

Risk Assessment Report - Automatic Carton Erecting and Case Sealing Cell (v1.0)

Compliance with the Machinery Directive and EN ISO 12100

PROJECT / MACHINE NAME	Automatic Carton Erecting and Case Sealing Cell
MACHINE MODEL	ACE-CSC-1200
SERIAL NUMBER	ACE-2026-LM01
ASSESSOR	John Smith
ASSESSMENT DATE	10.04.2026
REFERENCE NUMBER	RA_ACECSC1200R_20260410_v1_0

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Executive Summary

This document presents the risk assessment results for the machine **Automatic Carton Erecting and Case Sealing Cell**. The process was carried out in accordance with the methodology described in EN ISO 12100, using the assessment method **HRN**.



Audit Conclusion

All identified hazard scenarios have undergone the reduction process. The applied technical protective measures and information for users have reduced residual risk to an acceptable level. The machine meets the essential safety requirements.

1. Machine and assessment identification

Project / Machine name:	Automatic Carton Erecting and Case Sealing Cell
Machine model:	ACE-CSC-1200
Serial number (pattern/range):	ACE-2026-LM01
Year of construction:	2026
Manufacturer details	
Manufacturer:	Safety Software Sp. z o.o.
Trade name / Trademark:	Safety Software
Manufacturer address:	Półanki 80, 30-870, Kraków, POLAND
VAT ID:	PL6793342803
Risk assessment details	
Assessment date:	10.04.2026
Assessment version:	1.0
Assessor:	John Smith
Documentation reference number:	RA_ACECSC1200R_20260410_v1_0

2. Intended use and reasonably foreseeable misuse

2.1. Intended use

The machine is intended for the automatic erection, folding, and sealing of corrugated cartons used for secondary packaging of non-hazardous consumer goods packed in unit loads. Flat carton blanks are fed into the machine, erected into carton form, transferred through the process, and closed by flap folding and tape application. The machine is intended for industrial packaging duty in repetitive production service.

The machine is designed to operate automatically in normal production mode with safeguarded access to hazardous zones. The process includes carton blank supply, carton forming, transfer, flap folding, sealing, and discharge. Hazardous movements may occur in the erecting section, transfer section, sealing section, and associated drive areas during automatic operation, test movement, setup, fault recovery, and maintenance.

The machine is intended for installation in an indoor industrial environment and for use by trained adult personnel only. Intended user roles include operator, setter, maintenance technician, and electrically competent person for electrical fault-finding and intervention. Intended use includes

normal production, start-up, stopping, reset after protective device actuation, consumable replenishment, permitted minor intervention, setup and adjustment, functional testing, fault-finding, cleaning of accessible areas, maintenance, isolation of energy sources, replacement of worn parts, decommissioning, and dismantling, all in accordance with the operating instructions and defined safe procedures.

The machine is intended to be used only with the specified carton formats, consumables, utilities, and process parameters defined by the manufacturer. Protective measures described in this assessment, including fixed and movable guards, interlocking devices, safety-related control functions, emergency stop devices, isolation means, and information for use, form part of the intended use conditions.

Source text (as entered by user).

2.2. Reasonably foreseeable misuse

Reasonably foreseeable misuse includes attempting to remove jams, waste material, or misfed carton blanks while hazardous movement is still available; reaching through openings or accessing the guarded interior area without following the intended intervention procedure; restarting the machine before verifying that all persons are clear of the danger zone; and defeating, bypassing, misadjusting, or otherwise impairing protective devices or safety-related control functions.

It is also reasonably foreseeable that users may attempt setup, adjustment, cleaning, fault recovery, or troubleshooting in an unsuitable operating mode; enter the machine area without complete isolation of electrical or pneumatic energy where such isolation is required; use incorrect carton blanks or consumables; or perform fault-finding on electrical equipment without appropriate competence, authorization, or verification of de-energized condition where applicable.

Further reasonably foreseeable misuse includes operation by untrained or unauthorized persons, operation outside specified environmental or utility limits, use of improvised tools or methods during intervention, and attempts to restore production rapidly without completing the prescribed reset, restart, verification, and safeguarding checks.

Source text (as entered by user).

3. Machine limits

USAGE

The machine is intended to be used only by trained adult personnel assigned to defined user roles, including operator, setter, maintenance technician, and electrically competent person for electrical intervention and diagnostics. Each user role shall perform only those tasks that correspond to its level of authorization, competence, and training.

The machine is intended to operate in defined operating modes, including automatic production, setup/adjustment, functional test, fault-finding, cleaning of accessible areas, maintenance, and energy isolation. Access to hazardous zones is permitted only where the selected operating mode, protective measures, and safe procedure allow such access. Tasks involving intervention in or near hazardous zones shall be carried out only under defined safe conditions and in accordance with the operating instructions.

The intended use excludes operation with defeated, bypassed, or misadjusted protective devices, access to hazardous areas without the required safeguarding state, restart without zone-clear verification where required, and performance of electrical or pneumatic intervention by unauthorized or non-competent persons. The machine shall be used only within the intended process scope, user role definition, and procedural controls established by the manufacturer.

Source text (as entered by user).

SPACE

The machine is intended for installation on a level industrial floor in a dry indoor production environment with adequate lighting, sufficient maintenance and operator clearance, and safe access to the HMI, emergency stop devices, guard doors, isolation points, consumable replenishment positions, electrical cabinet, and pneumatic service points.

The spatial limits of the machine include the carton magazine area, carton erecting area, transfer and sealing area, discharge area, guarded interior area, electrical cabinet area, pneumatic service area, and maintenance access area. The surrounding layout shall not reduce visibility of safeguarding devices, obstruct emergency access, restrict safe operator movement, or create additional trapping, crushing, or access hazards through interfaces with adjacent equipment or structures.

The machine is intended to operate only where the required safety distances, access clearances, service clearances, evacuation routes, and operator standing areas can be maintained throughout the machine life cycle, including installation, production, cleaning, maintenance, and dismantling.

Source text (as entered by user).

TIME

The machine is intended for repeated industrial duty within the service life specified by the manufacturer, provided that routine inspection, cleaning, preventive maintenance, safety verification, and replacement of wear parts are carried out at defined intervals. The timing limits of safe operation depend on continued performance of guards, interlocking devices, safety-related control functions, emergency stop devices, electrical equipment, pneumatic components, and isolation means throughout the machine life cycle.

The assessment covers all relevant life cycle phases, including transport, installation, commissioning, setup, normal production, minor intervention, jam recovery, functional testing, fault-finding, cleaning, maintenance, decommissioning, and dismantling. Exposure duration includes continuous operator presence during production shifts, repeated short-duration intervention during minor disturbances, and longer-duration access during maintenance, fault-finding, and replacement activities under defined safe conditions.

The machine is intended to remain in service only where the response times, stopping behavior, restart behavior, safety function validation status, and maintenance intervals remain consistent with the assumptions made in this risk assessment.

Source text (as entered by user).

OTHER

The machine is intended to process non-hazardous corrugated carton blanks and standard sealing consumables only, within the dimensional, mass, stiffness, and performance limits defined by the manufacturer. The machine is not intended for explosive atmospheres, corrosive environments, washdown conditions, outdoor operation, hazardous substances, or incompatible product formats that may affect movement stability, guarding assumptions, or process reliability.

The machine depends on correctly supplied utilities, including electrical power and compressed air within specified limits, and on correct implementation of safety-related functions associated with guarding, restart prevention, manual reset, emergency stop, isolation, and intervention control. Any change to process parameters, carton characteristics, line interfaces, control logic, safety function architecture, or adjacent equipment may invalidate the assumptions of this assessment and require re-evaluation of risk.

Where safety-related control functions are used to control access to hazardous movement or prevent unexpected start-up, the intended conditions of use include correct validation, maintenance, and fault response of those functions in accordance with the selected safety concept.

Source text (as entered by user).

4. Applied standards and harmonized standards

ISO 14119:2013 **HARMONIZED**

Safety of machinery - Interlocking devices associated with guards - Principles for design and selection (ISO 14119:2013)

STANDARD CLAUSE

- Interlocking devices associated with guards; selection and application principles for movable guard interlocking.

VERIFICATION

- Effectiveness was verified by review of the safety concept, confirmation of the PL d safety function architecture, validation of guard monitoring and restart prevention logic, functional testing of manual reset behavior, and verification that hazardous movement cannot restart automatically after access or power restoration.
- Effectiveness was verified by review of the safeguarding concept, confirmation of the PL d function for prevention of hazardous movement during access, validation of guard status monitoring, and functional testing confirming that hazardous movement is inhibited while access conditions are not safe.
- Effectiveness was verified by review of the safeguarding concept, confirmation of the PL d jam-recovery-related safety function, validation of guard interlocking and restart prevention logic, and functional testing confirming that hazardous movement is not available during jam recovery under defined safe conditions.

PROTECTIVE MEASURE

- Step 2: A safety-related control function with required performance level PL d prevents unexpected start-up and automatic restart after guard opening, protective device actuation, or power restoration. The function is realized by interlocked movable guards, monitored guard status, safety logic, and a monitored manual reset followed by a separate deliberate start command. Hazardous movement is inhibited until all required safe conditions are satisfied.
- Step 2: Access to hazardous movement during minor intervention is restricted by interlocked guards and by a safety-related control function with required performance level PL d that prevents hazardous movement while guarded access is available and requires restoration of safe conditions before restart.
- Step 2: Access to hazardous movement during jam recovery is controlled by interlocked guards and by a safety-related control function with required performance level PL d that inhibits hazardous motion during intervention and prevents restart until safe conditions for intervention completion, reset, and restart have been established.

