

# CORRUGATOR GUARDING AND SAFE WORKING PRACTICES

## Inspection Checklist



## 1. Foreword

The Health and Safety Executive (HSE) were consulted and involved with PABIAC in producing this guidance. HSE endorses the guidance, as it follows a sensible and proportionate approach to managing health and safety.

## 2. Introduction

This guidance has been written by the PABIAC Corrugated Industry Delivery Committee. The aim of the guidance is to help identify the main hazards associated with running a corrugator machine, to assess existing controls and where appropriate suggest practical control measures to help reduce the risk of injury.

Aimed primarily at health and safety practitioners, managers, supervisors and users of corrugated machinery, this guidance highlights the main health and safety issues to consider when designing, installing, adjusting or operating a corrugator.

While it can be used for carrying out workplace inspections, is not intended to be a substitute for a suitable and sufficient risk assessment. However, when using the checklist to identify current risk reduction measures against the standards set out in this document, the process may lead to a review of existing risk assessments and controls.

### **Note:**

*As part of managing health and safety in your business, you must ensure that control measures are implemented to prevent people being injured while working on or around machinery.*

*On a corrugator machine, as with any other pieces of plant or equipment, the starting point is to identify and document where people intervene. Whether it is an operational or maintenance task, can anyone potentially approach dangerous parts (e.g. for setting, making adjustments, cleaning, clearing blockages, maintenance and inspection etc).*

*When reviewing tasks and deciding upon your controls, use previous experience and incidents (including details of incidents from other sites), past accidents and near miss data including any procedural violations. Don't rely purely on PPE or a safe system of work as being a sufficient control. A simple change to machinery guarding, task design or an improved layout and access could prevent an injury.*

*Ensure effective controls are in place including effective energy isolation and lock-off procedures, and procedures are in place for managers / supervisors to perform formal measurement / monitoring checks at suitable intervals to confirm that the controls and arrangements are working.*

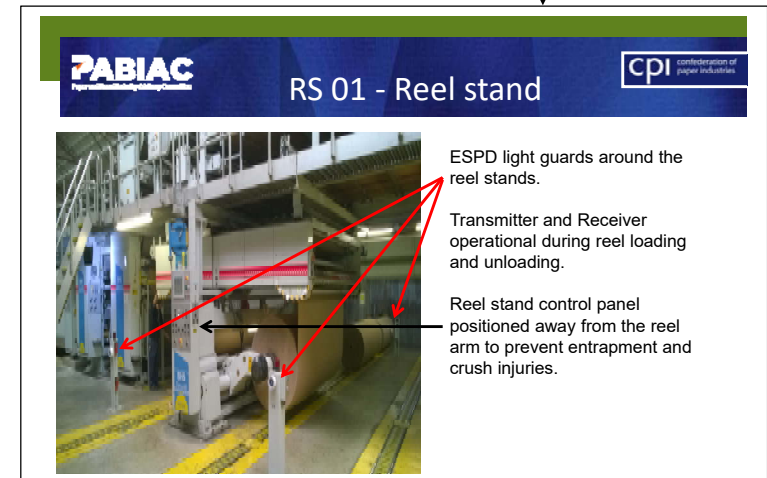
### 3. Scope

The checklist does not cover every hazard in your workplace or on a corrugated machine e.g. converting and finishing equipment, transfer cars, hazardous substances.

### 4. How to use the checklist

4.1 The checklist follows a typical start to finish layout of a corrugator machine process. Based on a standard risk assessment approach, it is designed as an inspection checklist and is accompanied by a visual aid, which will enable users to cross check their existing safety standards against this industry 'good practice' guidance.

Ref No:	Machine / Equipment:	Hazard:	Risk Identified:	Recommended Control Measures:
RS 01	Reel Stand	Contact with object falling or ejected from machinery (reel slipping from stand dollies or chucks during the loading process).	Impact / crushing injuries.	ESPE (light guards). Fixed scanner. Controls to be positioned remotely from reel arms.



