulting in hazardous accessible emission level (AEL) of laser radiation), the operating mode selector switch shall be lockable and integrated in the safety control of the machine. The requirements on the operating mode selector switch (here PLr) shall be determined in accordance with ISO 13849-1:2015 and ISO 12100:2010. NOTE If appropriate, an operating mode selector switch can be applied to avoid manipulation (see also ISO 14119:2013).	Considered	P
5.3.4	Engineering control measures	See below	P

EN ISO 11553-1:2020+A11:2020

Clause	Requirement	Remarks - Results	Verdict
	In the following, engineering control measures with regard to design and controls are listed: — The manufacturer shall follow general principles for design, risk assessment and risk reduction for laser processing machines explained in ISO 12100:2010. — The general requirements for the safety of the electrical equipment of laser processing machines described in IEC 60204-1:2016 shall be observed. — The start/stop controls of a laser processing machine shall comply with the requirements specified in ISO 60204-1:2016 and ISO 13849-1:2015. — The emergency stop controls shall be designed according to the requirements specified in ISO 13850:2012 and IEC 60204-1:2016. — Safety related parts of control systems of laser processing machines shall comply with the requirements given in IEC 60825-1:2014, IEC 60204-1:2016, ISO 13849-1:2015, or ISO 62061:2005. A risk assessment shall be performed according to ISO 12100:2010. — This risk estimation for damage to sight leads at least to a required Performance Level PLr = c or in a Safety Integrity Level SIL = 1. If the accessible irradiance or the radiant exposure exceeds ten times the AEL of laser class 1 as defined in IEC 60825-1:2014, then a Performance Level PLr = d is required. — Provisions for the safe isolation of the laser beam shall be designed in compliance with IEC 60825-1:2014, 4.3 (reasonably foreseeable single fault condition for normal operation).	Considered	P
6	Verification of the safety requirements and risk reduction measures	See below	P
	The manufacturer shall verify the following. The verification of the safety requirements and risk reduction measures for the laser processing machine and the validation of the design and the function of the laser processing machine shall be carried out in accordance with relevant standards, see Table 2. The risk assessment shall be verified to ensure that all reasonably foreseeable hazards and reasonably foreseeable fault conditions are identified and, if necessary, corrective measures have been taken. The verification and validation of the safety requirements and risk reduction measures includes following measures, but are not limited to a) visual inspection, b) practical inspection/functional tests, c) measurements, d) observation during operation, e) Verification of application-specific schematics, circuits layouts and design document,	Considered	P

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Clause	Requirement	Remarks - Results	Verdict
	f) Verification of safety-related application specific hardware and software or software documentation (SRP/CS), g) Verification of the risk assessment, (incl. evaluations, calculations), h) Verification of the detailed description, the layout drawings and mounting description, i) Verification of specification values and information to user. NOTE See Table 2. Verification of risk reduction measures against laser radiation hazards is related to different technical issues. Table 2 provides information on the safety requirement/measure, the method of verification/validation and gives reference to applicable standards.	Considered	P
7	Information for use	As below	P
	The manufacturer shall follow the requirements of ISO 12100:2010, 6.4, preparing the chapter “information for use”. The manufacturer should consider IEC/IEEE 82079-1:2019. The information for use (manual) of the laser machine shall at least include the following laser radiation hazards related issues. The manufacturer shall: — define the normal use of the machine and all other operating modes intended for the laser processing machine. — describe the residual risks or the hazards related to laser radiation respectively for all phases of machine life and for every applicable operating mode and shall indicate the level of accessible laser radiation or the laser class (according to IEC 60825-1:2014) respectively. — advise users of known potential laser radiation hazards by providing a prominently placed warning statement in the user instructions and/or operator's manual. — include information on laser safety requirements for all operating modes, including if applicable for the setting mode, the manual intervention mode and service mode. This information shall include general notes on — technical protective measures, — organizational protective measures, — personal protective measures, or personal protective equipment, respectively,	Considered	P

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Clause	Requirement	Remarks - Results	Verdict
	— if necessary, specify requirements on the required protective equipment and refer to respective standards; e.g. — technical and organizational laser protective measures: IEC 60825-1:2014, — laser guards: IEC 60825-4:2006, — SRP/CS for safe isolation of the laser radiation: ISO 13849-1:2015, ISO 13849-2:2012 (and/or IEC 62061:2005), — laser protective eyewear: EN 207:2017. — provide sufficient and adequate information how to operate the laser processing machine in other operating modes than the normal use without being exposed to laser hazards; especially if safety equipment is removed or overridden instructions for the use of adequate protective measures including personal protective equipment shall be given. — define which authorization measures (to enter the laser hazard area) are comprised and have to be followed if access to hazardous laser radiation can be possible. — if necessary, define the level of qualification of personnel (related to laser safety), gained by training and education and instructions, which is required to select specified operating modes and/or which is required according to the accessible laser radiation or the location (see Table 1), in which the laser processing machine is operated.	Considered	P
8	Labelling	As below	P
	Laser processing machines shall be labelled regarding laser radiation hazards as following: a) Each laser processing machine shall be equipped with labelling in accordance with ISO 3864 (all parts). — Safety signs (prohibition/warning/mandatory signs); — Colours, sizes and print styles of the labels shall comply with the design principles for product safety labels according to ISO 3864 (all parts); — Laser radiation labels shall be as described in IEC 60825-1:2014. b) The location of labels shall satisfy the following requirement: — the size and location of the labels shall be such as to make the appropriate labels legible from outside the hazard zones without exposing anyone to any of the laser hazards listed in Clause 4. — if different operation modes make different sets of safety signs necessary (e.g. for normal use and service), it shall clearly be indicated for which operating mode which set of safety signs is applicable. NOTE In addition to the labelling required by IEC 60825-1:2014, the laser processing machine can, if necessary according to the risk assessment, carry other pertinent cautionary and warning labels (e.g. warning signs about harmful substances or incoherent radiation).	Considered	P

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Clause	Requirement	Remarks - Results	Verdict
Annex A (informative)	**Potential hazards**	Considered.	P
Annex B (informative)	**Protection against other hazards**	Considered.	P
Annex ZA (informative)	**Relationship between this European Standard and the essential requirements of Directive2006/42/EC aimed to be covered**	Considered.	P

End of Part III Test Report