ISO 14118:2017 **HARMONIZED**

Safety of machinery - Prevention of unexpected start-up (ISO 14118:2017)

STANDARD CLAUSE

- Prevention of unexpected start-up during intervention, maintenance, and access to hazard zones.
- Prevention of unexpected start-up during intervention and jam recovery.

VERIFICATION

- Effectiveness was verified by review of the safety concept, confirmation of the PL d safety function architecture, validation of guard monitoring and restart prevention logic, functional testing of manual reset behavior, and verification that hazardous movement cannot restart automatically after access or power restoration.
- Effectiveness was verified by review of the safeguarding concept, confirmation of the PL d jam-recovery-related safety function, validation of guard interlocking and restart prevention logic, and functional testing confirming that hazardous movement is not available during jam recovery under defined safe conditions.

PROTECTIVE MEASURE

- Step 2: A safety-related control function with required performance level PL d prevents unexpected start-up and automatic restart after guard opening, protective device actuation, or power restoration. The function is realized by interlocked movable guards, monitored guard status, safety logic, and a monitored manual reset followed by a separate deliberate start command. Hazardous movement is inhibited until all required safe conditions are satisfied.
- Step 2: Access to hazardous movement during jam recovery is controlled by interlocked guards and by a safety-related control function with required performance level PL d that inhibits hazardous motion during intervention and prevents restart until safe conditions for intervention completion, reset, and restart have been established.

ISO 13849-1:2023 **HARMONIZED**

Safety of machinery - Safety-related parts of control systems - Part 1: General principles for design (ISO 13849-1:2023)

STANDARD CLAUSE

- Safety-related parts of the control system implementing guard monitoring, restart prevention, and monitored manual reset with required PL d.
- Safety-related parts of the control system preventing hazardous movement during guarded access with required PL d.
- Safety-related parts of the control system implementing jam recovery access control, restart prevention, and monitored reset with required PL d.

VERIFICATION

- Effectiveness was verified by review of the safety concept, confirmation of the PL d safety function architecture, validation of guard monitoring and restart prevention logic, functional testing of manual reset behavior, and verification that hazardous movement cannot restart automatically after access or power restoration.
- Effectiveness was verified by review of the safeguarding concept, confirmation of the PL d function for prevention of hazardous movement during access, validation of guard status monitoring, and functional testing confirming that hazardous movement is inhibited while access conditions are not safe.
- Effectiveness was verified by review of the safeguarding concept, confirmation of the PL d jam-recovery-related safety function, validation of guard interlocking and restart prevention logic, and functional testing confirming that hazardous movement is not available during jam recovery under defined safe conditions.

PROTECTIVE MEASURE

- Step 2: A safety-related control function with required performance level PL d prevents unexpected start-up and automatic restart after guard opening, protective device actuation, or power restoration. The function is realized by interlocked movable guards, monitored guard status, safety logic, and a monitored manual reset followed by a separate deliberate start command. Hazardous movement is inhibited until all required safe conditions are satisfied.
- Step 2: Access to hazardous movement during minor intervention is restricted by interlocked guards and by a safety-related control function with required performance level PL d that prevents hazardous movement while guarded access is available and requires restoration of safe conditions before restart.
- Step 2: Access to hazardous movement during jam recovery is controlled by interlocked guards and by a safety-related control function with required performance level PL d that inhibits hazardous motion during intervention and prevents restart until safe conditions for intervention completion, reset, and restart have been established.

EN 60204-1:2018 **HARMONIZED**

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

STANDARD CLAUSE

- Electrical equipment of machines; protection against electric shock, isolation of supply, and safe access to electrical equipment for intervention.
- Electrical equipment of machines; protection against electric shock, access to electrical equipment, isolation of supply, and defined conditions for electrical intervention and diagnostics.

VERIFICATION

- Effectiveness was verified by review of the electrical design, confirmation of enclosure and access protection, verification of isolation means, and functional verification of safe disconnection and absence-of-voltage checking procedure before access.
- Effectiveness was verified by review of the electrical design, verification of access protection, confirmation of isolation means, and review of diagnostic and intervention conditions for electrical fault-finding activities.

PROTECTIVE MEASURE

- Step 2: Access to live parts is prevented by an enclosed electrical cabinet, suitable protective barriers, and an isolation arrangement that allows safe disconnection and verification of de-energized condition before access to electrical components.
- Step 2: Access to live electrical parts during fault-finding is restricted by the enclosed electrical cabinet, protected access to electrical equipment, and an isolation arrangement that supports safe diagnosis and intervention under defined conditions.

5. Selected risk assessment methodology

Method:	HRN (hrn)
Description:	HRN (Hazard Rating Number) method - risk assessment based on 4 parameters: LO (likelihood of occurrence), FE (frequency of exposure), DPH (degree of possible harm), NC (number of persons exposed). Result: $HRN = LO \times FE \times DPH \times NC$.

5.1. Risk assessment scales

Likelihood of Occurrence (LO)

Value	Description
0	Impossible
1	Very low
2	Low
5	Medium
8	High
10	Extreme
15	Sure

Frequency of Exposure (FE)

Value	Description
0.1	0.1
0.2	0.2
1	1
1.5	1.5
2.5	2.5
4	4
5	5

Degree of Possible Harm (DPH)

Value	Description
0.1	0.1
0.5	0.5
1	1
2	2
4	4
8	8
15	15

Number of People Concerned (NC)

Value	Description
1	1
2	2
4	4
8	8
12	12

5.2. Result interpretation thresholds

Result range	Risk category	Recommended action
0 - 5	LOW	Low level: monitor / minimal actions (if ALARP).
5 - 50	MEDIUM	Medium level: plan risk reduction actions within a defined timeframe.
50 - 150	HIGH	High level: urgent risk reduction measures required.
150 - 15000	CRITICAL	Critical level: immediate and thorough risk reduction required before further use.

6. Detailed risk analysis and risk reduction measures

Number of identified hazard situations: 16

- ISO 12100 scenarios (tasks): 13
- Hazardous events (B.4): 3

6.1. ISO 12100 scenarios (tasks)

[1] ISO 12100 scenario

Task: Minor interventions during operation (e.g., removing waste material, eliminating jams, local cleaning) | Zone: Guarded interior area

Hazard scenario definition	
Type:	ISO 12100 scenario (task)
Task / Operation:	Minor interventions during operation (e.g., removing waste material, eliminating jams, local cleaning)
Hazard source:	moving elements
Hazard category:	Mechanical hazards
Consequences:	<ul style="list-style-type: none"> crushing
Danger zone:	Guarded interior area
Additional information:	<p>Operator intervention to remove carton jams, waste material, or misfed carton blanks during operation may expose hands or fingers to hazardous movement inside the guarded interior area, particularly where access is attempted before complete cessation of hazardous movement.</p> <p><i>Source text (as entered by user).</i></p>

Initial risk assessment	
Assessment parameters:	LO (likelihood): 2 , FE (frequency): 4 , DPH (severity): 2 , NC (number of people): 1
Result (RPN/HRN):	16
Risk category:	MEDIUM
Is reduction required?	Yes (reduction required)
Conclusion:	Risk reduction is required.

IMPLEMENTED REDUCTION STEPS:

STEP 1: INHERENTLY SAFE DESIGN

Event trace:

- **Decision in step:** Step: Step 1, Decision: NO

At this stage, has risk been effectively reduced?

Decision: **NO**

By: John Smith (13.04.2026 15:32)

STEP 2: TECHNICAL AND ORGANIZATIONAL MEASURES

- **Protective measure:** Access to hazardous movement during minor intervention is restricted by interlocked guards and by a safety-related control function with required performance level PL d that prevents hazardous movement while guarded access is available and requires restoration of safe conditions before restart.

Event trace:

- **Decision in step:** Step: Step 2, Decision: YES
At this stage, has risk been effectively reduced?
Decision: **YES**
By: John Smith (13.04.2026 15:32)
- **Protective measure added:** Step: Step 2, Protective measure: Access to hazardous movement during minor intervention is restricted by interlocked guards and by a safety-related control function with required performance level PL d that prevents hazardous movement while guarded access is available and requires restoration of safe conditions before restart.
By: John Smith (13.04.2026 15:33)
- **Secondary hazard decision:** Step: Step 2, Decision: NO
At this stage, has a new secondary hazard appeared?
Decision: **NO**
By: John Smith (13.04.2026 15:34)

STEP 3: INFORMATION FOR USE

- **Protective measure:** The operating instructions shall prohibit minor intervention while hazardous motion is available and shall define the safe procedure for clearing waste material, correcting misfeeds, and carrying out local cleaning only under defined safe conditions.

