Pakkemasinate ohutus. Osa 6: Kaubaaluste pakkemasinad

Safety of packaging machines - Part 6: Pallet wrapping machines

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Standard on jõustunud sellekohase teate avaldamisega EVS Teatajas.	This standard has been endorsed with a notification published in the official bulletin of the Estonian Centre for Standardisation.
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EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

EN 415-6

May 2013

ICS 55.200

Supersedes EN 415-6:2006+A1:2009

English Version

Safety of packaging machines - Part 6: Pallet wrapping machines

Sécurité des machines d'emballage - Partie 6 : Machines d'emballage de palettes

Sicherheit von Verpackungsmaschinen - Teil 6: Paletteneinschlagmaschinen

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Foreword

This document (EN 415-6:2013) has been prepared by Technical Committee CEN/TC 146 “Packaging Machines Safety”, the secretariat of which is held by UNI.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by November 2013, and conflicting national standards shall be withdrawn at the latest by November 2013.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN [and/or CENELEC] shall not be held responsible for identifying any or all such patent rights.

This document supersedes EN 415-6:2006+A1:2009.

This document has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association, and supports essential requirements of EU Directive(s).

For relationship with EU Directive(s), see informative Annex ZA, which is an integral part of this document.

Annex E provides details of significant technical changes between this European Standard and the previous edition: EN 415-6:2006+A1:2009.

EN 415 "Safety of packaging machines" consists of the following parts:

— *Part 1: Terminology and classification of packaging machines and associated equipment*

— *Part 2: Pre-formed rigid container packaging machines*

— *Part 3: Form, fill and seal machines*

— *Part 4: Palletisers and depalletisers*

— *Part 5: Wrapping machines*

— *Part 6: Pallet wrapping machines*

— *Part 7: Group and secondary packaging machines*

— *Part 8: Strapping machines*

— *Part 9: Noise measurement methods for packaging machines, packaging lines and associated equipment, grade of accuracy 2 and 3*

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Introduction

Pallet wrapping machines are used extensively in Europe, in an increasingly wide range of industries. They contain several significant hazards and have the potential to cause serious injury.

Pallet wrapping machines fulfil the following major tasks:

— securing of palletised or unpalletised loads to prevent them collapsing and displacing during transport, handling, storage;

— pooling of loads and parts to form loads suitable for transport;

— protection against external influences;

— conditional protection against theft.

This document is a type C standard as defined in the Introduction of EN ISO 12100:2010.

The machinery concerned and the extent to which hazards, hazardous situations and events are covered are indicated in the scope of this standard.

When provisions of this type C standard are different from those, which are stated in type A or B standards, the provisions of this type C standard take precedence.

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1 Scope

This European Standard applies to the following groups of machines:

— pallet banding machines;

— stretch film pallet wrapping machines;

— stretch film hood application machines;

— mobile stretch film wrapping machines;

— semi automatic self driving stretch film wrapping machines;

— shrink film pallet wrapping machines;

— shrink film hood application machines;

— film removing machines;

— shrinking systems;

— sleeve wrapping machines for product greater than 400 mm in one direction;

— product centralising machines.

The individual machines are described in 3.2.

This standard deals with safety requirements for machine design, construction, installation, commissioning, operation, adjustment, maintenance and cleaning of pallet wrapping machines.

The extents to which hazards, hazardous situations and events are covered are indicated in Clause 4.

Exclusions

This European Standard is not applicable to the following machines:

— machines that were manufactured before the date of publication of this document by CEN;

— pallet strapping machines and destrapping machines. These machines are within the scope of EN 415-8;

— conveying systems that connect packaging machines with each other, but includes conveying systems that are part of the machines.

This standard does not consider the following hazards:

— the use of pallet wrapping machines in potentially explosive atmospheres;

— the health, safety or hygiene hazards associated with the products that may be handled by the machines, but does include general advice on this subject;

— hazards that may be associated with electromagnetic emissions from pallet wrapping machines;

— hazards that may be associated with decommissioning pallet wrapping machines.

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2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN 203-1:2005+A1:2008 *Gas heated catering equipment — Part 1: General safety rules*

EN 349:1993+A1:2008, *Safety of machinery — Minimum gaps to avoid crushing of parts of the human body*

EN 415-1:2000+A1:2009, *Packaging machines safety — Part 1: Terminology and classification of packaging machines and associated equipment*

EN 415-9:2009, *Safety of packaging machines — Part 9: Noise measurement methods for packaging machines, packaging lines and associated equipment, grade of accuracy 2 and 3*

EN 574:1996+A1:2008, *Safety of machinery — Two-hand control devices — Functional aspects — Principles for design*

EN 614-1, *Safety of machinery — Ergonomic design principles — Part 1: Terminology and general principles*

EN 614-2*, Safety of machinery — Ergonomic design principles — Part 2: Interactions between the design of machinery and work tasks*

EN 619, *Continuous handling equipment and systems — Safety and EMC requirements for equipment for mechanical handling of unit loads*

EN 626-1, *Safety of machinery — Reduction of risks to health from hazardous substances emitted by machinery — Part 1: Principles and specifications for machinery manufacturers*

EN 626-2, *Safety of machinery — Reduction of risk to health from hazardous substances emitted by machinery — Part 2: Methodology leading to verification procedures*

EN 894-1, *Safety of machinery — Ergonomics requirements for the design of displays and control actuators — Part 1: General principles for human interactions with displays and control actuators*

EN 894-2, *Safety of machinery — Ergonomics requirements for the design of displays and control actuators — Part 2: Displays*

EN 894-3, *Safety of machinery — Ergonomics requirements for the design of displays and control actuators — Part 3: Control actuators*

EN 953:1997+A1:2009, *Safety of machinery — Guards — General requirements for the design and construction of fixed and movable guards*

EN 1005-3, *Safety of machinery — Human physical performance — Part 3: Recommended force limits for machinery operation*

EN 1037, *Safety of machinery — Prevention of unexpected start-up*

EN 1088:1995+A2:2008, *Safety of machinery — Interlocking devices associated with guards — Principles for design and selection*

EN 1672-2:2005+A1:2009, *Food processing machinery — Basic concepts — Part 2: Hygiene requirements*

EN 1760-1, *Safety of machinery — Pressure sensitive protective devices — Part 1: General principles for the design and testing of pressure sensitive mats and pressure sensitive floors*

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EN 1760-2, *Safety of machinery — Pressure sensitive protective devices — Part 2: General principles for the design and testing of pressure sensitive edges and pressure sensitive bars*

EN 13478, *Safety of machinery — Fire prevention and protection*

EN 60204-1:2006, *Safety of machinery — Electrical equipment of machines — Part 1: General requirements (IEC 60204-1:2005, modified)*

EN 61310-1:2008, *Safety of machinery — Indication, marking and actuation — Part 1: Requirements for visual, acoustic and tactile signals (IEC 61310-1:2007)*

EN 61310-3, *Safety of machinery — Indication, marking and actuation — Part 3: Requirements for the location and operation of actuators (IEC 61310-3)*

EN 61496-1:2004, *Safety of machinery — Electro-sensitive protective equipment — Part 1: General requirements and tests (IEC 61496-1:2004, modified)*

EN 61496-3, *Safety of machinery — Electro-sensitive protective equipment — Part 3: Particular requirements for Active Opto-electronic Protective Devices responsive to Diffuse Reflection (AOPDDR)*

