MATERIALS HANDLING SYSTEMS GUARDING STANDARDS

CPI CORRUGATED SECTOR GUIDANCE DOCUMENT

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Materials Handling Systems Safe Operating and Guarding Standards

1. Foreword

This Confederation of Paper Industries – Corrugated Sector Body guide dealing with materials handling safety issues will, if applied by the industry, help to reduce the unnecessary injuries that occur every year on this equipment.

The guide has benefited from being written following a study of materials handling systems in the workplace. It has allowed the authors to address activities and hazards observed during the study and which might otherwise be missed. Consequently, the safety guide is able to provide practical help in both the risk assessment process and in determining the appropriate control measures needed to ensure the items of equipment that comprise these systems are installed, operated, adjusted and maintained safely.

For all involved with materials handling systems and whatever your level of experience it provides a benchmark tool to help find gaps or shortcomings with existing safeguards across the full range of activities performed by these systems.

2. Introduction

This guide has been prepared by the Health & Safety Committee of the Confederation of Paper Industries (CPI) – Corrugated Sector Body following a survey of a sample of materials handling installations in the UK. It is intended as an aid for those who own, operate or maintain materials handling systems in the corrugated industry. An analysis of accidents experienced on the types of equipment covered and compiled from historical accident statistics 1990 to 2005 recorded 146 RIDDOR Reportable lost time accident, as follows:

Accident Type	Proportion of total
Standing, walking, descending from rollers, pushing loads, stepping through gap (missing rollers)	62%
Trapped between powered rollers	7%
Trapped by pallet pusher	7%
Other accident types Which included: Trapped between board lift, roller or frame trapped in chain drive and trapped by transfer car. Cut, friction burn from moving roller, contact with moving belt and maintenance activities	24%
Note: This analysis does not identify the number of injuries categorised as manual handling where employees have attempted to move loads / pallets that have jammed or are falling from mechanical handling equipment.	

This analysis can help in prioritising actions to be taken following risk assessment.

The guide contains practical advice to aid the risk assessment process and help decide the control measures needed to ensure this equipment is operated, worked with and maintained safely.

3. Scope

The guide applies to the range of materials handling equipment in common use within the corrugated industry including Transfer Cars, Linear Conveyors, Load Pushing and Rotating Devices, Stack and Pallet Handling Devices.

The guide is designed to provide a practical interpretation of the requirements of the Health & Safety at Work Act and Provision and Use of Work Equipment Regulations (PUWER) as applied to materials handling equipment. It was compiled following examination of types of equipment in common use in 2005. Every effort has been made to take into account the impact of the relevant British and European Standards that apply to this type of equipment and should determine the safety features that are incorporated into equipment that will be manufactured in the future. Purchasers of new equipment or those who are upgrading current systems should find the guide useful in establishing if the equipment they propose to purchase and the planned installation meet relevant safety standards.

The scope is limited to equipment safety issues, i.e. preventing physical injury, and associated ergonomic issues, particularly manual handing and equipment layout. Other health and safety issues such as electrical safety and noise are outside the scope of this document.

4. Definitions

Transfer Car – mechanically guided car on a track for transferring loads taken from a conveyor and delivered to another conveyor
Bi-directional Chain Conveyors – chains positioned between conveyor rollers, lifted by pneumatic energy, with electric drive units to convey stacks in a 90º change of direction
Pivoting Units – sections of driven conveyors mounted on wheels at three corners pivoting on a fixed point by an electric drive unit to locate with a further conveyor run which can be in any direction
Rotational Turn Unit – a circular unit with three support wheels and a central pivot point, powered by electric drive unit and used to provide 90º/ 180º turns
Electro Sensitive Protection Equipment (ESPE) – Electrosensitive equipment (e.g. photo-electric beam or curtain) that stops the dangerous moving parts before any part of a person's body can reach the danger zone (see Appendix I)

5. Hazards

Materials handling systems have a number of dangerous parts with the potential to cause crushing, shearing, entanglement, drawing in, impact, slips, trips or fall injuries. In addition there is the potential for injuries to be caused by falling, jammed or trapped objects; as well as hazards associated with the layout of the systems and its interface with other equipment and activities. These include the following