- 4.2 To get the best out of the checklist, it is advisable to take a team approach. A typical team might include the production, engineer and safety manager, supervisor / team leader, safety / employee representative and most importantly the operator who works on the machine.
- 4.3 Concentrate on the real risks - those that are most likely to cause harm. Think about both routine and non-routine operational and maintenance tasks such as preparing a reel, threading up, cleaning, carrying out adjustments, engineering maintenance, and clearing blockages and how those tasks are performed.
- 4.4 Work through the checklist, using the examples of control measures and photographs as a basis to benchmark your machine. Remember the control measures are not a definitive list, there may be other effective controls which could be adopted.
- 4.5 Within the document there are references to British and International Standards relevant to corrugator machinery. Standards are periodically reviewed and updated. For the most up to date information on Standards visit the BSI website or the *Official Journal of the European Union*

## 5. Definitions

### **bridge**

transport system positioned above the single facers, serving as storage facility.

### **crawl speed**

continuous movement at a steady slow speed and initiated by a momentary contact control.

### **distance guard**

guard which does not completely enclose a hazard zone, but which prevents or reduces access by virtue of its dimensions and its distance from the hazard zone, for example a perimeter fence or tunnel guard.

### **downstacker**

stacking device on corrugated board machines where the position of the feeding conveyor remains unchanged and the pile is created by the lowering movement of the pile carrier.

### **electro-sensitive protective equipment (ESPE)**

assembly of devices and/or components working together for protective tripping or presence sensing purposes and comprising as a minimum

- a sensing device;
- controlling/monitoring devices;
- output signal switching devices and/or a safety-related data interface.

**fixed guard**

guard affixed in such a manner (for example by screws, nuts, and welding) that it can only be opened or removed by the use of tools or by destruction of the means by which the guard is affixed.

**glue unit**

machine which applies a layer of adhesive to the fluted board peaks.

**guard**

physical barrier, designed as part of the machine, to provide protection.

**guard locking device**

device intended to lock a guard in the closed position and linked to the control system.

**hold-to-run control device**

control device which initiates and maintains machine functions only as long as the manual control (actuator) is actuated.

**in-running nip**

area created either by two rotating components that are rotating inward, or by one component rotating toward an adjacent surface.

**interlocking device**

mechanical, electrical or other type of device, the purpose of which is to prevent the operation of hazardous machine functions under specified conditions (generally as long as a guard is not closed).

**interlocking guard**

guard associated with an interlocking device so that, together with the control system of the machine, the following functions are performed:

- the hazardous machine functions “covered” by the guard cannot operate until the guard is closed;
- if the guard is opened while hazardous machine functions are operating, a stop command is given;
- when the guard is closed, the hazardous machine functions “covered” by the guard can operate (the closure of the guard does not by itself start the hazardous machine functions).

**pre-heater**

equipment for pre-heating the paper web where the web is brought into contact with a steam heated cylinder.

**pressure sensitive protective device**

sensitive protective equipment of the “mechanically activated trip” type intended to detect the touch of a person or body part of a person and which can also act as impeding device.

**reel stand**

equipment which allow the winding or unwinding of the material.

**reel unwinding device or unit**

part of a machine used for unrolling web type material for processing.

**reel rewinding device or unit**

part of a machine used for rewinding the processed web type material.

**rotary shear**

rotary cutter for cutting the traveling corrugated cardboard web across the working width in the event of format change and for removing waste material.

**single facer**

equipment where corrugations are embossed into a paper web by using two corrugating rollers and where a liner is glued onto one side.

**slitter scorer**

machines which slits and scores material to a pre-determined width.

**splicer**

machine which cut processed material and join (splice) new material together.

**two-hand control device**

control device which requires at least simultaneous actuation by both hands in order to initiate and to maintain hazardous machine functions, thus providing a protective measure only for the person who actuates it.

**trapped key**

a removable key which can be trapped either in the guard lock, or in the switch lock. The lock on the guard is arranged so that the key can be released only when the guard has been closed and locked.

**upstacker**

stacking device on corrugated board machines where the position of the pile carrier remains unchanged and the pile is created by the upward movement of the conveyor belt.

**wrap arm**

arm moving around the pre-heating cylinder in such a way as to vary the length of the paper web in contact with the pre-heating cylinder.

## 5. Hierarchy of safeguarding measures

- 5.1 A risk assessment is the starting point for choosing safeguards. Safeguards fall into a hierarchy of levels. Each must be considered in turn, beginning with the highest level of protection and then working down the hierarchy, making use of the measures as far as practicable. Combined measures from more than one level may be required to reduce the risk. However, the preference should always be to adopt the highest level of safeguarding possible.

The three levels of the hierarchy are:

- fixed (enclosing) guards;
- other guards or protection devices, e.g. interlocking guards, nip guards, guard locking;
- protection appliances, e.g. trip nip bars (which do not prevent access but stop the movement of the dangerous part before injury occurs and preferably before contact is made) and hold-to-run control devices.