EN 61508-1*, Functional safety of electrical/electronic/programmable electronic safety-related systems — Part 1: General requirements (IEC 61508-1)*

EN 61508-2*, Functional safety of electrical/electronic/programmable electronic safety-related systems — Part 2: Requirements for electrical/electronic/programmable electronic safety-related systems (IEC 61508-2)*

EN 61508-3*, Functional safety of electrical/electronic/programmable electronic safety-related systems — Part 3: Software requirements*

EN 62061:2005, *Safety of machinery — Functional safety of safety-related electrical, electronic and programmable electronic control systems (IEC 62061:2005)*

EN ISO 4413:2010, *Hydraulic fluid power — General rules and safety requirements for systems and their components (ISO 4413:2010)*

EN ISO 4414:2010, *Pneumatic fluid power — General rules and safety requirements for systems and their components (ISO 4414:2010)*

EN ISO 12100:2010, *Safety of machinery — General principles for design — Risk assessment and risk reduction (ISO 12100:2010)*

EN ISO 13732-1 *Ergonomics of the thermal environment – Methods for the assessment of human responses to contact with surfaces – Part 1: Hot surfaces (ISO 13732-1)*

EN ISO 13849-1:2008, *Safety of machinery — Safety-related parts of control systems — Part 1: General principles for design (ISO 13849-1:2006)*

EN ISO 13850, *Safety of machinery — Emergency stop — Principles for design (ISO 13850)*

EN ISO 13855, *Safety of machinery — Positioning of safeguards with respect to the approach speeds of parts of the human body (ISO 13855)*

EN ISO 13857:2008, *Safety of machinery – Safety distances to prevent hazard zones being reached by upper and lower limbs (ISO 13857:2008)*

EN ISO 14122-1:2001, *Safety of machinery — Permanent means of access to machinery — Part 1: Choice of fixed means of access between two levels (ISO 14122-1:2001)*

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EN ISO 14122-2, *Safety of machinery — Permanent means of access to machinery — Part 2: Working platforms and walkways (ISO 14122-2)*

EN ISO 14122-3, *Safety of machinery — Permanent means of access to machinery — Part 3: Stairs, stepladders and guard-rails (ISO 14122-3)*

EN ISO 14122-4, *Safety of machinery — Permanent means of access to machinery — Part 4: Fixed ladders (ISO 14122-4)*

ISO 7000, *Graphical symbols for use on equipment — Registered symbols*

3 Terms and definitions

For the purposes of this document the terms and definitions given in Clause 3 of EN ISO 12100:2010, and EN 415-1:2000+A1:2009 and the following apply.

3.1 Definition of terms

3.1.1
product
article or articles, with or without pallet, that are handled in the pallet wrapping machine

3.1.2
pack
assembly of product and packaging materials produced by a pallet wrapping machine

3.1.3
packaging material
material used to secure a product, e.g. stretch film

3.1.4
flexible packaging material
relatively thin paper, plastic film or flexible laminate

3.1.5
stretch film
flexible elastic plastic film which can be pulled tightly around a product to form an envelope. It may stick to itself on contact or require heat sealing

3.1.6
stretch wrapping
wrapping process in which the stretch film is stretched and wrapped around the product and sealed under tension

3.1.7
thermoplastic film, shrink film
plastic film which shrinks when heated

3.1.8
film reel, packaging material reel
continuous sheet of paper, plastic film, metal foil or flexible laminate wound on a cylindrical core

3.1.9
film clamp
device to hold the film at the product for the first wrap. Also called film fixture

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3.1.10
manual operation
machine functions or modes where the only power source is directly applied manual effort

3.1.11
top sheet
piece of packaging material which is applied to the top of the product e.g. to achieve water and dust protection

3.2 Description of pallet wrapping machines

3.2.1 General

Pallet wrapping machines are machines listed in Clause 1 that secure product for transport and other purposes e.g. by applying packaging material or shrinking shrink film. Many of the machines deal with palletised products, therefore they are called, e.g.: pallet shrink wrapping machine, pallet shrink oven (see 3.12.3 of EN 415-1:2000+A1:2009). In many cases, however, machines can function without a pallet or with an alternative form of support for the pack.

3.2.2 Spiral stretch wrapping machines

3.2.2.1 General

The stretching method uses film webs that are wound around product according to a given winding pattern (e.g. single or cross bracing). The number of the bottom windings or bottom edge windings or the degree of overlapping of the film webs can be variably adjusted.

Stretch film wrapping machines wind a stretch film spirally around product, thus resulting in an envelope with horizontal and vertical tension forces.

Pallet stretch wrapping machines include:

- Automatic stretch film wrapping machines: The machine is loaded and unloaded automatically by a conveyor. The application of the stretch film, stretching and cutting of the stretch film are done automatically.

- Semiautomatic stretch film wrapping machines: One or more of the following are done manually: loading or unloading of the machine, application or cutting of the stretch film. The wrapping movement is done automatically.

- Manual stretch film wrapping machines: Like semiautomatic stretch film wrapping machines, but additionally the movement of the lifting mechanism is done manually.

The following types of stretch film wrapping machines exist.

3.2.2.2 Rotary table machine

Product, which is positioned on a table that rotates, is wrapped. When used, vertically moveable film carriage and pre-stretching device are fitted to a column. The functional principle of a rotary table machine is shown in Figure 1. On manual rotary machine the vertical movement of the film carriage is done by an operator (see Figure 2). An example of a fully automatic rotary table machine is shown in Figure 3.

The principle components are rotating table and film reel.

Optional assemblies: conveyors, film clamp, film knife, film sealing device, hold-down plate, pre-stretching unit on the film reel assembly, top sheet feeder.

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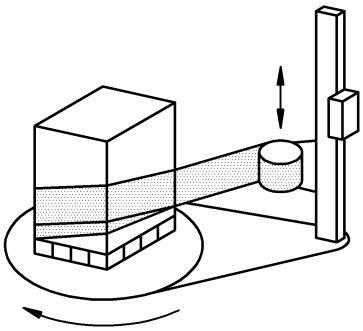


Figure 1 — Principle of rotary table machine

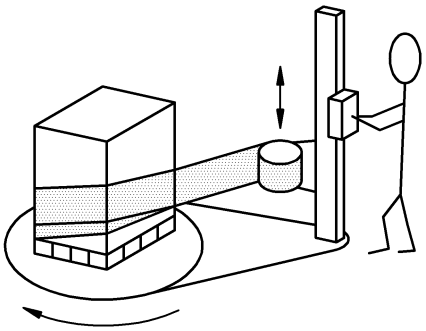
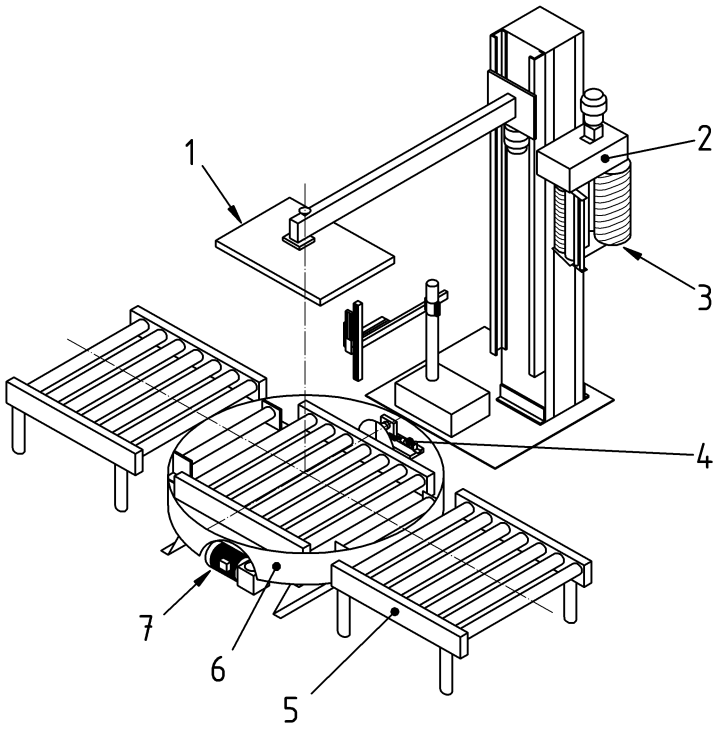