- Being struck by internal transport (powered and pedestrian operated)
- Being trapped between parts moving against, or past, one another or fixed parts
- A trap, shear, or impact between moving part and fixed structures above the height of conveyor beds
- A trap or shear between two systems components e.g. conveyor walkover route (plates) adjacent to a transfer car line
- Striking against projecting sharp edges, teeth, wedges, screws, lubricating nipples, shafts, shaft ends etc.
- Being trapped by traction or carrying elements, supporting rollers, pushers, and moving equipment
- Being struck by falling objects
- Being injured while trying to free objects jammed, trapped or caught in the system

- Falls from height
- High pressure fluid ejection if hydraulic or pneumatic power is used
- As a result of falls, body parts (e.g. fingers) being brought into contact with moving parts or materials, including in-running nips

6. Principles of Risk Reduction

As well as helping operators of material handling systems to assess the risks this guidance is also designed to help them complete the following steps.

- Eliminate mechanical and physical hazards by design. Examples being – (mechanical) chain driven rollers that might be accessed by the fingers of someone who has fallen (physical) ensuring all services e.g. cable ducts are sunk into the floor
- Eliminate, or if this is not possible minimise need for people to approach dangerous moving parts of the system. Apply the principles of pedestrian separation associated with internal transport, and provide safe walkways and access routes where required.
- Ensure that any dangerous moving parts that could potentially be approached are properly safeguarded with the guards and safety devices properly maintained and inspected.
- Where sensing devices are used on moving equipment e.g. transfer cars, ensure that there is effective under and over scanning of adjoining fixed objects such as conveyor beds or adjacent stanchions (see Continuous Handling Examples 2). By this process the laser beam can extend 100 mm on either side of the transfer car and provided material stacks are controlled at a distance of 500mm from the conveyor edge and the conveyor legs are set back more than 100mm from the end of the conveyor (160 mm recommended) the scanner can effectively pick up any person who could be trapped while at the same time not being brought to a halt by detecting the material or conveyor legs or any other structures.
- Eliminate or reduce the risk of falls by engineering out the need for interface with product whilst it is being moved on conveyors e.g. by spray printing identification data on stack and removing need to insert labels
- Eliminate or reduce falls by ensuring that, where operators have to undertake tasks that could potentially bring them into contact with rollers, all powered rollers can be held stationary under breaking and that free running rollers have been eliminated. Alternatively by installing roller conveyors with a belt conveyor system running over a platform.
- Reduce impact of falls by installing conveyors at floor level or placing platforms alongside that are at the same level as the conveyors so that persons crossing the conveyors, by approved routes, do not have to step down. If the conveyor height exceeds 190mm intermediate step or steps will also be required to provide suitable safe descent to the floor
- Ensure that any residual risks remaining are properly controlled by providing and maintaining safe systems of work.
- Ensure that the equipment is deigned to EN 982 & 983 (1996) Safety requirements of power fluid systems: hydraulics & pneumatics
- Eliminate access to hazards or where access cannot be avoided apply the hierarchy of: Isolation and Lock-off, followed by Safe System of Work

Tasks that could potentially lead to the need for close approach to moving parts include the following.

- Operating machinery controls
- Inserting protection pieces and identification labels
- Identifying materials to be processed
- Taking materials and tooling to work areas
- Clearing blockages or jammed materials and tooling
- Cleaning, Fault finding, Maintenance

7. General Approach to Safeguarding of Dangerous Parts

There are a number of reasonably practicable measures that can be taken to safeguard dangerous parts of materials handling systems. It is common practice to use a combination of measures chosen from the following.