Event trace:

- **Decision in step:** Step: Step 3, Decision: YES
At this stage, has risk been effectively reduced?
Decision: **YES**
By: John Smith (13.04.2026 15:34)
- **Protective measure added:** Step: Step 3, Protective measure: The operating instructions shall prohibit minor intervention while hazardous motion is available and shall define the safe procedure for clearing waste material, correcting misfeeds, and carrying out local cleaning only under defined safe conditions.
By: John Smith (13.04.2026 15:34)
- **Secondary hazard decision:** Step: Step 3, Decision: NO
At this stage, has a new secondary hazard appeared?
Decision: **NO**
By: John Smith (13.04.2026 15:34)

Residual Risk – Details

Assessment step:	Final
Assessment parameters:	LO (likelihood): 1 , FE (frequency): 1 , DPH (severity): 1 , NC (number of people): 1
Score:	1
Risk category:	LOW (1)
Reduction status	No further reduction required (target level reached)
Assessed by:	John Smith (13.04.2026 15:34)
Notes:	Residual risk remains limited to foreseeable misuse or failure to follow the defined intervention procedure. After application of safeguarding, the PL d access-related safety function, and information for use, the remaining risk is considered acceptable for intended use. <i>Source text (as entered by user).</i>

RESIDUAL RISK: LOW (1) YES

[2] ISO 12100 scenario

Task: Minor interventions during operation (e.g., removing waste material, eliminating jams, local cleaning) | Zone: Transfer and sealing area

Hazard scenario definition	
Type:	ISO 12100 scenario (task)
Task / Operation:	Minor interventions during operation (e.g., removing waste material, eliminating jams, local cleaning)
Hazard source:	moving elements
Hazard category:	Mechanical hazards
Consequences:	• shearing
Danger zone:	Transfer and sealing area
Additional information:	During minor intervention in the carton transfer or sealing section, a person may be exposed to shearing points created by moving transport elements, flap-folding components, or sealing mechanisms. <i>Source text (as entered by user).</i>

Initial risk assessment	
Assessment parameters:	LO (likelihood): 2 , FE (frequency): 1 , DPH (severity): 1 , NC (number of people): 1
Result (RPN/HRN):	2
Risk category:	LOW
Is reduction required?	No (reduction is not required)
Conclusion:	Initial risk is low - no reduction was required.
Acceptance rationale:	The initial risk is accepted because exposure is limited to short-duration minor intervention activities and the expected injury severity remains low under the intended conditions of use. <i>Source text (as entered by user).</i>

[3] ISO 12100 scenario

Task: Recovering from jam | Zone: Carton erecting area

Hazard scenario definition	
Type:	ISO 12100 scenario (task)
Task / Operation:	Recovering from jam
Hazard source:	moving elements
Hazard category:	Mechanical hazards
Consequences:	<ul style="list-style-type: none"> crushing
Danger zone:	Carton erecting area
Additional information:	<p>During jam recovery in the carton erecting area, a person may enter or reach into the machine to free trapped carton material and may be exposed to crushing hazards caused by moving or reactivated machine elements.</p> <p><i>Source text (as entered by user).</i></p>

Initial risk assessment	
Assessment parameters:	LO (likelihood): 2 , FE (frequency): 4 , DPH (severity): 2 , NC (number of people): 1
Result (RPN/HRN):	16
Risk category:	MEDIUM
Is reduction required?	Yes (reduction required)
Conclusion:	Risk reduction is required.

IMPLEMENTED REDUCTION STEPS:

STEP 1: INHERENTLY SAFE DESIGN

Event trace:

- **Decision in step:** Step: Step 1, Decision: NO

At this stage, has risk been effectively reduced?

Decision: **NO**

By: John Smith (13.04.2026 15:35)

STEP 2: TECHNICAL AND ORGANIZATIONAL MEASURES

- **Protective measure:** Access to hazardous movement during jam recovery is controlled by interlocked guards and by a safety-related control function with required performance level PL d that inhibits hazardous motion during intervention and prevents restart until safe conditions for intervention completion, reset, and restart have been established.

Event trace:

- **Decision in step:** Step: Step 2, Decision: YES
At this stage, has risk been effectively reduced?
Decision: **YES**
By: John Smith (13.04.2026 15:35)
- **Protective measure added:** Step: Step 2, Protective measure: Access to hazardous movement during jam recovery is controlled by interlocked guards and by a safety-related control function with required performance level PL d that inhibits hazardous motion during intervention and prevents restart until safe conditions for intervention completion, reset, and restart have been established.
By: John Smith (13.04.2026 15:36)
- **Secondary hazard decision:** Step: Step 2, Decision: NO
At this stage, has a new secondary hazard appeared?
Decision: **NO**
By: John Smith (13.04.2026 15:36)

STEP 3: INFORMATION FOR USE

- **Protective measure:** The operating instructions shall require jam recovery only under defined safe conditions, prohibit reaching into hazardous areas during available machine movement, and require verification that the hazard zone is clear before reset and restart.

Event trace:

- **Decision in step:** Step: Step 3, Decision: YES
At this stage, has risk been effectively reduced?
Decision: **YES**
By: John Smith (13.04.2026 15:36)
- **Protective measure added:** Step: Step 3, Protective measure: The operating instructions shall require jam recovery only under defined safe conditions, prohibit reaching into hazardous areas during available machine movement, and require verification that the hazard zone is clear before reset and restart.
By: John Smith (13.04.2026 15:37)
- **Secondary hazard decision:** Step: Step 3, Decision: NO
At this stage, has a new secondary hazard appeared?
Decision: **NO**
By: John Smith (13.04.2026 15:37)

Residual Risk – Details

Assessment step:	Final
Assessment parameters:	LO (likelihood): 1 , FE (frequency): 1 , DPH (severity): 1 , NC (number of people): 1
Score:	1
Risk category:	LOW (1)
Reduction status	No further reduction required (target level reached)
Assessed by:	John Smith (13.04.2026 15:37)
Notes:	Residual risk remains limited to foreseeable misuse or failure to follow the defined jam recovery procedure. After application of safeguarding, the PL d jam recovery safety function, and information for use, the remaining risk is considered acceptable for trained personnel. <i>Source text (as entered by user).</i>

Residual risk iteration history:

Final: Score: **1**, **LOW**, Reduction status: Further reduction required (level still too high)

Assessed by: John Smith (13.04.2026 15:37)

Final: Score: **1**, **LOW**, Reduction status: No further reduction required (target level reached)

Assessed by: John Smith (13.04.2026 15:37)

RESIDUAL RISK: LOW (1) YES

[4] ISO 12100 scenario

Task: Adjustment and setting of protective devices and other components | Zone: Guarded interior area

Hazard scenario definition	
Type:	ISO 12100 scenario (task)
Task / Operation:	Adjustment and setting of protective devices and other components
Hazard source:	moving elements
Hazard category:	Mechanical hazards
Consequences:	<ul style="list-style-type: none">• crushing
Danger zone:	Guarded interior area
Additional information:	Adjustment or setting of protective devices and machine components may require access to the guarded interior area, where a person may be exposed to crushing hazards created by moving machine elements during adjustment or test movement. <i>Source text (as entered by user).</i>

Initial risk assessment	
Assessment parameters:	LO (likelihood): 2 , FE (frequency): 1 , DPH (severity): 2 , NC (number of people): 1
Result (RPN/HRN):	4
Risk category:	LOW
Is reduction required?	No (reduction is not required)
Conclusion:	Initial risk is low - no reduction was required.
Acceptance rationale:	The initial risk is accepted because the task is performed only occasionally by instructed personnel, exposure is limited, and the expected injury severity remains low under controlled adjustment conditions. <i>Source text (as entered by user).</i>

[5] ISO 12100 scenario

Task: Adjustment and setting of protective devices and other components | Zone: Carton erecting area

Hazard scenario definition	
Type:	ISO 12100 scenario (task)
Task / Operation:	Adjustment and setting of protective devices and other components
Hazard source:	moving elements
Hazard category:	Mechanical hazards
Consequences:	• shearing
Danger zone:	Carton erecting area
Additional information:	Adjustment or setting of protective devices and machine components in the carton erecting area may expose a person to shearing points created between moving and fixed machine elements during adjustment or test movement. <i>Source text (as entered by user).</i>

Initial risk assessment	
Assessment parameters:	LO (likelihood): 2 , FE (frequency): 1 , DPH (severity): 1 , NC (number of people): 1
Result (RPN/HRN):	2
Risk category:	LOW
Is reduction required?	No (reduction is not required)
Conclusion:	Initial risk is low - no reduction was required.
Acceptance rationale:	The initial risk is accepted because the task is infrequent, performed under controlled conditions, and associated with a low level of possible harm. <i>Source text (as entered by user).</i>

[6] ISO 12100 scenario

Task: Functional test, trials | Zone: Guarded interior area

Hazard scenario definition	
Type:	ISO 12100 scenario (task)
Task / Operation:	Functional test, trials
Hazard source:	moving elements
Hazard category:	Mechanical hazards
Consequences:	<ul style="list-style-type: none">• crushing
Danger zone:	Guarded interior area
Additional information:	During functional testing or trial operation, a person may be exposed to crushing hazards if access to the guarded interior area is required while machine movements are being verified. <i>Source text (as entered by user).</i>

Initial risk assessment	
Assessment parameters:	LO (likelihood): 2 , FE (frequency): 1 , DPH (severity): 2 , NC (number of people): 1
Result (RPN/HRN):	4
Risk category:	LOW
Is reduction required?	No (reduction is not required)
Conclusion:	Initial risk is low - no reduction was required.
Acceptance rationale:	The initial risk is accepted because the activity is carried out under controlled trial conditions and the expected consequence remains low. <i>Source text (as entered by user).</i>