Figure 2 — Manual rotary table machine



Key

1 hold down plate
2 pre-stretching device
3 film reel
4 film fixture system
5 conveyor
6 rotary table
7 film cutting device

Figure 3 — Automatic rotary table machine

3.2.2.3 Rotary arm machine

Machine which wraps product in film or net, from a reel on an arm which rotates around the stationary product (see Figure 4 and Figure 5).

The principle components are: rotating arm, film reel assembly and lifting mechanism which moves the arm up and down.

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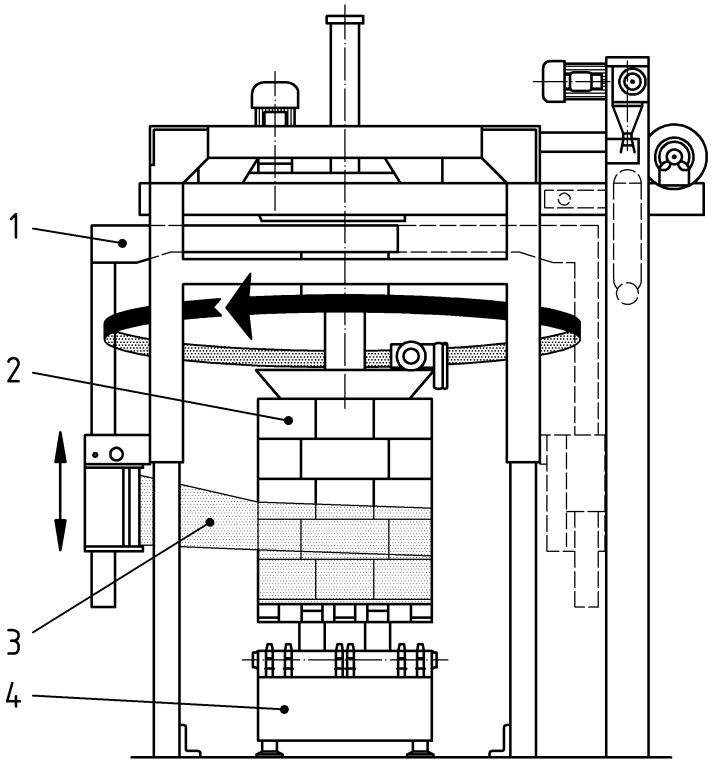
Optional assemblies: conveyors, film clamp, film knife, film sealing device, hold-down plate, pre-stretching unit on the film reel assembly, top sheet feeder.



Key

1 rotary arm
2 product
3 film
4 conveying device

Figure 4 — Semiautomatic rotary arm machine

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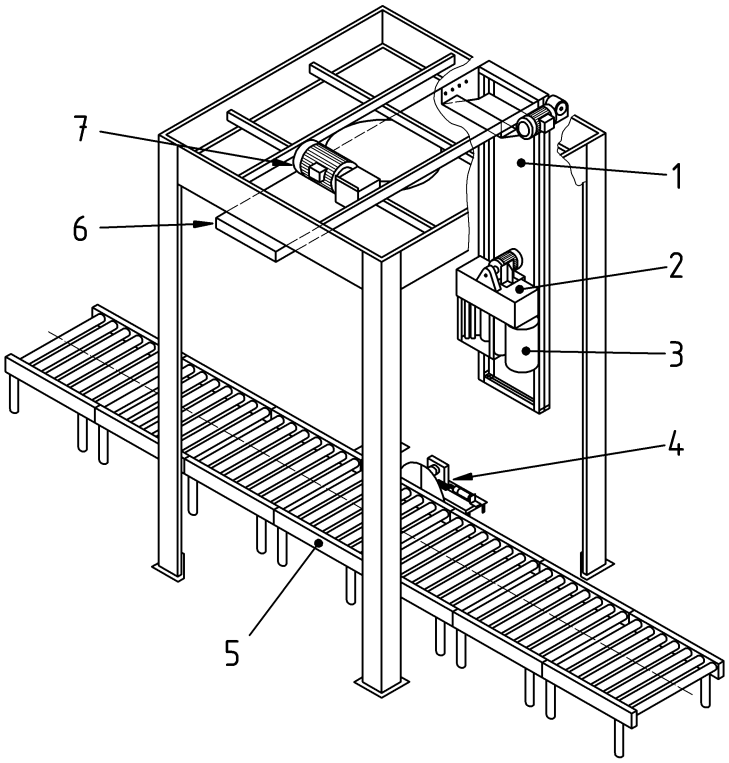

Key

1 vertical slide device
2 pre-stretching device
3 film reel assembly
4 film fixture system
5 conveying device
6 rotary arm
7 top sheet feeder

Figure 5 — Fully automatic rotary arm machine

3.2.2.4 Ring machine

In a ring machine a film carriage guided on a ring moves circularly around the stationary product (see Figure 6). Some examples have a tilting ring to apply a diagonal wrap.

The principle components are: rotating mechanism on a ring, film reel assembly and lifting mechanism which moves the ring up and down.

Optional assemblies: conveyors, film clamp, film knife, film sealing device, hold-down plate, pre-stretching unit on the film reel assembly, top sheet feeder.