- Fixed guards – including perimeter fencing, enclosing guards fitted in close proximity to the individual dangerous parts of the system and localised close nip guards. Fixed guards are ones that only need to be removed infrequently e.g. for maintenance purposes and are secured in position by engineering fixings that require the use of a special tool, held by the maintenance engineer, for removal. Guards that have to be opened or removed frequently should be interlocked
- Interlocking guards (which are commonly incorporated into perimeter fencing) – where the interlocks ensure that the system cannot operate with the door or gate open. Where this type of guarding is used consideration has to be given to the potential for the interlocked gate to be closed with a person still inside and in proximity to the hazard. It may be necessary depending on the level of risk, and visual contact from the equipment controls, to provide further hazard point guarding, ESPE and, in the final resort, a robust safe working method.
- Trip devices – that stop the dangerous moving parts before any part of a person's body can reach the danger zone and prevent the system from being run, while the presence of the person close to the danger zone is detected. These devices include:
  a) pressure sensitive mats; and
  b) Electro Sensitive Protection Equipment (ESPE) e.g. photo-electric (light beam) devices etc
- Controlling the speed of moving equipment e.g. powered conveyors and adjusting such control in relation to the height above the surrounding floor or platform level
- Roller conveyor crossing points designed in accordance with BS EN 619: 2002, so that infill treads have a minimum width of 0.1 m with an anti-slip coating (e.g. checkered plates, or expanded metal grates) and a total width of at least 0.5 m

Guards should be designed and installed in accordance with current best practice and adopting the requirements of British and European standards in an appropriate way to achieve best practice. For example BSEN 294 "Safety of Machinery – safe distances to prevent danger zones being reached by upper limbs" specifies the correct positioning of fixed guards.

The "Sources of Further Information & Guidance" at Appendix 11, provides a list of the main standards current at the time of publication.

10. Pedestrian Access

10.1. General Pedestrian Access

Systems are designed and laid out to support the workflow through the plant and it is commonly necessary for pedestrians to be moving through the area, to get to place of work or to another area of the plant on authorised business, or to welfare facilities such as canteen, toilets, changing rooms, clocking area (including visitors under the direction of authorised responsible person).

The potential hazards include: Impact injuries, slips, trips and falls. Trapped (blocked route) as a result of materials, tooling or fixed equipment

The likely risks include: struck by moving equipment, slips, trips or falls over/on/off equipment or services.

You can use the following questions to help you decide if your pedestrian controls are adequate. For you to have confidence that the controls are adequate the answers to all questions should be "Yes".

Questions to help determine if control system is adequate.	Yes	No
10.1.1 Are all pedestrian walkways and access to transfer car roadways clearly marked and signposted?		
10.1.2 Is there adequate pedestrian / moving vehicle or equipment segregation in the walkways around materials handling equipment?		
10.1.3 Are barriers / distance guarding provided to prevent pedestrian access to hazards, where it is practicable to do so without inhibiting the passage of goods, materials or work in progress?		
10.1.4 Are cables, ducts etc, sunk into floor or walk over ramps provided?		
10.1.5 Are you sure there are no informal / unauthorised routes through the area that create a hazard?		
10.1.5.1 If the answer above is No: are the reasons for using a shortcut understood and thereby the options for providing an alternative route clearly defined?		
10.1.5.2 If the answer above is No: Are procedures in place to replace such routes with authorised walkways?		
10.1.6 Are tread plates provided at the appropriate and approved conveyor crossing points that are sufficiently wide and numerous to ensure safe walking?		
10.1.7 Are platforms provided to the sides and between conveyors in authorised pedestrian areas?		
10.1.8 Where tread plates or side platforms are provided is an intermediate step down provided if the rise exceeds 190 mm?		
10.1.9 Do visitor control procedures provide for safety in the area of conveyors and are they implemented?		

10.2. Specific Pedestrian Access

In addition to the above it is often necessary for specific pedestrian access by employees, and employees of suppliers, sub-contractors etc who move through the area for work purposes such as delivery of tooling, equipment, supplies or materials, or other purposes e.g. emergency escape, fire escape route etc.

These pedestrians are liable to encounter the same hazards and risks as for general access.

You can use the following additional questions to help you decide if your pedestrian controls are adequate. For you to have confidence that the controls are adequate the answers to all questions should be “Yes”.

Questions to help determine if control system is adequate.	Yes	No
10.2.1 Have authorised routes been assessed to see if they provide reasonable access for the size and types of load to be carried, or moved by use of hand trolley or cart?		
10.2.2 Are the controls for powered equipment linked to the fire alarm system so the equipment becomes inoperative if the alarm is activated?		
10.2.3 Are Gap sensors provided on powered conveyors and adequately maintained?		