[7] ISO 12100 scenario

Task: Functional test, trials | Zone: Transfer and sealing area

Hazard scenario definition	
Type:	ISO 12100 scenario (task)
Task / Operation:	Functional test, trials
Hazard source:	moving elements
Hazard category:	Mechanical hazards
Consequences:	<ul style="list-style-type: none">• shearing
Danger zone:	Transfer and sealing area
Additional information:	During trial operation or verification of machine functions, moving transport or sealing elements may create shearing points in the transfer and sealing area. <i>Source text (as entered by user).</i>

Initial risk assessment	
Assessment parameters:	LO (likelihood): 2 , FE (frequency): 1 , DPH (severity): 2 , NC (number of people): 1
Result (RPN/HRN):	4
Risk category:	LOW
Is reduction required?	No (reduction is not required)
Conclusion:	Initial risk is low - no reduction was required.
Acceptance rationale:	The initial risk is accepted because functional testing is performed under defined conditions by instructed personnel and the expected severity and exposure remain limited. <i>Source text (as entered by user).</i>

[8] ISO 12100 scenario

Task: Isolation and energy dissipation | Zone: Electrical cabinet area

Hazard scenario definition	
Type:	ISO 12100 scenario (task)
Task / Operation:	Isolation and energy dissipation
Hazard source:	live parts
Hazard category:	Electrical hazards
Consequences:	• shock
Danger zone:	Electrical cabinet area
Additional information:	During isolation and verification of de-energized condition, a person may be exposed to electric shock if access to the electrical cabinet or energized components is required before safe isolation has been fully established and verified. <i>Source text (as entered by user).</i>

Initial risk assessment	
Assessment parameters:	LO (likelihood): 2 , FE (frequency): 1 , DPH (severity): 4 , NC (number of people): 1
Result (RPN/HRN):	8
Risk category:	MEDIUM
Is reduction required?	Yes (reduction required)
Conclusion:	Risk reduction is required.

IMPLEMENTED REDUCTION STEPS:

STEP 1: INHERENTLY SAFE DESIGN

Event trace:

- **Decision in step:** Step: Step 1, Decision: NO

At this stage, has risk been effectively reduced?

Decision: **NO**

By: John Smith (13.04.2026 15:39)

STEP 2: TECHNICAL AND ORGANIZATIONAL MEASURES

- **Protective measure:** Access to live parts is prevented by an enclosed electrical cabinet, suitable protective barriers, and an isolation arrangement that allows safe disconnection and verification of de-energized condition before access to electrical components.

Event trace:

- **Decision in step:** Step: Step 2, Decision: YES
At this stage, has risk been effectively reduced?
Decision: **YES**
By: John Smith (13.04.2026 15:39)
- **Protective measure added:** Step: Step 2, Protective measure: Access to live parts is prevented by an enclosed electrical cabinet, suitable protective barriers, and an isolation arrangement that allows safe disconnection and verification of de-energized condition before access to electrical components.
By: John Smith (13.04.2026 15:40)
- **Secondary hazard decision:** Step: Step 2, Decision: NO
At this stage, has a new secondary hazard appeared?
Decision: **NO**
By: John Smith (13.04.2026 15:40)

STEP 3: INFORMATION FOR USE

- **Protective measure:** The operating and maintenance instructions shall require isolation of the electrical supply, verification of absence of voltage before access to the electrical cabinet or electrical components, and access only by authorized and electrically competent personnel.

Event trace:

- **Decision in step:** Step: Step 3, Decision: YES
At this stage, has risk been effectively reduced?
Decision: **YES**
By: John Smith (13.04.2026 15:40)
- **Protective measure added:** Step: Step 3, Protective measure: The operating and maintenance instructions shall require isolation of the electrical supply, verification of absence of voltage before access to the electrical cabinet or electrical components, and access only by authorized and electrically competent personnel.
By: John Smith (13.04.2026 15:41)
- **Secondary hazard decision:** Step: Step 3, Decision: NO
At this stage, has a new secondary hazard appeared?
Decision: **NO**
By: John Smith (13.04.2026 15:41)

Residual Risk – Details

Assessment step:	Final
Assessment parameters:	LO (likelihood): 1 , FE (frequency): 1 , DPH (severity): 1 , NC (number of people): 1
Score:	1
Risk category:	LOW (1)
Reduction status	No further reduction required (target level reached)
Assessed by:	John Smith (13.04.2026 15:41)
Notes:	Residual risk remains limited to foreseeable maintenance activities requiring access to electrical equipment and depends on correct application of isolation and absence-of-voltage verification procedures by authorized personnel. <i>Source text (as entered by user).</i>

RESIDUAL RISK: LOW (1) YES

[9] ISO 12100 scenario

Task: Isolation and energy dissipation | Zone: Pneumatic service area

Hazard scenario definition	
Type:	ISO 12100 scenario (task)
Task / Operation:	Isolation and energy dissipation
Hazard source:	stored energy
Hazard category:	Mechanical hazards
Consequences:	<ul style="list-style-type: none">• impact
Danger zone:	Pneumatic service area
Additional information:	<p>During isolation and energy dissipation, residual pneumatic energy may be released unexpectedly, causing sudden movement of machine elements or components and exposing a person to impact or crushing hazards in the pneumatic service area.</p> <p><i>Source text (as entered by user).</i></p>

Initial risk assessment	
Assessment parameters:	LO (likelihood): 1 , FE (frequency): 1 , DPH (severity): 2 , NC (number of people): 1
Result (RPN/HRN):	2
Risk category:	LOW
Is reduction required?	No (reduction is not required)
Conclusion:	Initial risk is low - no reduction was required.
Acceptance rationale:	<p>The initial risk is accepted because exposure is limited to specific isolation activities and the expected consequence remains low when the procedure is performed as intended.</p> <p><i>Source text (as entered by user).</i></p>

[10] ISO 12100 scenario

Task: Replacement of worn parts | Zone: Maintenance access area

Hazard scenario definition

Type:	ISO 12100 scenario (task)
Task / Operation:	Replacement of worn parts
Hazard source:	moving elements
Hazard category:	Mechanical hazards
Consequences:	<ul style="list-style-type: none">• crushing
Danger zone:	Maintenance access area
Additional information:	<p>During replacement of worn parts, a person may be exposed to crushing hazards if machine elements move unexpectedly or if access to internal machine areas is required during part removal and installation.</p> <p><i>Source text (as entered by user).</i></p>

Initial risk assessment

Assessment parameters:	LO (likelihood): 1 , FE (frequency): 1 , DPH (severity): 2 , NC (number of people): 1
Result (RPN/HRN):	2
Risk category:	LOW
Is reduction required?	No (reduction is not required)
Conclusion:	Initial risk is low - no reduction was required.
Acceptance rationale:	<p>The initial risk is accepted because replacement activities are infrequent, performed under maintenance conditions, and associated with a low foreseeable level of harm.</p> <p><i>Source text (as entered by user).</i></p>

[11] ISO 12100 scenario

Task: Replacement of worn parts | Zone: Maintenance access area

Hazard scenario definition	
Type:	ISO 12100 scenario (task)
Task / Operation:	Replacement of worn parts
Hazard source:	effort
Hazard category:	Ergonomic hazards
Consequences:	<ul style="list-style-type: none">• musculoskeletal disorder
Danger zone:	Maintenance access area
Additional information:	Replacement of worn parts may require manual handling of components in restricted access conditions, creating physical effort and musculoskeletal strain. <i>Source text (as entered by user).</i>

Initial risk assessment	
Assessment parameters:	LO (likelihood): 1 , FE (frequency): 1 , DPH (severity): 1 , NC (number of people): 1
Result (RPN/HRN):	1
Risk category:	LOW
Is reduction required?	No (reduction is not required)
Conclusion:	Initial risk is low - no reduction was required.
Acceptance rationale:	The initial risk is accepted because the expected ergonomic load is low, exposure is limited, and the foreseeable consequence remains minor under intended maintenance conditions. <i>Source text (as entered by user).</i>

[12] ISO 12100 scenario

Task: Fault-finding | Zone: Guarded interior area

Hazard scenario definition	
Type:	ISO 12100 scenario (task)
Task / Operation:	Fault-finding
Hazard source:	moving elements
Hazard category:	Mechanical hazards
Consequences:	• crushing
Danger zone:	Guarded interior area
Additional information:	During fault-finding, access to the guarded interior area may expose a person to crushing hazards if machine movement occurs during diagnosis, verification, or troubleshooting activities. <i>Source text (as entered by user).</i>

Initial risk assessment	
Assessment parameters:	LO (likelihood): 2 , FE (frequency): 1 , DPH (severity): 2 , NC (number of people): 1
Result (RPN/HRN):	4
Risk category:	LOW
Is reduction required?	No (reduction is not required)
Conclusion:	Initial risk is low - no reduction was required.
Acceptance rationale:	The initial risk is accepted because fault-finding involving limited access to internal machine areas is performed only occasionally by instructed personnel under controlled conditions, and the expected level of harm remains low. <i>Source text (as entered by user).</i>

[13] ISO 12100 scenario

Task: Fault-finding | Zone: Electrical cabinet area

Hazard scenario definition	
Type:	ISO 12100 scenario (task)
Task / Operation:	Fault-finding
Hazard source:	live parts
Hazard category:	Electrical hazards
Consequences:	• shock
Danger zone:	Electrical cabinet area
Additional information:	During fault-finding, access to electrical components, terminals, or control equipment may expose a person to electric shock if live parts are contacted during diagnosis or measurement activities. <i>Source text (as entered by user).</i>

Initial risk assessment	
Assessment parameters:	LO (likelihood): 2 , FE (frequency): 4 , DPH (severity): 4 , NC (number of people): 1
Result (RPN/HRN):	32
Risk category:	MEDIUM
Is reduction required?	Yes (reduction required)
Conclusion:	Risk reduction is required.