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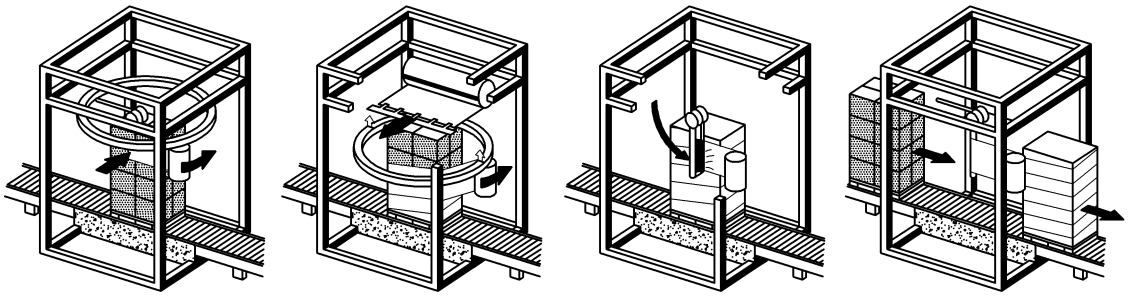
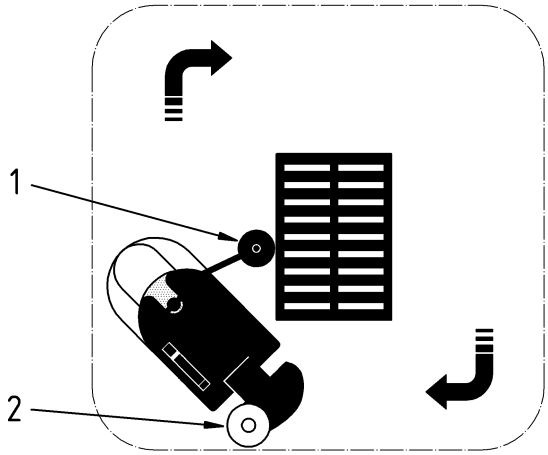


Figure 6 — Ring machine – Principle of operation

3.2.2.5 Semi automatic self driving pallet stretch wrapping machines

Semi automatic self driving pallet stretch wrapping machines apply a stretch film by the whole machine driving around the product (see Figure 7). The machine is guided around the product by a contact wheel which is mounted on a moveable lever.

The principle components are the contact wheel and the film reel assembly.



Key
1 contact wheel
2 film reel assembly

Figure 7 — Semi automatic self driving pallet stretch wrapping machine

3.2.2.6 Mobile pallet stretch wrapping machines

Mobile stretching machines (see Figure 8) are moved to the pallet manually, usually assisted by a motor drive. Usually the pallet is lifted by a lifting mechanism and so fixed on the stretch wrapping machine. The machine wraps a product in film or net, from a reel on an arm which rotates around the stationary product (rotary arm machine).

The principle components are: pallet support, rotary arm and film reel assembly.

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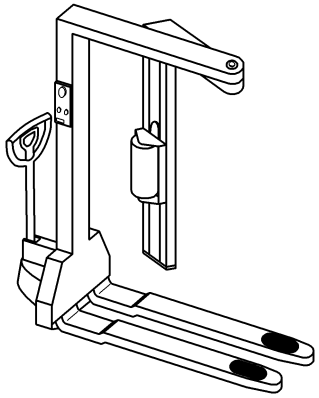

Figure 8 — Mobile pallet stretch wrapping machine

3.2.3 Curtain stretching machine

A conveyor transports the product into a film curtain that is stretched and subsequently welded on the rear side.

Working principle is the so-called passage method according to which the product in the machine bumps against the film web rolling off two rollers and drags this along. In this manner, the stretch film envelopes the advancing product. After this a closing and cutting tool tightens up and separates the film (see Figure 9).

The principle components are: conveyor, film reel assembly, sealing and cutting mechanism.

Optional assemblies: Top sheet assembly.

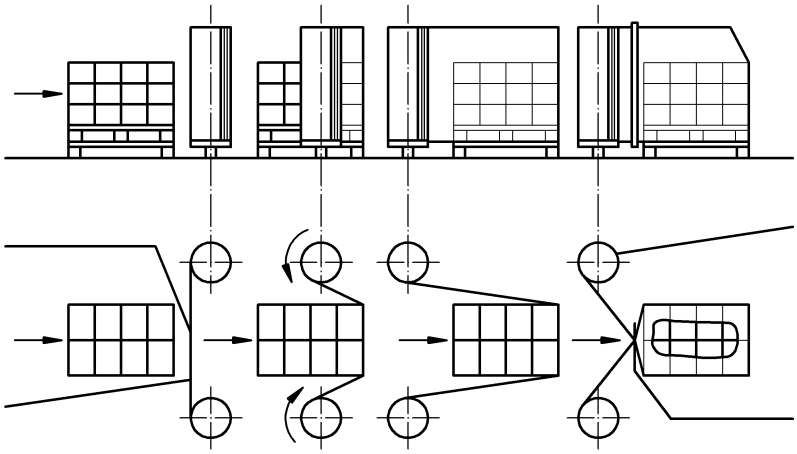

Figure 9 — Curtain stretching machine – Principle of operation

3.2.4 Hood stretching machines

Hood stretching machines apply a stretch film hood which is prefabricated or taken from a film tube roll to a product by stretching it and pulling it over the product. When a film tube is used, the required length of the hood is pulled off the reel then sealed and cut off.

Hood stretching can be either semiautomatic or fully automatic. In case of semiautomatic hood stretching, the essential automatic operations are only gathering and stretching. The hood is loaded manually. Prefabricated hoods or hoods on reels with perforated separation seam are used.

A hood stretching machine and the stretching procedure is shown in Figure 10.

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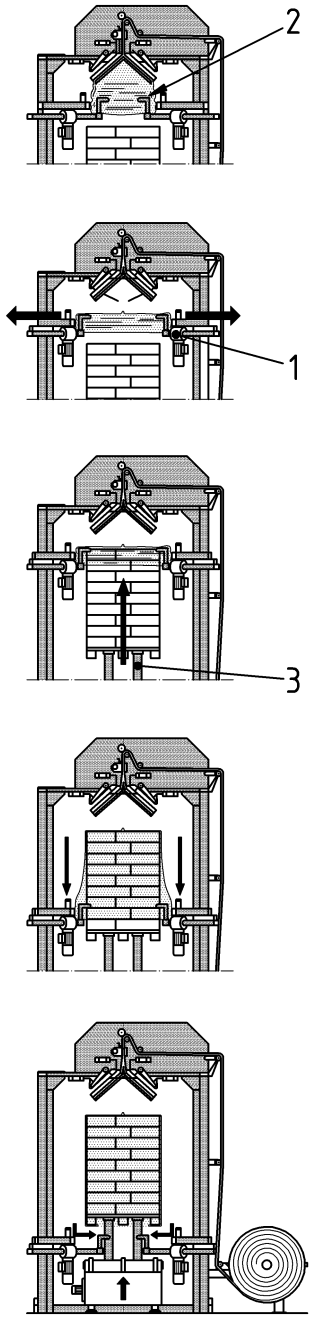
The principle components are: tube film reel assembly, tube opening mechanism, tube placement mechanism, tube cutting.

Optional assemblies: conveyors, edge protection feeders.



Key

1 gathering fingers
2 hood dispenser
3 product lifting platform

Figure 10 — Hood stretching machine

Fully automatic machines use reels of square tubes with gussets or of flat tubes. The film web to be uncoiled is guided via deviation or dancer rolls into the head of the machine operating according to the vertical principle.

Mechanically, pneumatically or vacuum driven opening devices open the tube to a rectangular format and put it into the gathering device. Similar to the case with the semiautomatic version this device consists of

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gathering fingers. In one version, transfer of the forward end of the hood to the gathering fingers is made from top while it is made from the bottom in another version.

The hood length needed is pulled off a roll in accordance with the stack height in each case, then welded and cut off. Once the hood has been gathered, the gathering devices move diagonally outward and stretch the hood film in horizontal direction. After the head area of the hood is put on the uppermost stack layer during the downward movement, the gathered hood is pulled off the gathering fingers so that different values for stretching in vertical position can be achieved.

3.2.5 Shrink film pallet wrapping machines

3.2.5.1 General

When using the shrinking method, the product is first wrapped with thermoplastic film. Subsequently, the thermoplastic film is shrunk under the effect of heat around the pack. See 3.2.6 for descriptions of shrinking systems.