10.3 Operative Pedestrian Access
Working in an area (authorised / permitted)

10.3.1 Transfer cars
There is a range of hazards associated with the movement of transfer car, including being struck by, cuts, trapped between the moving car and fixed equipment, such as conveyor track or end stops. There are hazards associated with working or travelling on a moving car or the rollers on the deck of a car. The integrity of the sensing systems or its failure can also constitute a hazard.
The risks that can be encountered include impact injuries, shear or crushing injuries, cuts, fractures, slips, trips and falls.
Many of the controls are similar to those that are appropriate for internal transport and comprise segregation of people and moving equipment.
You can use the following questions to help you decide if your transfer car controls are adequate. For you to have confidence that the controls are adequate the answers to all questions should be "Yes".

Questions to help determine if control system is adequate.	**Yes**	**No**
10.3.1.1 Can transfer car roadways be bridged over (elevated walkways)?		
10.3.1.1.1 If the answer to the above is No (and in many cases for Brownfield sites this will not offer a reasonably practicable solution): Are transfer car routes fenced to give segregation between transfer cars and pedestrians?		
10.3.1.2 Are authorised pedestrian entry points to the transfer car road controlled by signals or stop system? (This can include interlocked gates, audio or visual signals, and switch arrangement that deactivates a moving car)		
10.3.1.3 Are all trap/nip points between transfer car and conveyor frame or other fixtures associated with the system or building structure or stacked materials suitably guarded by appropriate sensing equipment?		
10.3.1.3.1 In addition to avoid crushing of body parts is a suitable safety area maintained in every instance of transfer car passing the objects outlined above? *Note: a practical separation distance could be ½ meter as applied in at least one other EU Country and compatible with BS EN349 Table 1(minimum gap to avoid crushing body)*		
10.3.1.4 Is the emergency stopping distance of the transfer car effective and is this validated by 10.3.1.4.1 Function tests of protection measures that are checked recorded and monitored? 10.3.1.4.2 All emergency stop controls tested, recorded and monitored? 10.3.1.4.3 Is the frequency of testing established in proportion to the level of risk? (e.g. daily visual checks, weekly and monthly function tests, and half yearly system checks which including stopping distances)		
10.3.1.5 Where a car is ride on operator controlled is the operator's station fenced to prevent the operator falling in the case of a sudden stop?		
10.3.1.6 Where a car is ride on operator controlled does the operator have unrestricted view in both directions of travel?		

Questions to help determine if control system is adequate.	Yes	No
10.3.1.7 Where a car is fixed console operator controlled does the operator have unrestricted view of the full length of the car roadway?		
10.3.1.8 Is the transfer car fitted with suitable warning device, either audio or visual or both?		
10.3.1.9 Is there a suitable procedure in place to prevent people riding on the car, other than in the approved operator position?		
10.3.1.10 Where operatives have to undertake tasks that could potentially bring them into contact with the transfer car rollers (e.g. picking up fallen stacks or inserting identification labels etc) Have you: 10.3.1.10.1implemented a system to ensure that powered rollers are held stationary, isolated and locked off? 10.3.1.10.2 established a system to prevent start up when operatives are dealing with incident? 10.3.1.10.3 introduced procedure or system to reduce likelihood of stack falling? 10.3.1.10.4 you provided work equipment that will remove / reduce the risk of a trip or fall?		
10.3.1.10.5 If the answer above is No: have you provided fall distance minimisation and consequence equipment?		

10.3.2 Linear Conveyors

There are a number of common hazards that have been identified and the most frequently occurring is people having to undertake tasks that could potentially bring them into contact with the conveyor rollers whilst interfacing with the load being conveyed to taking corrective action, such as picking up fallen stacks of material, or to identify loads.

The Common risks are trips, falls or being drawn in between rollers.

These controls are based on a hierarchy comprising:

1. Avoid the work where you can.
2. Use work equipment
3. If cannot eliminate, use equipment or other measures to minimise distance and consequences of fall.

The other significant hazard associated with this equipment is being struck by falling objects such as materials, tools, top boards, bundles of goods etc.

You can use the following questions to help you decide if your linear conveyor controls are adequate. For you to have confidence that the controls are adequate the answers to all questions should be “Yes”.