IMPLEMENTED REDUCTION STEPS:

STEP 1: INHERENTLY SAFE DESIGN

Event trace:

- **Decision in step:** Step: Step 1, Decision: NO
At this stage, has risk been effectively reduced?
Decision: **NO**
By: John Smith (13.04.2026 15:41)

STEP 2: TECHNICAL AND ORGANIZATIONAL MEASURES

- **Protective measure:** Access to live electrical parts during fault-finding is restricted by the enclosed electrical cabinet, protected access to electrical equipment, and an isolation arrangement that supports safe diagnosis and intervention under defined conditions.

Event trace:

- **Decision in step:** Step: Step 2, Decision: YES
At this stage, has risk been effectively reduced?
Decision: **YES**
By: John Smith (13.04.2026 15:42)
- **Protective measure added:** Step: Step 2, Protective measure: Access to live electrical parts during fault-finding is restricted by the enclosed electrical cabinet, protected access to electrical equipment, and an isolation arrangement that supports safe diagnosis and intervention under defined conditions.
By: John Smith (13.04.2026 15:43)
- **Secondary hazard decision:** Step: Step 2, Decision: NO
At this stage, has a new secondary hazard appeared?
Decision: **NO**
By: John Smith (13.04.2026 15:44)

STEP 3: INFORMATION FOR USE

- **Protective measure:** The operating and maintenance instructions shall require that electrical fault-finding is carried out only by authorized and electrically competent personnel, using defined diagnostic procedures, with isolation and absence-of-voltage verification applied wherever required by the intervention method.

Event trace:

- **Decision in step:** Step: Step 3, Decision: YES
At this stage, has risk been effectively reduced?
Decision: **YES**
By: John Smith (13.04.2026 15:44)
- **Protective measure added:** Step: Step 3, Protective measure: The operating and maintenance instructions shall require that electrical fault-finding is carried out only by authorized and electrically competent personnel, using defined diagnostic procedures, with isolation and absence-of-voltage verification applied wherever required by the intervention method.
By: John Smith (13.04.2026 15:44)
- **Secondary hazard decision:** Step: Step 3, Decision: NO
At this stage, has a new secondary hazard appeared?
Decision: **NO**
By: John Smith (13.04.2026 15:44)

Residual Risk – Details

Assessment step:	Final
Assessment parameters:	LO (likelihood): 1 , FE (frequency): 1 , DPH (severity): 1 , NC (number of people): 1
Score:	1
Risk category:	LOW (1)
Reduction status	No further reduction required (target level reached)
Assessed by:	John Smith (13.04.2026 15:45)
Notes:	Residual risk remains limited to exceptional fault-finding activities involving electrical equipment and depends on correct application of defined diagnostic procedures, isolation rules, and access by authorized electrically competent personnel. <i>Source text (as entered by user).</i>

RESIDUAL RISK: LOW (1) YES

6.2. Hazardous events (B.4)

[1] Hazardous event

Hazardous event: Unintended/unexpected start-up

Hazard scenario definition	
Type:	Hazardous event (B.4)
Hazardous event:	Unintended/unexpected start-up
Hazardous event source:	Control system
Additional information:	Unexpected start-up of the machine or a machine section during intervention, jam recovery, setup, fault-finding, or maintenance may expose a person in the hazard zone to hazardous movement before safe conditions have been re-established. <i>Source text (as entered by user).</i>

Initial risk assessment	
Assessment parameters:	LO (likelihood): 5 , FE (frequency): 4 , DPH (severity): 2 , NC (number of people): 1
Result (RPN/HRN):	40
Risk category:	MEDIUM
Is reduction required?	Yes (reduction required)
Conclusion:	Risk reduction is required.

IMPLEMENTED REDUCTION STEPS:

STEP 1: INHERENTLY SAFE DESIGN

- **Protective measure:** The machine layout and control concept are designed to minimize the need for operator access to hazardous areas during normal operation, jam recovery, setup, fault-finding, and maintenance, and to reduce exposure by separating routine operating functions from hazardous machine movements.

Event trace:

- **Decision in step:** Step: Step 1, Decision: YES

At this stage, has risk been effectively reduced?

Decision: **YES**

By: *John Smith (13.04.2026 15:26)*

- **Protective measure added:** Step: Step 1, Protective measure: The machine layout and control concept are designed to minimize the need for operator access to hazardous areas during normal operation, jam recovery, setup, fault-finding, and maintenance, and to reduce exposure by separating routine operating functions from hazardous machine movements.

By: *John Smith (13.04.2026 15:26)*

- **Secondary hazard decision:** Step: Step 1, Decision: NO

At this stage, has a new secondary hazard appeared?

Decision: **NO**

By: *John Smith (13.04.2026 15:26)*

STEP 2: TECHNICAL AND ORGANIZATIONAL MEASURES

- **Protective measure:** A safety-related control function with required performance level PL d prevents unexpected start-up and automatic restart after guard opening, protective device actuation, or power restoration. The function is realized by interlocked movable guards, monitored guard status, safety logic, and a monitored manual reset followed by a separate deliberate start command. Hazardous movement is inhibited until all required safe conditions are satisfied.

Event trace:

- **Decision in step:** Step: Step 2, Decision: YES

At this stage, has risk been effectively reduced?

Decision: **YES**

By: John Smith (13.04.2026 15:28)

- **Protective measure added:** Step: Step 2, Protective measure: A safety-related control function with required performance level PL d prevents unexpected start-up and automatic restart after guard opening, protective device actuation, or power restoration. The function is realized by interlocked movable guards, monitored guard status, safety logic, and a monitored manual reset followed by a separate deliberate start command. Hazardous movement is inhibited until all required safe conditions are satisfied.

By: John Smith (13.04.2026 15:29)

- **Secondary hazard decision:** Step: Step 2, Decision: NO

At this stage, has a new secondary hazard appeared?

Decision: **NO**

By: John Smith (13.04.2026 15:30)

STEP 3: INFORMATION FOR USE

- **Protective measure:** The operating instructions shall state that access to the hazard zone is permitted only under defined safe conditions, that automatic restart is prohibited after guard opening or protective device actuation, and that restart requires a deliberate manual reset and separate start command. Operators and maintenance personnel shall be trained in guard interlock function, safe intervention, isolation of energy where required, and verification that no person remains in the hazard zone before restart.

Event trace:

- **Decision in step:** Step: Step 3, Decision: YES
At this stage, has risk been effectively reduced?
Decision: **YES**
By: John Smith (13.04.2026 15:30)
- **Protective measure added:** Step: Step 3, Protective measure: The operating instructions shall state that access to the hazard zone is permitted only under defined safe conditions, that automatic restart is prohibited after guard opening or protective device actuation, and that restart requires a deliberate manual reset and separate start command. Operators and maintenance personnel shall be trained in guard interlock function, safe intervention, isolation of energy where required, and verification that no person remains in the hazard zone before restart.
By: John Smith (13.04.2026 15:30)
- **Secondary hazard decision:** Step: Step 3, Decision: NO
At this stage, has a new secondary hazard appeared?
Decision: **NO**
By: John Smith (13.04.2026 15:30)

Residual Risk — Details

Assessment step:	Final
Assessment parameters:	LO (likelihood): 1 , FE (frequency): 1 , DPH (severity): 1 , NC (number of people): 1
Score:	1
Risk category:	LOW (1)
Reduction status	No further reduction required (target level reached)
Assessed by:	John Smith (13.04.2026 15:31)
Notes:	Residual risk remains limited to foreseeable misuse, failure to follow instructions, or deliberate bypassing of protective measures. After application of the inherently safe design measures, the PL d restart prevention function, and information for use, the remaining risk is considered acceptable for trained personnel under intended conditions of use. <i>Source text (as entered by user).</i>

[2] Hazardous event

Hazardous event: Falling or ejection of objects

Hazard scenario definition	
Type:	Hazardous event (B.4)
Hazardous event:	Falling or ejection of objects
Hazardous event source:	Kinetic energy and/or potential energy (gravity) of the machine, parts of the machine, tools and materials used, processed, handled
Additional information:	During operation, adjustment, or jam recovery, carton material, machine parts, or components may be displaced or ejected, creating a hazard of impact to persons in the danger zone. <i>Source text (as entered by user).</i>