3.2.5.2 Banding, curtain and sleeve wrapping machines

A conveyor transports product into a curtain of thermoplastic or non elastic film that is welded on the rear side.

Working principle is the so-called passage method according to which, the product in the machine bumps against the film web rolling off two rollers and drags this along. In this manner, the film wraps the advancing product. Working principle see Figure 9.

Differentiation is made between horizontal and vertical machines.

In the horizontal machine the film reels are arranged in vertical position next to the product conveying system.

In the vertical machine one film reel is positioned above and another one below the conveying system.

The principle components are: conveyor, film reel assembly, film closing/fixing mechanism, cutting mechanism.

Optional assemblies: Top sheet assembly, sealing mechanism.

3.2.5.3 Spiral pallet wrapping machines

A spiral pallet wrapping machine processes a shrink film that is wound spirally around product and product carrier in the same way as by a pallet stretching machine, but without sufficient tension to stretch the film. This method allows packaging of product which varies in height or base, using one machine and one film width. See Figure 11.

The principle components are: rotating table, film reel assembly and lifting mechanism which moves the film reel assembly vertically thus producing a spiral wrap.

Optional assemblies: conveyors, film clamp, film knife, film sealing device, hold-down plate, pre-stretching unit on the film reel assembly, top sheet feeder.

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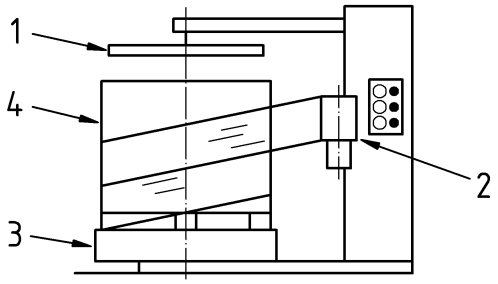

Key

1 hold down plate
2 film reel assembly
3 rotary table
4 product

Figure 11 — Spiral pallet wrapping machine

3.2.5.4 Hood application machines

3.2.5.4.1 General

Hood application machines generally use a square profile tube with gussets. The machine detects the height of the product and forms the hood length accordingly. There are two principle operating types between two versions: vertical hood and parachute hood application, which are described below.

3.2.5.4.2 Vertical hood application machine

The film hood is formed above the product and put on vertically, i.e. opening, welding and cutting device are located above the product (see Figure 12). Opening of the hood is usually assisted by a blower. After the hood has been put on, the product is fed to a shrinking device.

The principle components are: tube film reel assembly, tube opening mechanism, tube placement mechanism, tube cutting device, hood application mechanism

Optional assemblies: conveyors, edge protection feeding device, blower.

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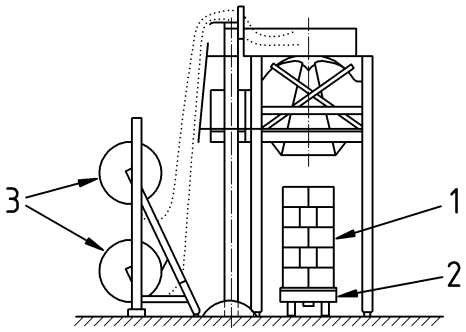


Key

1 product
2 conveyor
3 film reels (two formats)

Figure 12 — Vertical hood application machine

3.2.5.4.3 Parachute hood application machine

In the case of parachute hood application machines, the assembling unit is located at floor level, at the side of the application machine. The film is withdrawn from the assembling unit, the hood welded and cut off. The so assembled hood is turned and put on the product standing next to the assembling unit (see Figure 13).

The principle components are:

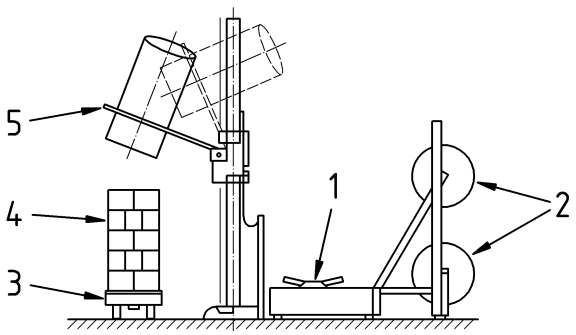
— Film reels

— Film transport mechanism

— Turning arm

— Assembling unit (sealing and opening unit)

— Conveyor



Key

1 film assembling unit
2 film reels (2No)
3 conveyor
4 product
5 turning arm

Figure 13 — Parachute hood application machine

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3.2.6 Shrinking systems

3.2.6.1 Shrinking frame, shrinking hood

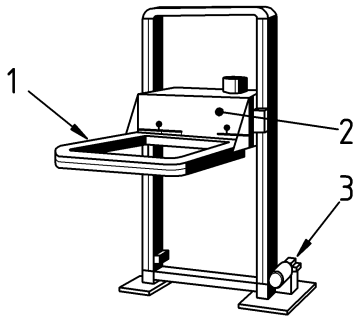
The shrinking frame (see Figure 14) shrinks a thermoplastic film around the product while the frame is guided over the surface of the product. Shrinking frames either have a single continuous heat outlet (e.g. slot along the frame) or multiple heat outlets (e.g. a number of air nozzles positioned along the frame). The heat source usually is electric energy or gas.

Shrinking hoods are rectangular containers with open bottom that are guided over a product enveloped with a thermoplastic film. They exist both with central heating device and continuously arranged heating elements.

In both cases the product is fed either manually or by a conveyor.

The principle components are: frame or hood with a source of heat, lifting mechanism which moves the hood or frame up and down, heating system.

Optional assemblies: conveyors.



Key

1 shrinking frame
2 moving frame mechanism
3 moving drive

Figure 14 — Shrinking frame

3.2.6.2 Shrinking oven

A shrinking oven is a heated space in which the thermoplastic film put around a product is shrunk. Shrinking ovens are available as chamber ovens (see Figure 15) or as continuous ovens (see Figure 16) as well. They can use direct gas heating, indirect oil heating or also be fitted with electrical heater coils.

The principle components are: conveyors, source of heat, automatic doors.

Optional assemblies: fans.