- 5.2 The provision of information, instruction, training and supervision is an additional measure to the three levels of the hierarchy and complements each them.

For full descriptions of the types of safeguards please see the [Provision and Use of Work Equipment Regulations Approved Code of Practice 1998](#).

- 5.3 Safeguarding measures need to be carefully designed and provide the required protection without creating unnecessary difficulties for maintenance and production. See BS EN ISO 12100-1: 2010 and BS EN ISO 12100 –2: 2010 'Safety of machinery - General principles for design - Risk assessment and risk reduction'. BS EN ISO 14121: 2007

## CORRUGATOR GUARDING AND SAFE WORKING PRACTICES

### Inspection Checklist

Ref No:	Machine / Equipment:	Hazard:	Risk Identified:	Recommended Control Measures:
RS 01	Reel stand	Contact with object falling or ejected from machinery (reel slipping from stand dollies or chucks during the loading process).	Impact / crushing injuries.	ESPE (light guards). Fixed scanner. Controls to be positioned remotely from reel arms.
RS 02	Reel stand	Contact with moving machinery (reel stand chains, sprockets, arms, reel chucks, hydraulic lead screws).	Drawing-in or trapping, crushing and/or shearing of body parts	Fixed guarding. Fixed convex mirrors.
RS 03	Reel stand	Machine/equipment failure (core jams).	Crushing of limbs.	Safe System of Work (SSoW). Inspection and maintenance programme.
RS 04	Reel stand	Contact with electrical apparatus.	Electrocution.	Full electrical isolation of unit within machine line Electrical panels secured, PtW if working on live equipment, trained electrical engineers.
Ref No:	Machine / Equipment:	Hazard:	Risk Identified:	Recommended Control Measures:
SP 01	Splicer	Contact with moving machinery or workpiece (splicer head include dancer roll/cartridge).	Amputation, impact / crushing injuries, cuts and lacerations.	Fixed guarding. Emergency stop / tripwire Local isolation of the machine unit SSoW for task
SP 02	Splicer	Contact with transmission machinery.	Drawing-in or trapping, crushing and/or shearing of body parts.	Fixed guarding.
SP 03	Splicer	Contact with static object (machine framework).	Impact injuries.	Display warning signage. Head protection advisory. Sharp edges to be protected.
SP 04	Splicer	Contact with knife/blade (splicer air knife).	Amputation, cuts/laceration.	Fixed guarding. Full pneumatic isolation of unit within machine line.
SP 05	Splicer	Contact with electrical apparatus.	Electrocution.	Electrical panels secured, PTW if working on live equipment, trained electrical engineers.