Questions to help determine if control system is adequate.	Yes	No
10.3.2.1 Have you eliminated the need to go onto conveyors to deal with incident?		
10.3.2.2. Where operatives have to undertake tasks that could potentially bring them into contact with the conveyor rollers (e.g. picking up fallen stacks or inserting identification labels etc) have you: 10.3.2.2.1 implemented a system to ensure that powered rollers are held stationary isolated and locked off? 10.3.2.2.3 introduced procedure or system to reduce likelihood of stack falling?		

Questions to help determine if control system is adequate.	Yes	No
10.3.2.2.4 If the answer above is No: have you provided fall distance minimisation and consequence equipment? *Precautions could include (for example): Providing handling equipment that would move the fallen stack to a position where it could be reached whilst standing beside the conveyor or standing boards that can be placed on braked rollers.*		
10.3.2.3 Have you installed platforms either side and between conveyors at conveyor height?		
10.3.2.4 Have you established a system to prevent start up when operatives are dealing with incident?		
10.3.2.4.1 Does the above system adequately safeguard against the reversing of roller direction (to free possible jam or re-combine a separated stack etc.)?		
10.3.2.5 Have you introduced procedure or system to reduce likelihood of stack falling?		
10.3.2.6 Have you replaced roller conveyors with a belt conveyor system running over a platform base?		
10.3.2.6.1 If the answer above is No: Have you provided a means of access that eliminates the possibility of standing on free moving rollers? (e.g. plastic belt inserted in conveyor at crossover point, with stop activation system?)		
10.3.2.7 Are suitable measures in place to ensure falling objects do not strike people?		
10.3.2.8 Is suitable distance fencing provided or appropriate pedestrian control?		
10.3.2.9 Are measures in place to control the stability of loads on the system and to retain in place any packaging requirements such as top boards?		
10.3.2.10. Have you installed an appropriate start up warning in all areas where there is authorised pedestrian access?		

10.3.3 Load Pushing and Rotating Devices

The common hazard for equipment in this category is being struck by falling objects such as materials, tools, top boards, bundles of goods etc.

There are significant hazards associated with being caught or crushed between parts of the system, the causes of which can include: moving parts or fixed and moving parts, lifting / lowering parts, rotating and fixed sections or rotating table and fixed sections (side frame or conveyor) and the load and pushing section, or the pushing section and frame.

You can use the following questions to help you decide if your load pushing and rotating devices controls are adequate. For you to have confidence that the controls are adequate the answers to all questions should be “Yes”.

Questions to help determine if control system is adequate.	Yes	No
10.3.3.1 Are suitable measures in place to ensure falling objects do not strike people?		
10.3.3.2 Is there suitable distance fencing or appropriate pedestrian control?		
10.3.3.3 Are measures in place to control the stability of loads on the system and to retain in place any packaging requirements such as top boards?		

Questions to help determine if control system is adequate.	Yes	No
10.3.3.4 Is access prevented by perimeter protection (Appropriate combination of Fencing & ESPE)?		
10.3.3.5 Is there an effective isolation procedure and operative entry control system in place?		
10.3.3.6 Bi-directional chain conveyors. Chain entry devices (CED)		
10.3.3.6.1 Are potential nip or crushing points adequately guarded		
10.3.3.6.2 Are the gaps in the guards to the required standard (e.g. max gap 5 mm at drawing in point on raised chain) and are these standards maintained after reasonable wear and tear of the unit?		
10.3.3.6.3 If the guarding gaps have increased in excess of the standard, has alternative distance guarding and access control been introduced?		
10.3.3.7 Pivoting units. Pivoting conveyor (PVC)		
10.3.3.7.1 Where access is essential is moving equipment guarded by safe edge or laser detection device?		
10.3.3.7.2 Is there a visible and or audible warning system with time delay for start up of system?		
10.3.3.8. Rotational turn unit. Turntable. Centred-pivot conveyor (CPC)		
10.3.3.8.1 Where access is required is the gap between the table and fixed parts not greater than 5mm (to meet guarding standard)?		
10.3.3.8.2 Is a strict monitoring regime in place to assess if normal operational wear has increased the gap?		
10.3.3.8.3 Are procedures provided to deal with this eventuality?		
10.3.3.9. Pusher bar. Load entry devices (LED)		
10.3.3.9.1 Where access is required is an ESPE device installed to identify if a person is present in exposed area?		
10.3.3.9.2 If not have you provided distance guarding (perimeter fencing or ESPE) around pushing parts with entry control system?		
10.3.3.9.3 Are visible and or audible warning systems provided, with time delay, for start up or return stroke of system?		
10.3.3.10. Centralisers. Load centering and squaring device (LCD/CSD)		
10.3.3.10.1 Where access is required is effective isolation provided to ensure that the equipment cannot operate whilst the person is attending to the approved duties?		