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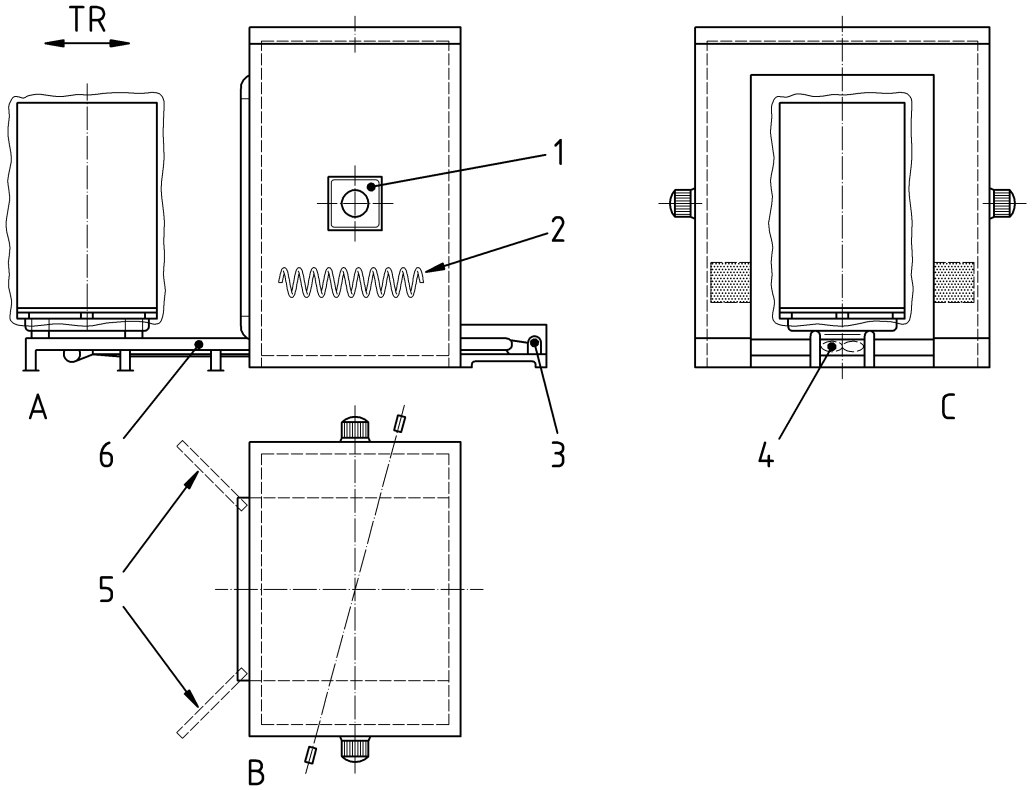

Key

1 fan circulating air
2 electric heating unit
3 bogie drive unit
4 bottom shrink device
5 automatic doors
6 conveyor
A side view
B plan view
C end view
TR product transport direction

Figure 15 — Chamber shrinking oven with electric heating device

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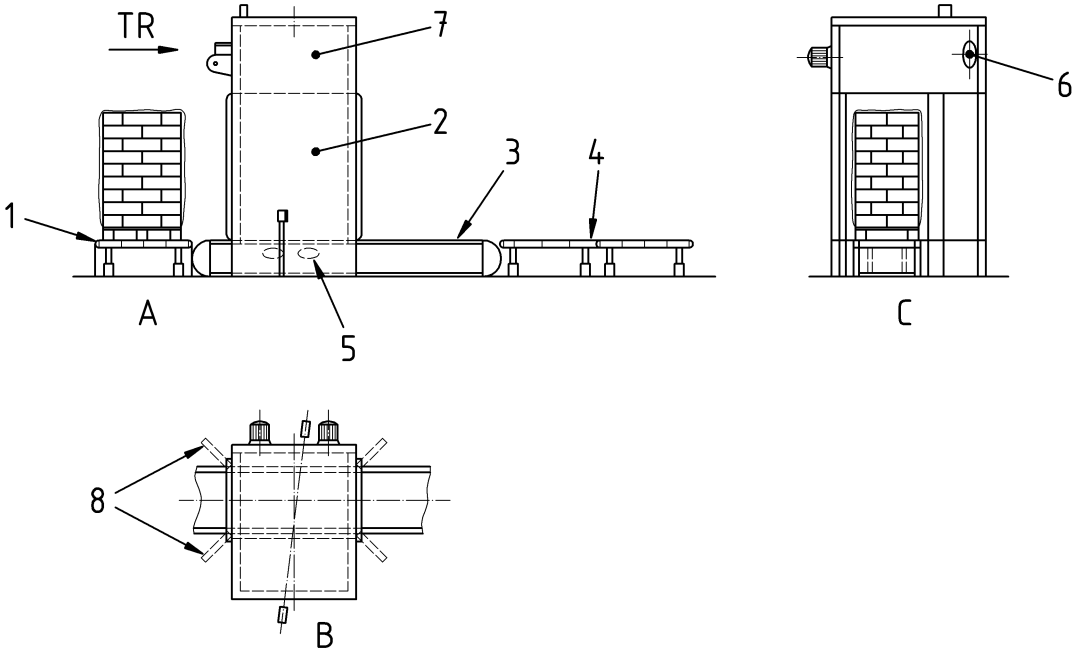

Key

1 infeed conveyor
2 product position in oven
3 product position after shrink cycle
4 discharge conveyor
5 bottom shrink device
6 heating element
7 shrinking zone
8 automatic doors
A side view
B plan view
C end view
TR product transport direction

Figure 16 — Continuous shrinking oven using thermal combustion heating

3.2.6.3 Shrinking column

Shrinking columns are devices in which a thermoplastic film is shrunk around product using heating devices that are positioned in usually one or two vertical columns at the side of a rotating table which can be part of a conveyor. Shrinking columns exist as rotating shrinking column with stationary product or as stationary shrinking column with rotating product. The heating device can be heated electrically or by means of gas.

The principle components are: source of heat, turn table.

Optional assemblies: conveyors.

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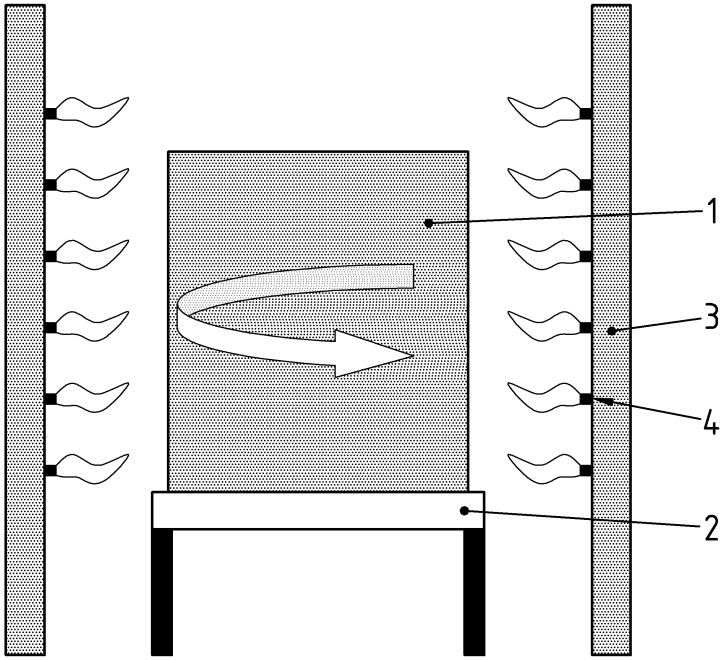

Key

1 product
2 roller conveyor with turntable
3 column
4 heating elements

Figure 17 — Shrinking column using thermal combustion

3.2.7 Auxiliary machines

3.2.7.1 Top sheet feeder

To place the top sheet, one film sheet is put on top of product. The top sheet is pulled off a reel, cut off, drawn over product or put on it. Subsequently, the top sheet hanging down on the sides is enveloped using the spiral film winding method.

Differentiation is made between the following working methods:

— When working according to the passage principle, the top sheet feeder uncoils the top sheet from the roll while product is passing. Subsequently, the top sheet is cut off.

— When working according to the tensioning principle, the top sheet is uncoiled from the reel, then pulled over the top of the stationary product, cut off and put down.

The principle components are: film reel assembly or top sheet magazine, application mechanism, gripping mechanism.

Optional assemblies: film clamp, film cutting device.