Initial risk assessment	
Assessment parameters:	LO (likelihood): 1 , FE (frequency): 1 , DPH (severity): 1 , NC (number of people): 1
Result (RPN/HRN):	1
Risk category:	LOW
Is reduction required?	No (reduction is not required)
Conclusion:	Initial risk is low - no reduction was required.
Acceptance rationale:	The initial risk is accepted because the event is unlikely, exposure is limited, and the expected consequence remains minor under normal and intended conditions of use. <i>Source text (as entered by user).</i>

[3] Hazardous event

Hazardous event: Projection of high pressure fluids

Hazard scenario definition	
Type:	Hazardous event (B.4)
Hazardous event:	Projection of high pressure fluids
Hazardous event source:	Pneumatic, hydraulic equipment
Additional information:	During isolation, maintenance, or fault recovery, unexpected release of stored pneumatic energy may cause sudden movement of machine elements or components and expose a person to impact or crushing hazards. <i>Source text (as entered by user).</i>

Initial risk assessment	
Assessment parameters:	LO (likelihood): 2 , FE (frequency): 1 , DPH (severity): 2 , NC (number of people): 1
Result (RPN/HRN):	4
Risk category:	LOW
Is reduction required?	No (reduction is not required)
Conclusion:	Initial risk is low - no reduction was required.
Acceptance rationale:	The initial risk is accepted because the event is foreseeable only during specific intervention activities, exposure is limited, and the expected consequence remains low when the machine is used and maintained as intended by trained personnel. <i>Source text (as entered by user).</i>

10. Residual risk summary - input for user manual

The summary below contains all residual risks remaining after protective measures were applied. These details should be included in the machine user manual.

#1 Minor interventions during operation (e.g., removing waste material, eliminating jams, local cleaning) ISO SCENARIO

- Source: moving elements
- Zone: Guarded interior area
- Additional information: Operator intervention to remove carton jams, waste material, or misfed carton blanks during operation may expose hands or fingers to hazardous movement inside the guarded interior area, particularly where access is attempted before complete cessation of hazardous movement.

APPLIED PROTECTIVE MEASURES

[Step 2: Technical and organizational measures] Access to hazardous movement during minor intervention is restricted by interlocked guards and by a safety-related control function with required performance level PL d that prevents hazardous movement while guarded access is available and requires restoration of safe conditions before restart.; [Step 3: Information for use] The operating instructions shall prohibit minor intervention while hazardous motion is available and shall define the safe procedure for clearing waste material, correcting misfeeds, and carrying out local cleaning only under defined safe conditions.

RESIDUAL RISK: 1 LOW YES

Information for user: Residual risk remains limited to foreseeable misuse or failure to follow the defined intervention procedure. After application of safeguarding, the PL d access-related safety function, and information for use, the remaining risk is considered acceptable for intended use.

#2 Minor interventions during operation (e.g., removing waste material, eliminating jams, local cleaning) ISO SCENARIO

- Source: moving elements
- Zone: Transfer and sealing area
- Additional information: During minor intervention in the carton transfer or sealing section, a person may be exposed to shearing points created by moving transport elements, flap-folding components, or sealing mechanisms.

RESIDUAL RISK: 2 LOW YES

Information for user: The initial risk is accepted because exposure is limited to short-duration minor intervention activities and the expected injury severity remains low under the intended conditions of use.

#3 Recovering from jam ISO SCENARIO

- Source: moving elements
- Zone: Carton erecting area
- Additional information: During jam recovery in the carton erecting area, a person may enter or reach into the machine to free trapped carton material and may be exposed to crushing hazards caused by moving or reactivated machine elements.

APPLIED PROTECTIVE MEASURES

[Step 2: Technical and organizational measures] Access to hazardous movement during jam recovery is controlled by interlocked guards and by a safety-related control function with required performance level PL d that inhibits hazardous motion during intervention and prevents restart until safe conditions for intervention completion, reset, and restart have been established.; [Step 3: Information for use] The operating instructions shall require jam recovery only under defined safe conditions, prohibit reaching into hazardous areas during available machine movement, and require verification that the hazard zone is clear before reset and restart.

RESIDUAL RISK: 1 LOW YES

Information for user: Residual risk remains limited to foreseeable misuse or failure to follow the defined jam recovery procedure. After application of safeguarding, the PL d jam recovery safety function, and information for use, the remaining risk is considered acceptable for trained personnel.

#4 Adjustment and setting of protective devices and other components ISO SCENARIO

- Source: moving elements
- Zone: Guarded interior area
- Additional information: Adjustment or setting of protective devices and machine components may require access to the guarded interior area, where a person may be exposed to crushing hazards created by moving machine elements during adjustment or test movement.

RESIDUAL RISK: 4 LOW YES

Information for user: The initial risk is accepted because the task is performed only occasionally by instructed personnel, exposure is limited, and the expected injury severity remains low under controlled adjustment conditions.

#5 Adjustment and setting of protective devices and other components ISO SCENARIO

- Source: moving elements
- Zone: Carton erecting area
- Additional information: Adjustment or setting of protective devices and machine components in the carton erecting area may expose a person to shearing points created between moving and fixed machine elements during adjustment or test movement.

RESIDUAL RISK: 2 LOW YES

Information for user: The initial risk is accepted because the task is infrequent, performed under controlled conditions, and associated with a low level of possible harm.

#6 Functional test, trials ISO SCENARIO

- Source: moving elements
- Zone: Guarded interior area
- Additional information: During functional testing or trial operation, a person may be exposed to crushing hazards if access to the guarded interior area is required while machine movements are being verified.

RESIDUAL RISK: 4 **LOW** **YES**

Information for user: *The initial risk is accepted because the activity is carried out under controlled trial conditions and the expected consequence remains low.*

#7 Functional test, trials ISO SCENARIO

- Source: moving elements
- Zone: Transfer and sealing area
- Additional information: During trial operation or verification of machine functions, moving transport or sealing elements may create shearing points in the transfer and sealing area.

RESIDUAL RISK: 4 **LOW** **YES**

Information for user: *The initial risk is accepted because functional testing is performed under defined conditions by instructed personnel and the expected severity and exposure remain limited.*

#8 Isolation and energy dissipation ISO SCENARIO

- Source: live parts
- Zone: Electrical cabinet area
- Additional information: During isolation and verification of de-energized condition, a person may be exposed to electric shock if access to the electrical cabinet or energized components is required before safe isolation has been fully established and verified.

APPLIED PROTECTIVE MEASURES

[Step 2: Technical and organizational measures] Access to live parts is prevented by an enclosed electrical cabinet, suitable protective barriers, and an isolation arrangement that allows safe disconnection and verification of de-energized condition before access to electrical components.;
[Step 3: Information for use] The operating and maintenance instructions shall require isolation of the electrical supply, verification of absence of voltage before access to the electrical cabinet or electrical components, and access only by authorized and electrically competent personnel.

RESIDUAL RISK: 1 **LOW** **YES**

Information for user: *Residual risk remains limited to foreseeable maintenance activities requiring access to electrical equipment and depends on correct application of isolation and absence-of-voltage verification procedures by authorized personnel.*

#9 Isolation and energy dissipation ISO SCENARIO

- Source: stored energy
- Zone: Pneumatic service area
- Additional information: During isolation and energy dissipation, residual pneumatic energy may be released unexpectedly, causing sudden movement of machine elements or components and exposing a person to impact or crushing hazards in the pneumatic service area.

RESIDUAL RISK: 2 LOW YES

Information for user: *The initial risk is accepted because exposure is limited to specific isolation activities and the expected consequence remains low when the procedure is performed as intended.*

#10 Replacement of worn parts ISO SCENARIO

- Source: moving elements
- Zone: Maintenance access area
- Additional information: During replacement of worn parts, a person may be exposed to crushing hazards if machine elements move unexpectedly or if access to internal machine areas is required during part removal and installation.

RESIDUAL RISK: 2 LOW YES

Information for user: *The initial risk is accepted because replacement activities are infrequent, performed under maintenance conditions, and associated with a low foreseeable level of harm.*

#11 Replacement of worn parts ISO SCENARIO

- Source: effort
- Zone: Maintenance access area
- Additional information: Replacement of worn parts may require manual handling of components in restricted access conditions, creating physical effort and musculoskeletal strain.

RESIDUAL RISK: 1 LOW YES

Information for user: *The initial risk is accepted because the expected ergonomic load is low, exposure is limited, and the foreseeable consequence remains minor under intended maintenance conditions.*

#12 Fault-finding ISO SCENARIO

- Source: moving elements
- Zone: Guarded interior area
- Additional information: During fault-finding, access to the guarded interior area may expose a person to crushing hazards if machine movement occurs during diagnosis, verification, or troubleshooting activities.

RESIDUAL RISK: 4 LOW YES

Information for user: The initial risk is accepted because fault-finding involving limited access to internal machine areas is performed only occasionally by instructed personnel under controlled conditions, and the expected level of harm remains low.

#13 Fault-finding ISO SCENARIO

- Source: live parts
- Zone: Electrical cabinet area
- Additional information: During fault-finding, access to electrical components, terminals, or control equipment may expose a person to electric shock if live parts are contacted during diagnosis or measurement activities.

APPLIED PROTECTIVE MEASURES

[Step 2: Technical and organizational measures] Access to live electrical parts during fault-finding is restricted by the enclosed electrical cabinet, protected access to electrical equipment, and an isolation arrangement that supports safe diagnosis and intervention under defined conditions.; [Step 3: Information for use] The operating and maintenance instructions shall require that electrical fault-finding is carried out only by authorized and electrically competent personnel, using defined diagnostic procedures, with isolation and absence-of-voltage verification applied wherever required by the intervention method.