10.3.4 Stacking and Pallet Handling Equipment (The Strapping Line) May consist of some or all of the following stations:

- Pallet inserter
- Shrouding insertion (most commonly a manual function)
- Top Board insertion (mechanical or manual)
- Compression Strapper
- Stretchwrap
- Conveyors - the stations will be joined by roller conveyors (powered or free moving) and controlled by one or more of the following; programmable logic systems, operator controlled consoles and operator physical intervention.
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Hazards

There is a range of hazards associated with the operations with this category of equipment, which include: shearing, impact, crushing, severing and puncture. The common intervention issues are associated with people entering within guarded areas to undertake tasks that require them to interface with the materials being processed, which include: inserting identification labels, picking up fallen items, straightening loads or pallets on the line and undertaking service or maintenance functions.

Examples of potential hazards: -

- Pallet inserter – Struck by: moving parts pushers, overhead carriers or moving materials resulting in possible impact, shearing or crushing injuries
- Shrouding insertion (most commonly a manual function) – Manual handing issues, falls on conveyors
- Top Board insertion - (mechanical) - Struck by overhead carriers or moving materials resulting in possible impact or crushing injuries
  (manual) - Manual handing issues, falls on conveyors
- Compression Strapper - Struck by: moving parts, pushers, overhead platen or moving materials resulting in possible impact, shearing or crushing injuries
- Stretchwrap - Struck by: moving parts pushers, wrapper arm or moving materials, trapped by wrapping materials, resulting in possible impact, shearing, trapping or crushing injuries
- Conveyors – the physical guarding, sensing equipment and movement control critical points occur at the changeover points between stations. The use of equipment from different manufacturers for different stations increases the risk that unauthorised and undetected entry can be more easily achieved at these points leading to exposure to the hazards identified above.

10.3.4.1 Controls

Guarding of machinery is based on the established principles, that wherever possible, risks are always controlled in the order given:

- eliminate the risks or if that is not possible;
- take hardware measures to control the risks such as the provision of fixed enclosing guards;
- the provision of other guards or protection devices such as interlocked guards and pressure mats;
- the provision of protection appliances such as jigs, holders and push-sticks etc.

Guards are typically secured in place by permanent fixings i.e. welded, riveted or removable fixings such as a padlock, bolt, screw. If a fixing can be removed, i.e. via a tool, this operation would be considered to be a task for a qualified person (who has the appropriate tool) however risk assessment should consider

- Who may be likely to remove the guard
- Forseeability of the guard not being put back
- Training of personnel
- Use of a more specialised tool (such as a key, C head bolt) to restrict access i.e. for maintenance personnel.

When a combination of machinery is configured to form a process system, the overall assembly of machines must be assessed to ensure it is designed to work together before use. The system is intended to work together and therefore all safeguards, safety controls, emergency stop and isolators, must stop the machinery and all associated equipment when operated, if the continued operation of a component creates health and safety risks upstream or downstream.

If components are purchased separately, then somebody must be appointed to ensure that the safety interaction functions correctly.

The key exchange system is commonly used in the protection of combined-process systems and provides a high integrity of safeguarding. It is based on the premise that no one key can be in two places at once. Key interlock systems can be located on guard access panels, configured to ensure a predetermined sequence of events takes place, to result in physical disconnection and isolation of power source to the equipment, before operators can become exposed to dangerous parts. The system should be integrated into the machinery safety so that as a minimum, it ensures

- A single fault does not lead to loss of safety function
- A single fault is detected when practicable
- An accumulation of undetected faults does not lead to loss of safety function
-

Accident data obtained from HSE's Manufacturing sector highlights that personnel often attempt to intervene whilst machinery remains operational in order to maintain production and to prevent the compound effect of a particular problem. The operator in these circumstances tended to concentrate on the immediate problem, rather than the potential dangers and consequences following intervention.