3.2.7.2 Product centralising machines

Product centralising machines push the product, usually placed on a pallet, in the correct position by pressing with two lateral metal plates. The machine usually is loaded automatically by a pallet conveyor.

The principle components are: pushing plates, conveyor.

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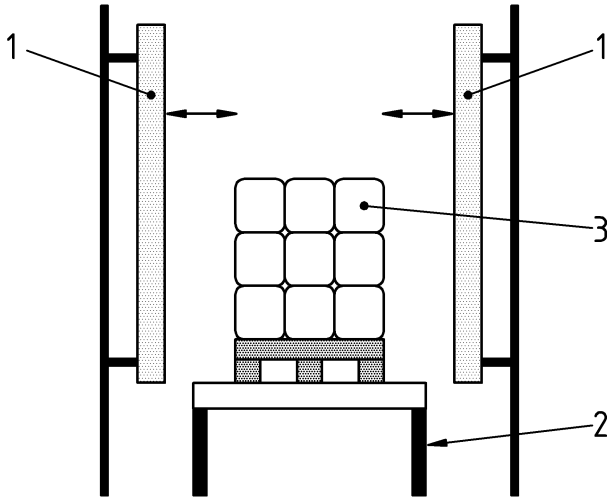

Key

1 pushing plates
2 roller conveyor
3 product

Figure 18 — Product centralizing machine

3.2.7.3 Film removing machines

Film removing machines remove the film from palletised or unpalletised product. Usually the film is cut vertically by a cutting device and then removed by low pressure. Mostly a product centralising assembly is used to hold the product. The machine is usually loaded automatically by a pallet conveyor which usually comprises an integrated lifting platform.

The principle components are: cutting device, film removing assembly, film repository, conveyor with lifting platform.

4 List of hazards on pallet wrapping machines

4.1 General

This clause lists all the significant hazards, hazardous situations and events that can be found on typical pallet wrapping machines including integrated transport, feed and discharge devices.

Before using this standard, the manufacturer shall establish that the hazards on his machine correspond to the hazards described in this standard.

If the manufacturer identifies hazards that are not listed in this clause, he shall assess these hazards by using the principles detailed in EN ISO 12100.

The hazards on a specific machine can vary depending on its working principle; the type, size and mass of the product; the packaging material; auxiliary equipment attached to the machine and the environment in which the machine is used.

The hazards which occur on most pallet wrapping machines are listed in 4.2 and the hazards which are specific to particular types of pallet wrapping machines are listed in 4.3 to 4.5.

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4.2 General pallet wrapping machine hazards

4.2.1 Mechanical hazards

4.2.1.1 Moving parts

Pallet wrapping machines may incorporate moving parts which present a variety of mechanical hazards including crushing, shearing, cutting, entanglement, friction and drawing-in. Some of these hazards may persist after the power supply has been cut off due to stored energy.

4.2.1.2 Pneumatic and hydraulic equipment

Pneumatic and hydraulic equipment presents crushing, shearing, ejection of parts and injection of fluids hazards. Stored energy in pneumatic or hydraulic systems may cause mechanisms to move unexpectedly even when power supplies are disconnected. In addition hydraulic oil and pneumatic lubricating oil present a potential fire hazard and can contaminate agri-foodstuffs.

4.2.1.3 Slip, trip and fall hazards

Slip accidents can occur if liquids or solids from the machine e.g. lubricants, packaging materials or the product, spill onto traffic routes, work stations or means of access around the machine.

Trip accidents may occur if parts of the machine protrude beyond the machine frame at low level, or if cables and pipes associated with the machine are incorrectly installed.

Falls may occur if people climb or stand on parts of the machine above floor level, e.g. for magazine loading, size changing, maintenance or cleaning.

4.2.1.4 Loss of stability

If pallet wrapping machines become unstable and move unexpectedly or fall over they can cause crushing and impact injuries. Loss of stability can occur in the following circumstances:

a) while the machine is in operation for example:

   — if components are unbalanced;

   — if the centre of gravity of the machine is high relative to its base area;

   — if someone stands on the machine;

b) while the machine is being moved, for example:

   — if the manufacturers lifting instructions are not followed;

   — on machines fitted with wheels if the machine is moved on a slope or uneven surface.

4.2.1.5 Hazards from moveable guards

Movable guards may present crushing, shearing and impact hazards when they open or close if they have a high mass or move under gravity. If excessive effort is necessary to operate the guard or it is located in an unfavourable position, the operator may sustain strain injuries or damage to health. Powered guards may present crushing, shearing and impact hazards.

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4.2.2 Electrical hazards

4.2.2.1 Electrical equipment

Electrical equipment on the machine generates a potential electric shock and burn hazard and in the presence of combustible materials there is a potential fire hazard. Electrical systems may act as an ignition source. In the presence of flammable substances or products which may create explosive atmospheres, this could give rise to an explosion hazard.

If liquids, e.g. product spillage or cleaning substances like water, come into contact with the electrical conductors, there is a risk of electric shock.

4.2.2.2 Electrostatic phenomena

Electric shock hazards can arise if parts of the machine or materials are electrostatically charged, e.g. a plastic guide rail that is rubbed by passing products. Electrostatic discharge can be a source of ignition in the presence of flammable substances or explosive atmospheres.

4.2.3 Thermal hazards

Parts of the machine e.g. sealing mechanisms and drive motors, which have high surface temperatures, may cause burning hazards. See EN ISO 13732-1 for details of the burn thresholds for different materials and contact times.

The burning hazard will usually continue to exist for a period of time after power has been disconnected.

Thermal hazards are especially associated with

— thermal film separation and closing devices;

— shrinking systems in the shrink area.

4.2.4 Noise

Noise generated by pallet wrapping machines can result in:

— permanent hearing loss;

— tinnitus;

— tiredness, stress etc.;

— other effects such as loss of balance, loss of awareness;

— interference with speech communication;

— inability to hear acoustic warning signals.

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4.2.5 Hazards from products and materials

4.2.5.1 Hazards generated by products

Pallet wrapping machines are used to pack a wide range of products, some of which may be potentially hazardous to persons operating or in the vicinity of the packaging machine during normal operation or if product containing a hazardous substance is damaged in the packaging machine.

Hazards generated by the product can include:

a) ingestion of harmful substances e.g. insecticides, aggressive or harmful chemicals, pharmaceuticals;

b) fire or explosion e.g. flammable liquids, explosives, dusty products;

c) biological hazards e.g. vaccines;

d) electric shock from electrostatic discharges, e.g. products rubbing against plastic guide rails or at plastic film reel unwind mechanisms and plastic sheet feeding mechanisms.

4.2.5.2 Hazards generated by packaging materials

Pallet wrapping machines are intended to use a range of packaging materials, which can present the following hazards:

a) inhalation of harmful or unpleasant smoke or vapours from overheated or burning materials;

b) inhalation of harmful or unpleasant dusts, e.g. from paper;

c) cuts from handling packaging materials e.g. film, strap or paper edges;

d) fire due to overheating of combustible packaging materials, e.g. plastic films;

e) electric shock from electrostatic discharges, e.g. at plastic film reel unwind mechanisms and plastic sheet feeding mechanisms.