<b>Ref No:</b>	<b>Machine / Equipment:</b>	<b>Hazard:</b>	<b>Risk Identified:</b>	<b>Recommended Control Measures:</b>
<b>SF 01</b>	<b>Single facer operations – Corrugator Roll</b>	Contact with moving machinery (between corrugator roll & press roll including checking of glue gaps)	Amputation, drawing-in or trapping, crushing and/or shearing of body parts	Fixed guards. Trapped key interlocking device. Interlocking guards.
<b>SF 02</b>	<b>Single facer operations – Corrugator Roll</b>	Exposure to corrugator rolls/steam. Contact with hot surfaces.	Burns / Scalding.	Fixed guards. Trapped key interlocking device. Interlocking guards. Steam pipes to be lagged to a height of 2.70m from ground level. PPE - heat resistant hand/arm protection
<b>SF 03</b>	<b>Single facer operations – Pre-heater / Wrap Arms</b>	Contact with moving machinery (movement of wrap arms within the single facer).	Amputation, drawing-in or trapping, crushing and/or shearing of body parts.	Fixed guards. Trapped key interlocking device. Interlocking guards.
<b>SF 04</b>	<b>Single facer operations – Threading up paper</b>	Contact with moving machinery (threading paper around the pre-heater rolls & other rollers up to the sandwich belts).	Contact with hot surfaces, burns, scalds. Crushing of limbs.	Fixed guards. Trapped key interlocking device. Interlocking guards. PPE - heat resistant hand/arm protection.
<b>SF 05</b>	<b>Single facer operations – Threading up paper</b>	Contact with knife blade (preparing the paper web to a point).	Cuts/laceration	Retractable safety knives. PPE – cut resistant gloves.
<b>SF 06</b>	<b>Single facer operations – Threading up paper</b>	Contact with static objects (reaching/accessing under rollers).	Head / Impact injuries.	Display warning signage Head protection advisory Sharp edges to be protected
<b>SF 07</b>	<b>Single facer operations – Sandwich belts</b>	Contact with moving machinery (incline conveyor in facer units).	Amputation, drawing-in or trapping, crushing and/or shearing of body parts.	Fixed guards. Interlocking guards.
<b>SF 08</b>	<b>Single facer operations – Glue unit</b>	Contact with machinery (moving/adjusting the glue unit).	Amputation, drawing-in or trapping, crushing and/or shearing of body parts.	Fixed guards. Trapped key interlocking device. Interlocking guards.
<b>SF 09</b>	<b>Single facer operations – cartridges</b>	Inserting and removing interchangeable cartridges (exposure to heat. Corrugator roll on the cartridge, steam pipes, condensate return pipes & escaping steam).	Burns/scalds.	Isolation and exhaustion of steam supply. Minimum 30 minutes cooling period. Isolation of hydraulic supply. Steam pipes to be lagged to a height of 2.70m from ground level. PPE – heat resistant gloves/arm protection.
<b>SF 10</b>	<b>Single facer operations – cartridges</b>	Exposure to compressed air whilst connecting airline to moving cartridge.	Eye and skin injuries.	Isolation of compressed air during (dis)connection.
<b>SF 11</b>	<b>Single facer operations – cartridges</b>	Exposure to heat (contact with corrugator roll when removed from machine).	Burns/scalds.	Heat resistant blanket for cooling down a corrugator roll cartridge. PPE – heat resistant hand/arm protection.
<b>SF 12</b>	<b>Single facer operations – cartridges</b>	Contact with static object (working under the kappa belt).	Impact injury.	Display warning signage. Head protection advisory.

				Sharp edges to be protected.
<b>SF 13</b>	<b>Single facer operations – Drive side</b>	Contact with moving machinery/work piece (drive shafts, motors, gears).	Amputation, drawing-in or trapping, crushing and/or shearing of body parts.	Fixed guards. Trapped key interlocking device. Interlocking guards. ESPEs.
<b>SF 14</b>	<b>Single facer operations – Steam</b>	Exposure to heat (steam).	Burns/scalds.	Steam vessel lagging. Steam pipes to be lagged to a height of 2.70m from ground level.
<b>SF 15</b>	<b>Single facer operations</b>	Contact with electrical apparatus.	Electrocution.	Full electrical isolation of unit within machine line Electrical panels secured, PTW if working on live equipment, trained electrical engineers.
<b>SF 16</b>	<b>Single facer operations - Noise</b>	Exposure to noise.	Noise induced hearing loss.	Soundproof enclosures. Door closures maintained.
<b>SF 17</b>	<b>Single facer - Platform across single facer</b>	Contact with moving machinery	Amputation, drawing-in or trapping, crushing and/or shearing of body parts.	Fixed guarding and interlocked access gate / trapped key system installed on the bridge.
<b>SF 18</b>	<b>Single facer - Platform across single facer</b>	Falls from height	Multiple injuries, consistent with falling.	Access steps, handrails and guardrails should comply with BS EN 1010 – 1 & BS EN ISO 14122-3.
<b>Ref No:</b>	<b>Machine / Equipment:</b>	<b>Hazard:</b>	<b>Risk Identified:</b>	<b>Recommended Control Measures:</b>
<b>BD 01</b>	<b>Access to/from the bridge walkway</b>	Fall from height	Multiple injury/fatality	Access stairs should comply with BS EN 1010-1 & BS EN ISO 14122-3.
<b>BD 02</b>	<b>Working on bridge walkway</b>	Fall from height (external to machine).	Multiple injury/fatality.	If a fall of 500mm or more is possible, a handrail with a minimum height of 1100mm shall be fitted with a 150mm toe board and a maximum gap of 500 mm between rails.
<b>BD 03</b>	<b>Working on bridge walkway</b>	Fall from height (internal to machine web transfer)	Multiple injury/fatality	Guard rails / toe board installed on the operator and drive side of the corrugator bridge.
<b>BD 04</b>	<b>Working on bridge</b>	Contact with moving machinery (roller/shafts/belts/chain drives) on bridge unit/single facer.	Crushing of limbs/amputation.	Guard rails / toe board installed on the operator and drive side of the corrugator bridge. On a corrugator with 2 single facers, the web transfer on both need to have fixed interlock guards fitted, to protect persons working at height. Where stairs give access to a working area / platform, an inward opening, self-closing gate should be provided. The gate should have a handrail at 1100mm, and intermediate rail.
<b>Ref No:</b>	<b>Machine / Equipment:</b>	<b>Hazard:</b>	<b>Risk Identified:</b>	<b>Recommended Control Measures:</b>
<b>TD 01</b>	<b>Triple deck pre-heater</b>	Contact with moving machinery (pre-heater roll/wrap arms).	Amputation, drawing-in or trapping, crushing and/or shearing of body parts.	Fixed and interlocked guards.
<b>TD 02</b>	<b>Triple deck pre-heater</b>	Contact with moving machinery (pre-heater roll/wrap arms from above)	Amputation, drawing-in or trapping, crushing and/or shearing of body parts.	Fixed and interlocked guards.