Where access steps are provide to direct personnel across raised product conveyors, fit handrailing to the sides of the access steps. Consider use of a pause facility to reduce contact with palletised loads or moving conveyors, when accessing across the conveyor.

10.3.4.2 Palletiser line

In order to identify the hazards, the Company should complete a series of risk assessments on the palletiser lines. This may be achieved by:

i. Production of a general plan for the palletiser area
ii. Mark out (i.e. by use of coloured pens) each process zone and its entry point
iii. Produce an individual risk assessment for each zone identifying
- Motor drives to be isolated (consider key exchange)
- Pneumatic/ hydraulic energy sources to be isolated
- Ease of access to those parts of the equipment that remain operational within each zone (and likely injury). Identify physical guarding measures to prevent access to those dangerous parts.
- Equipment that remains live/ operational and safe systems of work intended to control the risks
- Ease of access to the adjacent zones (and likely injury). Identify physical barriers/ guarding measures to prevent access to those zones.

Assessment should also include designated control measures for the overall isolation and intervention with all the palletiser lines.

Further information can be obtained from Harmonised Standard BS EN 415-4 Safety of Packaging machines – Part 4: Palletisers and depalletisers.

10.3.4.3 Safe intervention with machinery

Reducing the Need for Intervention

One of the most likely causes leading to an intervention will be the collapse or fall of a load or part of a load. To reduce the likely need for an intervention it is important that the quality of pallets and stability of loads are given careful consideration. The sourcing and storage of pallets should be designed to minimise the risk of pallet damage and load design, as well as taking into account the issues of standardisation outlined above, should also consider the potential for a fall or reduction in stability and actions that can be taken to reduce this risk.

Fixed guards

Fixed guards can be used to prevent access to the moving parts and moving material on the line. The critical points occur where the materials being processed enter a station or move from one station to the next and manual intervention is required as part of the process. At these points ESPE can provide suitable safeguards to prevent access.

The Design of the line needs to allow for safe access to undertake maintenance tasks, corrective actions (such as picking up fallen boards or stacks) and to service equipment (e.g. replacing rolls or stretchwrap or banding wire). This will be best achieved by providing interlocked (captive key) gates at the identified authorised entry points, give consideration to the likely direction of operator approach to the area. Note: if the easiest access is along the conveyors and the entry gate is a long way from the operator there is an increased risk of an unsafe and unauthorised entry. The established principles of isolation and lock off need to be applied to the design and working practices for the line, which can be based on CPI Guidance (available on the web site) including:

To ensure the correct co-ordination and sequencing all forms of energy source isolation (including: electrical/ process/mechanical).

To ensure that the process and procedures are controlled by a suitable competent "authorised person".

Residual risks, such as the potential for a strapper platen to fall need to be taken into account when assessing the risks related to authorised access.

10.3.4.4 ESPE

Where ESPE is used as part of the safety related controls it will be designed to stop the identified hazardous moving parts in the event that an unauthorised entry is detected. The operator will also be provided with the facility to stop the equipment by use of the console controls. Both these procedures will be required to stop the equipment in the area of the line that is deemed hazardous and will have a suitable re-start procedure that can be implemented once it is established that the area is safe. The line should also be provided with appropriate Emergency Stop Controls (E-Stops) at points where they can easily be accessed by operator(s) working in the area, taking into account likely work stations. The E-Stop should be designed to stop the whole line so that in the event of an incident an operator can stop the line from any of the E-Stop positions, however near or far from the incident. Note: E-Stops are not provided nor should they be used for stopping the equipment to permit interventions.

The ESPE will need to have a muting facility that permits the load (materials to be processed) to pass through the entry point. Where materials have to be loaded into the system (e.g. a pallet hopper on a pallet inserter) a dual ESPE system with appropriate muting can be used to minimise the risk of people entering the system. The logic is to establish two zones, the holding conveyors and the pick up area, both protected by ESPE. When pallets are entered onto holding conveyors the first ESPE is muted and the ESPE leading into the pick up zone becomes the primary protection. When the pallets are moved on the conveyor into the pick up area then the ESPE for the holding conveyors becomes primary and the ESPE guarding entry to the pick up is muted. This principle may be adapted to other material entry points. ESPE can be used to detect people who are in a danger area and to assist in reducing the risk so it is as low as possible. This is achieved by identifying how the ESPE is integrated with the safety control system and how it will shut off mechanical hazards in the intrusion area.