RESIDUAL RISK: 1 LOW YES

Information for user: Residual risk remains limited to exceptional fault-finding activities involving electrical equipment and depends on correct application of defined diagnostic procedures, isolation rules, and access by authorized electrically competent personnel.

#14 Unintended/unexpected start-up B.4 EVENT

- Source: Control system

APPLIED PROTECTIVE MEASURES

[Step 1: Inherently safe design] The machine layout and control concept are designed to minimize the need for operator access to hazardous areas during normal operation, jam recovery, setup, fault-finding, and maintenance, and to reduce exposure by separating routine operating functions from hazardous machine movements.; [Step 2: Technical and organizational measures] A safety-related control function with required performance level PL d prevents unexpected start-up and automatic restart after guard opening, protective device actuation, or power restoration. The function is realized by interlocked movable guards, monitored guard status, safety logic, and a monitored manual reset followed by a separate deliberate start command. Hazardous movement is inhibited until all required safe conditions are satisfied.; [Step 3: Information for use] The operating instructions shall state that access to the hazard zone is permitted only under defined safe conditions, that automatic restart is prohibited after guard opening or protective device actuation, and that restart requires a deliberate manual reset and separate start command. Operators and maintenance personnel shall be trained in guard interlock function, safe intervention, isolation of energy where required, and verification that no person remains in the hazard zone before restart.

RESIDUAL RISK: 1 LOW YES

Information for user: Residual risk remains limited to foreseeable misuse, failure to follow instructions, or deliberate bypassing of protective measures. After application of the inherently safe design measures, the PL d restart prevention function, and information for use, the remaining risk is considered acceptable for trained personnel under intended conditions of use.

#15 Falling or ejection of objects B.4 EVENT

- Source: Kinetic energy and/or potential energy (gravity) of the machine, parts of the machine, tools and materials used, processed, handled

RESIDUAL RISK: 1 LOW YES

Information for user: The initial risk is accepted because the event is unlikely, exposure is limited, and the expected consequence remains minor under normal and intended conditions of use.

#16 Projection of high pressure fluids B.4 EVENT

- Source: Pneumatic, hydraulic equipment

RESIDUAL RISK: 4 LOW YES

Information for user: The initial risk is accepted because the event is foreseeable only during specific intervention activities, exposure is limited, and the expected consequence remains low when the machine is used and maintained as intended by trained personnel.

Note: All residual risks listed above must be included in the machine user manual. The user must be informed about remaining hazards and recommended precautions.

11. Consolidated decision trace

Total entries: 78

Date	User	Source	Decision/Event	Details
13.04.2026 15:45	John Smith	RISK REDUCTION EVENT	Residual risk iteration saved Scenario: Fault-finding	Step: Summary
13.04.2026 15:45	John Smith	RESIDUAL RISK ITERATION	Residual risk iteration saved Residual risk: Fault-finding	Step: Summary, score: 1, category: low, reduction status: YES Notes: Residual risk remains limited to exceptional fault-finding activities involving electrical equipment and depends on correct application of defined diagnostic procedures, isolation rules, and access by authorized electrically competent personnel.
13.04.2026 15:44	John Smith	RISK REDUCTION EVENT	Secondary hazard decision Scenario: Fault-finding	Step: Step 3, Decision: NO
13.04.2026 15:44	John Smith	RISK REDUCTION EVENT	Protective measure added Scenario: Fault-finding	Step: Step 3, Protective measure: The operating and maintenance instructions shall require that electrical fault-finding is carried out only by authorized and electrically competent personnel, ...
13.04.2026 15:44	John Smith	RISK REDUCTION EVENT	Decision in step Scenario: Fault-finding	Step: Step 3, Decision: YES
13.04.2026 15:44	John Smith	RISK REDUCTION EVENT	Secondary hazard decision Scenario: Fault-finding	Step: Step 2, Decision: NO
13.04.2026 15:43	John Smith	RISK REDUCTION EVENT	Protective measure added Scenario: Fault-finding	Step: Step 2, Protective measure: Access to live electrical parts during fault-finding is restricted by the enclosed electrical cabinet, protected access to electrical equipment, and an isolati...
13.04.2026 15:42	John Smith	RISK REDUCTION EVENT	Decision in step Scenario: Fault-finding	Step: Step 2, Decision: YES
13.04.2026 15:41	John Smith	RISK REDUCTION EVENT	Decision in step Scenario: Fault-finding	Step: Step 1, Decision: NO
13.04.2026 15:41	John Smith	RISK REDUCTION EVENT	Residual risk iteration saved Scenario: Isolation and energy dissipation	Step: Summary
13.04.2026 15:41	John Smith	RESIDUAL RISK ITERATION	Residual risk iteration saved Residual risk: Isolation and energy dissipation	Step: Summary, score: 1, category: low, reduction status: YES Notes: Residual risk remains limited to foreseeable maintenance activities requiring access to electrical equipment and depends on correct application of isolation and absence-of-voltage verification procedures by authorized personnel.
13.04.2026 15:41	John Smith	RISK REDUCTION EVENT	Secondary hazard decision Scenario: Isolation and energy dissipation	Step: Step 3, Decision: NO

Date	User	Source	Decision/Event	Details
13.04.2026 15:41	John Smith	RISK REDUCTION EVENT	Protective measure added Scenario: Isolation and energy dissipation	Step: Step 3, Protective measure: The operating and maintenance instructions shall require isolation of the electrical supply, verification of absence of voltage before access to the electrical...
13.04.2026 15:40	John Smith	RISK REDUCTION EVENT	Decision in step Scenario: Isolation and energy dissipation	Step: Step 3, Decision: YES
13.04.2026 15:40	John Smith	RISK REDUCTION EVENT	Secondary hazard decision Scenario: Isolation and energy dissipation	Step: Step 2, Decision: NO
13.04.2026 15:40	John Smith	RISK REDUCTION EVENT	Protective measure added Scenario: Isolation and energy dissipation	Step: Step 2, Protective measure: Access to live parts is prevented by an enclosed electrical cabinet, suitable protective barriers, and an isolation arrangement that allows safe disconnection ...
13.04.2026 15:39	John Smith	RISK REDUCTION EVENT	Decision in step Scenario: Isolation and energy dissipation	Step: Step 2, Decision: YES
13.04.2026 15:39	John Smith	RISK REDUCTION EVENT	Decision in step Scenario: Isolation and energy dissipation	Step: Step 1, Decision: NO
13.04.2026 15:37	John Smith	RISK REDUCTION EVENT	Residual risk iteration saved Scenario: Recovering from jam	Step: Summary
13.04.2026 15:37	John Smith	RESIDUAL RISK ITERATION	Residual risk iteration saved Residual risk: Recovering from jam	Step: Summary, score: 1, category: low, reduction status: YES Notes: Residual risk remains limited to foreseeable misuse or failure to follow the defined jam recovery procedure. After application of safeguarding, the PL d jam recovery safety function, and information for use, the remaining risk is considered acceptable for trained personnel.
13.04.2026 15:37	John Smith	RISK REDUCTION EVENT	Residual risk iteration saved Scenario: Recovering from jam	Step: Summary
13.04.2026 15:37	John Smith	RESIDUAL RISK ITERATION	Residual risk iteration saved Residual risk: Recovering from jam	Step: Summary, score: 1, category: low, reduction status: NO
13.04.2026 15:37	John Smith	RISK REDUCTION EVENT	Secondary hazard decision Scenario: Recovering from jam	Step: Step 3, Decision: NO
13.04.2026 15:37	John Smith	RISK REDUCTION EVENT	Protective measure added Scenario: Recovering from jam	Step: Step 3, Protective measure: The operating instructions shall require jam recovery only under defined safe conditions, prohibit reaching into hazardous areas during available machine movem...
13.04.2026 15:36	John Smith	RISK REDUCTION EVENT	Decision in step Scenario: Recovering from jam	Step: Step 3, Decision: YES
13.04.2026 15:36	John Smith	RISK REDUCTION EVENT	Secondary hazard decision Scenario: Recovering from jam	Step: Step 2, Decision: NO