<b>TD 03</b>	<b>Triple deck pre-heater</b>	Falls from height from the working platforms	Multiple injuries/burns/fatality.	If a fall of 500mm or more is possible, a handrail with a minimum height of 1100mm shall be fitted with a 150mm toe board and a maximum gap of 500mm between rails
<b>Ref No:</b>	<b>Machine / Equipment:</b>	<b>Hazard:</b>	<b>Risk Identified:</b>	<b>Recommended Control Measures:</b>
<b>DG 01</b>	<b>Glue unit</b>	Contact with moving machinery/work piece.	Crush injuries/amputation.	Fixed and interlocked guards.
<b>DG 02</b>	<b>Glue unit</b>	Exposure to heat from pre-heater.	Burns/scalds.	Fixed and interlocked guards Heat resistant gloves and sleeves.
<b>Ref No:</b>	<b>Machine / Equipment:</b>	<b>Hazard:</b>	<b>Risk Identified:</b>	<b>Recommended Control Measures:</b>
<b>DB 01</b>	<b>Double Backer</b>	Contact with moving machinery (during normal operation).	Amputation, drawing-in or trapping, crushing and/or shearing of body parts.	Interlocked gates on both operator and drive side of the machine.
<b>DB 02</b>	<b>Double Backer</b>	Contact with moving machinery (during threading operation).	Amputation, drawing-in or trapping, crushing and/or shearing of body parts.	Interlocked gates on both operator and drive side which slow the machine to the minimum crawl speed of the machine.
<b>DB 03</b>	<b>Double Backer</b>	Contact with static object (low machinery parts/components).	Impact / head injury.	Display warning signage. Head protection advisory. Sharp edges to be protected.
<b>DB 04</b>	<b>Double Backer</b>	Falls from height.	Multiple injuries/fatality.	If a fall of 500mm or more is possible, a guard rail with a minimum height of 1100mm shall be fitted with a 150mm toe board and a maximum gap of 470mm between rails.
<b>DB 05</b>	<b>Double Backer</b>	Exposure to heat (contact with steam pipes/accidental release of steam).	Burns/scalds.	Steam pipes to be lagged to a height of 2.70m from ground level. Isolation and exhaustion of steam supply. Minimum 30 minutes cooling period. PPE – heat resistant gloves/arm protection.
<b>Ref No:</b>	<b>Machine / Equipment:</b>	<b>Hazard:</b>	<b>Risk Identified:</b>	<b>Recommended Control Measures:</b>
<b>RS 01</b>	<b>Rotary Shear</b>	Contact with moving machinery.	Crushing of limbs/amputation.	Interlocked guards.
<b>RS 02</b>	<b>Rotary Shear</b>	Contact with moving machinery during process waste removal.	Crushing of limbs/traps/amputation.	Interlocked guard preventing access unless at crawl speed.
<b>RS 03</b>	<b>Rotary Shear</b>	Contact with moving machinery (hydraulics/pneumatics).	Crushing of limbs	Isolation, dissipation of energy. Interlocked guarding.
<b>RS 04</b>	<b>Rotary Shear</b>	Contact with knife/blade (sharp cutting blades on rotary shear).	Cuts/laceration.	Isolation prior to entry (LOTO). Cut resistant gloves and sleeves required during any intervention with the knife.
<b>RS 05</b>	<b>Rotary Shear</b>	Contact with static object (access under rotary shear leading to fixed parts).	Head injuries.	Display warning signage. Head protection advisory. Sharp edges to be protected.