Because of the need for muting consideration needs to be given to the possible use of additional physical barriers. Due to variation in the size of products being processed it is very unlikely that the entry point can be controlled to such an extent that materials can always pass through and at the same time a person cannot enter. However once the maximum load size is identified the physical barriers should be designed to prevent access beside the load i.e. a gap of no more than 200mm. A possible solution is to provide a movable funnelling system that can adapt to the variations in load size. If it is practicable then the funnelling can be incorporated into the physical guarding system. The process can also be aided by giving consideration to the design of load configuration and standardising as much as possible to ensure that variation in load size is minimised. It is recognised that customer demands will have a significant impact on load design and that the process of standardising and restricting variation can only be effectively carried out in consultation with customers.

At the same time it is important to consider the issue of part pallets, as it may be possible for a very low load to pass under a sensing device. The stacking on a pallet may also leave gaps between stacks that could be identified by sensing equipment and loose pallets labels or shrouding can cause mistaken identification by sensing devices. This issues need to be considered in regard to both the layout of the line, the sensing devices and the purpose for which they are provided.

10.3.4.5 Critical Point Control

Where there is an interchange / interaction between one station and another or one conveyor and another the integrity of the control system needs to be clearly defined, understood and tested. Possible violations can occur where there is a gap between sensing devices that allows access onto moving parts

and the software links between one station and the next must be designed so that if a sensing device is activated the associated moving parts of adjacent stations (both up and down stream) are properly controlled or stopped as appropriate.

Authorised Access
Where a person who may constitute a “lone worker” for significant periods operates the line, consideration should be given to providing a lone worker, identification device that either raises an alarm and or can operate a localised emergency stop if identified by a sensing device.

Persons who are required to work with the line, in any capacity, must have sufficient competence to recognise usual and unusual conditions (regular or irregular activities), understand who is competent to address the condition and what might be the expected outcomes of undertaking the required task or activity. This is most important where an intervention is essential, as the competence of the person making the intervention must include appropriate understanding of the safety systems and their integrity.

10.4 Monitoring and Review	**Yes**	**No**
If as a result of modifications arising from this assessment process have any new informal / unauthorised pedestrian routes been created?		
10.4.1If yes have they been eliminated?		

11. Maintenance
You can use the following questions to help you decide if your controls are adequate. The common hazards in undertaking this activity include: trapping, nipping and shearing. It should also be noted that as a result of inadequate maintenance the deterioration of the system leading to jams or falls of materials that are often the cause of operator’s falls, muscular-skeletal and other handling injuries. For you to have confidence that the controls are adequate the answers to all questions should be “Yes”.

Questions to help determine if control system is adequate.	**Yes**	**No**
11.1 When diagnosis is required under running conditions is there an effective procedure for isolation of other sections of the equipment not being worked on?		
11.1.1 If the answer above is yes, is it adhered to and monitored?		
11.2 When required to diagnose under running conditions is an appropriate safe system of work or permit to work system established and used on every occasion?		
11.3 Is there regular inspection of drive chains to ensure that any slack chains, which could lead to potential entrapment, are engineered out?		
11.4 Are all nip points on sprockets, drive shafts, gears and chains that can be accessed from under the equipment frame close guarded?		
Questions to help determine if control system is adequate.	**Yes**	**No**
11.5 Is preventative maintenance carried out in accordance with the recommendations, and time scales, provided by the equipment manufacturer?		

11.6 Are all engineers trained in the lockout and isolation procedure and do they use it on every occasion other than when required to diagnose under running conditions?		
11.7 Does the system provide for the release of potential stored energy following a stop by operator or safety device intervention, prior to entry into affected area?		
11.8 If lubrication is not automatic or possible without dismantling fixed or movable guards, is this task only carried out with power isolated and stored energy contained or safely dissipated?		
11.9 When required to work on parts of the equipment above ground level is suitable access provided at entry and exit positions for maintenance activities?		