Date	User	Source	Decision/Event	Details
13.04.2026 15:36	John Smith	RISK REDUCTION EVENT	Protective measure added Scenario: Recovering from jam	Step: Step 2, Protective measure: Access to hazardous movement during jam recovery is controlled by interlocked guards and by a safety-related control function with required performance level P...
13.04.2026 15:35	John Smith	RISK REDUCTION EVENT	Decision in step Scenario: Recovering from jam	Step: Step 2, Decision: YES
13.04.2026 15:35	John Smith	RISK REDUCTION EVENT	Decision in step Scenario: Recovering from jam	Step: Step 1, Decision: NO
13.04.2026 15:34	John Smith	RISK REDUCTION EVENT	Residual risk iteration saved Scenario: Minor interventions during operation (e.g., removing waste material, eliminating jams, local cleaning)	Step: Summary
13.04.2026 15:34	John Smith	RESIDUAL RISK ITERATION	Residual risk iteration saved Residual risk: Minor interventions during operation (e.g., removing waste material, eliminating jams, local cleaning)	Step: Summary, score: 1, category: low, reduction status: YES Notes: Residual risk remains limited to foreseeable misuse or failure to follow the defined intervention procedure. After application of safeguarding, the PL d access-related safety function, and information for use, the remaining risk is considered acceptable for intended use.
13.04.2026 15:34	John Smith	RISK REDUCTION EVENT	Secondary hazard decision Scenario: Minor interventions during operation (e.g., removing waste material, eliminating jams, local cleaning)	Step: Step 3, Decision: NO
13.04.2026 15:34	John Smith	RISK REDUCTION EVENT	Protective measure added Scenario: Minor interventions during operation (e.g., removing waste material, eliminating jams, local cleaning)	Step: Step 3, Protective measure: The operating instructions shall prohibit minor intervention while hazardous motion is available and shall define the safe procedure for clearing waste materia...
13.04.2026 15:34	John Smith	RISK REDUCTION EVENT	Decision in step Scenario: Minor interventions during operation (e.g., removing waste material, eliminating jams, local cleaning)	Step: Step 3, Decision: YES
13.04.2026 15:34	John Smith	RISK REDUCTION EVENT	Secondary hazard decision Scenario: Minor interventions during operation (e.g., removing waste material, eliminating jams, local cleaning)	Step: Step 2, Decision: NO
13.04.2026 15:33	John Smith	RISK REDUCTION EVENT	Protective measure added Scenario: Minor interventions during operation (e.g., removing waste material, eliminating jams, local cleaning)	Step: Step 2, Protective measure: Access to hazardous movement during minor intervention is restricted by interlocked guards and by a safety-related control function with required performance I...
13.04.2026 15:32	John Smith	RISK REDUCTION EVENT	Decision in step Scenario: Minor interventions during operation (e.g., removing waste material, eliminating jams, local cleaning)	Step: Step 2, Decision: YES

Date	User	Source	Decision/Event	Details
13.04.2026 15:32	John Smith	RISK REDUCTION EVENT	Decision in step Scenario: Minor interventions during operation (e.g., removing waste material, eliminating jams, local cleaning)	Step: Step 1, Decision: NO
13.04.2026 15:31	John Smith	RISK REDUCTION EVENT	Residual risk iteration saved Scenario: Unintended/unexpected start-up	Step: Summary
13.04.2026 15:31	John Smith	RESIDUAL RISK ITERATION	Residual risk iteration saved Residual risk: Unintended/unexpected start-up	Step: Summary, score: 1, category: low, reduction status: YES Notes: Residual risk remains limited to foreseeable misuse, failure to follow instructions, or deliberate bypassing of protective measures. After application of the inherently safe design measures, the PL d restart prevention function, and information for use, the remaining risk is considered acceptable for trained personnel under intended conditions of use.
13.04.2026 15:30	John Smith	RISK REDUCTION EVENT	Secondary hazard decision Scenario: Unintended/unexpected start-up	Step: Step 3, Decision: NO
13.04.2026 15:30	John Smith	RISK REDUCTION EVENT	Protective measure added Scenario: Unintended/unexpected start-up	Step: Step 3, Protective measure: The operating instructions shall state that access to the hazard zone is permitted only under defined safe conditions, that automatic restart is prohibited aft...
13.04.2026 15:30	John Smith	RISK REDUCTION EVENT	Decision in step Scenario: Unintended/unexpected start-up	Step: Step 3, Decision: YES
13.04.2026 15:30	John Smith	RISK REDUCTION EVENT	Secondary hazard decision Scenario: Unintended/unexpected start-up	Step: Step 2, Decision: NO
13.04.2026 15:29	John Smith	RISK REDUCTION EVENT	Protective measure added Scenario: Unintended/unexpected start-up	Step: Step 2, Protective measure: A safety-related control function with required performance level PL d prevents unexpected start-up and automatic restart after guard opening, protective devic...
13.04.2026 15:28	John Smith	RISK REDUCTION EVENT	Decision in step Scenario: Unintended/unexpected start-up	Step: Step 2, Decision: YES
13.04.2026 15:26	John Smith	RISK REDUCTION EVENT	Secondary hazard decision Scenario: Unintended/unexpected start-up	Step: Step 1, Decision: NO
13.04.2026 15:26	John Smith	RISK REDUCTION EVENT	Protective measure added Scenario: Unintended/unexpected start-up	Step: Step 1, Protective measure: The machine layout and control concept are designed to minimize the need for operator access to hazardous areas during normal operation, jam recovery, setup, f...
13.04.2026 15:26	John Smith	RISK REDUCTION EVENT	Decision in step Scenario: Unintended/unexpected start-up	Step: Step 1, Decision: YES

Date	User	Source	Decision/Event	Details
13.04.2026 13:18	John Smith	TASK STATUS	estimated ISO task: Isolation and energy dissipation	Initial risk estimated (method: HRN, score: 2, category: low)
13.04.2026 13:18	John Smith	TASK STATUS	accepted_initial ISO task: Isolation and energy dissipation	Initial risk accepted
13.04.2026 13:17	John Smith	TASK STATUS	estimated ISO task: Fault-finding	Initial risk estimated (method: HRN, score: 4, category: low)
13.04.2026 13:17	John Smith	TASK STATUS	accepted_initial ISO task: Fault-finding	Initial risk accepted
13.04.2026 13:17	John Smith	TASK STATUS	estimated ISO task: Replacement of worn parts	Initial risk estimated (method: HRN, score: 2, category: low)
13.04.2026 13:17	John Smith	TASK STATUS	accepted_initial ISO task: Replacement of worn parts	Initial risk accepted
13.04.2026 13:16	John Smith	TASK STATUS	estimated ISO task: Functional test, trials	Initial risk estimated (method: HRN, score: 4, category: low)
13.04.2026 13:16	John Smith	TASK STATUS	accepted_initial ISO task: Functional test, trials	Initial risk accepted
13.04.2026 13:16	John Smith	TASK STATUS	estimated ISO task: Functional test, trials	Initial risk estimated (method: HRN, score: 4, category: low)
13.04.2026 13:16	John Smith	TASK STATUS	accepted_initial ISO task: Functional test, trials	Initial risk accepted
13.04.2026 13:15	John Smith	TASK STATUS	estimated ISO task: Adjustment and setting of protective devices and other components	Initial risk estimated (method: HRN, score: 2, category: low)
13.04.2026 13:15	John Smith	TASK STATUS	accepted_initial ISO task: Adjustment and setting of protective devices and other components	Initial risk accepted
13.04.2026 13:15	John Smith	TASK STATUS	estimated ISO task: Adjustment and setting of protective devices and other components	Initial risk estimated (method: HRN, score: 4, category: low)
13.04.2026 13:15	John Smith	TASK STATUS	accepted_initial ISO task: Adjustment and setting of protective devices and other components	Initial risk accepted
13.04.2026 13:14	John Smith	TASK STATUS	estimated ISO task: Minor interventions during operation (e.g., removing waste material, eliminating jams, local cleaning)	Initial risk estimated (method: HRN, score: 2, category: low)
13.04.2026 13:14	John Smith	TASK STATUS	accepted_initial ISO task: Minor interventions during operation (e.g., removing waste material, eliminating jams, local cleaning)	Initial risk accepted
13.04.2026 13:13	John Smith	TASK STATUS	estimated ISO task: Replacement of worn parts	Initial risk estimated (method: HRN, score: 1, category: low)
13.04.2026 13:13	John Smith	TASK STATUS	accepted_initial ISO task: Replacement of worn parts	Initial risk accepted

Date	User	Source	Decision/Event	Details
13.04.2026 13:12	John Smith	TASK STATUS	estimated ISO task: Recovering from jam	Initial risk estimated (method: HRN, score: 16, category: medium)
13.04.2026 13:09	John Smith	TASK STATUS	estimated ISO task: Isolation and energy dissipation	Initial risk estimated (method: HRN, score: 8, category: medium)
13.04.2026 13:08	John Smith	TASK STATUS	estimated ISO task: Fault-finding	Initial risk estimated (method: HRN, score: 32, category: medium)
13.04.2026 13:07	John Smith	TASK STATUS	estimated ISO task: Minor interventions during operation (e.g., removing waste material, eliminating jams, local cleaning)	Initial risk estimated (method: HRN, score: 16, category: medium)
13.04.2026 12:51	John Smith	TASK STATUS	Has hazards ISO task: Fault-finding	First hazard added
13.04.2026 12:44	John Smith	TASK STATUS	Has hazards ISO task: Replacement of worn parts	First hazard added
10.04.2026 13:23	John Smith	TASK STATUS	Has hazards ISO task: Isolation and energy dissipation	First hazard added
10.04.2026 13:02	John Smith	TASK STATUS	Has hazards ISO task: Functional test, trials	First hazard added
10.04.2026 12:59	John Smith	TASK STATUS	Has hazards ISO task: Adjustment and setting of protective devices and other components	First hazard added
10.04.2026 12:56	John Smith	TASK STATUS	Has hazards ISO task: Recovering from jam	First hazard added
10.04.2026 12:50	John Smith	TASK STATUS	Has hazards ISO task: Minor interventions during operation (e.g., removing waste material, eliminating jams, local cleaning)	First hazard added

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