RS 06	Rotary Shear	Contact with moving machinery (moving conveyor belt).	Crushing of limbs.	Fixed and interlocked guards.
RS 07	Rotary Shear	Contact with electrical equipment / supply	Electric shock/death.	Isolation prior to entry (LOTO).
<b>Ref No:</b>	<b>Machine / Equipment:</b>	<b>Hazard:</b>	<b>Risk Identified:</b>	<b>Recommended Control Measures:</b>
RT 01	Rippa Tape	Contact with moving machinery.	Crushing of limbs.	Fixed guards.
RT 02	Rippa Tape	Falls from height (onto web).	Multiple injuries.	If a fall of 500mm or more is possible, a guard rail with a minimum height of 1100mm shall be fitted with a 150mm toe board and a maximum gap of 470mm between rails.
<b>Ref No:</b>	<b>Machine / Equipment:</b>	<b>Hazard:</b>	<b>Risk Identified:</b>	<b>Recommended Control Measures:</b>
SS 01	Slitter Scorer	Contact with moving machinery (shaft/blades).	Amputation/cuts/laceration.	Fixed and interlocked guarding.
SS 02	Slitter Scorer	Contact with static machinery (shafts/blades).	Cuts/lacerations.	Isolation prior to entry (LOTO). Cut resistant gloves and sleeves required during any intervention with the knife.
SS 03	Slitter Scorer	Falls from height.	Multiple injuries.	If a fall of 500mm or more is possible, a guard rail with a minimum height of 1100mm shall be fitted with a 150mm toe board and a maximum gap of 470mm between rails.
SS 04	Slitter Scorer waste pit	Falls from height.	Multiple injuries.	Fixed steps for access/egress.
SS 05	Slitter Scorer transfer section	Contact with moving web.	Cuts/lacerations.	Cut resistant gloves and sleeves.
SS 06	Slitter Scorer transfer section	Fall from height.	Multiple injuries	Fixed or lockable steps for access/egress.
SS 07	Slitter Scorer transfer section	Contact with moving machinery.	Crushing/amputation.	Fixed and interlocked guarding / trapped key system.
<b>Ref No:</b>	<b>Machine / Equipment:</b>	<b>Hazard:</b>	<b>Risk Identified:</b>	<b>Recommended Control Measures:</b>
CK 01	Cut-off knife	Contact with moving machinery during operation (knife)	Amputation.	Fixed and interlocked guarding / trapped key system.
CK 02	Cut-off knife	Contact with stationary machinery (knife)	Cuts/lacerations.	Isolation prior to entry (LOTO). Cut resistant gloves and sleeves required during any intervention with the knife.
<b>Ref No:</b>	<b>Machine / Equipment:</b>	<b>Hazard:</b>	<b>Risk Identified:</b>	<b>Recommended Control Measures:</b>
US/DS 01	Up / Downstacker	Contact with moving machinery (access under corrugator lift table).	Crushing of limbs/ fatality.	ESPE light guards. Flexible (bellow, concertina) curtain.
US/DS 02	Up / Downstacker	Falls from height (from the platform).	Multiple injuries.	Steady stack conveyors, handrails as required, highlight all edges, intermediate step.
US/DS 03	Up / Downstacker	Slip, trip and fall (transfer conveyor)	Multiple injuries.	Identify and sign any STF hazards.
US/DS 04	Up / Downstacker	Contact with moving machinery (lifting chains).	Trapping/crushing /amputation.	Fixed guarding. Light guards.

<b>US/DS 05</b>	<b>Up / Downstacker</b>	Contact with moving machinery (lift table during normal operation).	Trapping/crushing /amputation.	Fixed guarding. Light guards.
<b>US/DS 06</b>	<b>Up / Downstacker</b>	Machine/equipment failure.	Multiple injuries.	Isolation. Interlocked locking pins for table.
<b>Ref No</b>	<b>Machine/Equipment:</b>	<b>Hazard</b>	<b>Risk Identified</b>	<b>Recommended Control Measures</b>
<b>EC 01</b>	<b>Exit Conveyor</b>	Contact with moving machinery.	Multiple injuries.	Eliminate nip points on conveyors with a horizontal bar.
<b>EC 02</b>	<b>Exit Conveyor</b>	Slips, trips and falls.	Multiple injuries.	Highlight conveyor edges Intermediate step as necessary.