4.2.6 Hazards due to neglecting ergonomic principles

Hazards to safety and health can occur when people are carrying out the following activities on pallet wrapping machines:

a) Operation, cleaning and maintenance of machines under poor lighting conditions;

b) Loading packaging materials e.g. assuming a bad posture, using excessive effort, fatigue;

c) Loading products or unloading loads e.g. assuming a bad posture; performing unnatural hand or arm movements, using excessive effort;

d) Cleaning the machine e.g. assuming a bad posture, using excessive effort;

e) Maintenance e.g. assuming a bad posture, using excessive effort;

f) Moving the machine e.g. using excessive effort, fatigue.

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4.2.7 Hazards caused by failures

4.2.7.1 Failure of power supplies

The following hazards can occur on pallet wrapping machines if their power supplies fail:

a) uncontrolled lowering or falling of machine assemblies or product;

b) unexpected locking of brakes or other components;

c) failure of a braking function;

d) unexpected movement of assemblies when power is reconnected or due to stored energy.

4.2.7.2 Failure of safety related parts of control systems

Hazards can arise if components in safety related parts of control systems fail or if the system does not meet its safety requirements specification. Failures may occur due to mechanical damage, contact failure, electronic component failure. Hazards may also arise if safety systems are deliberately defeated by operators. Systematic faults may occur, especially in programmable systems, as a result either of errors in the safety requirements specification or of failures to meet the specification. Failures can lead to loss of safety functions resulting in unexpected start-up of moving parts, incorrect sequencing of machine operations or prevent moving parts from stopping as expected.

4.2.7.3 Failure of electronic drive systems

On electronic drive systems where the power supply to a drive motor is not disconnected while the guards are open, there is a risk of unexpected start-up with consequential mechanical hazards if the control system malfunctions or responds to an external disturbance such as electromagnetic interference.

4.2.8 Hazards due to neglecting hygienic design principles

On machines that are intended to pack agri-foodstuffs, pharmaceuticals or other products where hygiene is a consideration, product contamination hazards can result if inappropriate contact materials or construction methods are used or if lubricants or other contaminating substances are allowed to come into contact with the product.

4.2.9 Common mechanisms on pallet wrapping machines.

4.2.9.1 Cutting devices

Mechanical cutting devices present a cutting or shearing hazard:

a) when the machine is in normal operation;

b) when the machine’s power supplies are isolated the mechanism moves unexpectedly due to stored energy;

c) when threading film the operator touches the exposed cutting surface;

d) when the device is handled during setting-up, cleaning or maintenance.

4.2.9.2 Sealing devices

Mechanical sealing devices present a crushing hazard:

a) when the machine is in normal operation;

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b) when the machine's power supplies are isolated the mechanism moves unexpectedly due to stored energy.

Heated sealing devices present a burning hazard during normal operation. They also present a burning hazard for a period of time after power has been disconnected from the device.

There is a risk of electrical insulation in heating elements breaking down giving rise to an electric shock hazard.

There is a risk of fire if packaging materials remain in contact with a heated sealing device for too long or if the temperature of the sealing device is too high e.g. if the temperature of the heater controls is set too high or if the temperature control fails and the temperature rises uncontrollably.

Harmful fumes may be generated, giving rise to a health hazard by inhalation if certain materials, such as polyester film are heated on the sealing device.

4.2.9.3 Conveyors

4.2.9.3.1 Pallet chain conveyors

Drawing-in or trapping hazards can be present where chains pass over sprockets or at in-running nips between the chain and the conveyor frame. These hazards are increased if flights are attached to the chain. Crushing and shearing hazards may be present between the product and the substructure of the conveyor.

4.2.9.3.2 Roller conveyors

Drawing-in or trapping hazards can be generated by in-running nips between rotating rollers of roller conveyors and their frame or machine parts.

On low-level conveyors, slip, trip or fall accidents may occur if people walk or stand on the conveyor e.g. for maintenance or cleaning. Trip accidents may occur if the conveyor starts while people are walking or standing on it.

4.2.9.4 Drive systems

Pallet wrapping machines may incorporate mechanical, electrical, pneumatic or hydraulic drive mechanisms which present a variety of different hazards including crushing, shearing, cutting, entanglement, friction, drawing-in, electric shock and burning hazards. Some of these hazards may persist after the power supply has been cut off due to stored energy.

4.3 Specific hazards on pallet wrapping machines excluding shrinking systems and auxiliary machines

4.3.1 General

The hazards described in 4.2 and in this clause are specifically associated with pallet wrapping machines excluding shrinking systems and auxiliary machines.

4.3.2 Specific hazards on rotary table machines and spiral pallet wrapping machines

4.3.2.1 General

The hazards described in 4.2 and in this clause are specifically associated with a rotary table machine (see 3.2.2.2) and a spiral pallet wrapping machine (see 3.2.5.3).

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4.3.2.2 Rotary table

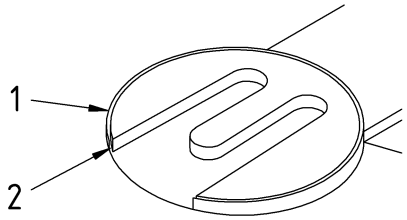
On rotary table machines there exist crushing, shearing and impact hazards between the rotating product and fixed machine parts. A person can be asphyxiated if trapped between the product and the film during the wrapping process.

On fully automatic rotary machines crushing, shearing and impact hazards can exist between the rotating table and infeed and discharge conveyors.

A shearing hazard can exist between moveable parts and the fixed substructure of the rotary table.

A crushing and impact hazard exists if the product tilts over or parts of the product are ejected.

Freely rotatable rotary tables present a trip hazard. Protruding parts or gaps of the rotary table present an entanglement hazard. On semiautomatic or manual rotary table machines a drawing-in hazard can exist between the rotary table and the frame around it or between the rotary table and the ramp. If instead of a ramp there are apertures in the table for loading the pallet e.g. with a low lift platform truck, a shearing and crushing hazard exists between the rotary table and the machine frame around it (see Figure 19).



Key

1 rotary table frame

2 crushing, shearing and drawing-in hazard location between rotary table and frame

Figure 19 — Semiautomatic or manual rotary table machines: crushing, shearing and drawing-in hazard location

4.3.2.3 Film reel assembly and film feeding

Crushing and shearing hazards exist between film reel assembly and lower machine frame or floor, between moveable parts of the lifting device of hold-down devices or film reel assembly. A drawing-in or trapping hazard exists between control rollers or feed rollers and the product, control rollers, feed rollers for winding films and top films, especially when changing the film.

Entanglement hazards can be generated by rotating film reels, winding rollers and stretching units. Drawing-in or trapping hazards can be generated by film feed rollers. An entanglement hazard exists on control rollers or feed rollers. A drawing-in or trapping hazard can exist when reels with a high mass are supported by rollers. Film reels falling from the film reel assembly generate a crushing and impact hazard.

If the power supply fails or is switched off, or a failure in the control circuit occurs, crushing, shearing and impact hazards exists due to uncontrolled lowering of the film reel assembly.

4.3.2.4 Film clamp

A crushing hazard exists between the clamping strips on the film clamp.

4.3.2.5 Hold down device

A crushing hazard exists between hold-down plate and product and between hold-down device and machine bottom.

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If the power supply fails or is switched off, or a failure in the control circuit occurs, crushing, shearing and impact hazards exists due to uncontrolled lowering of the hold-down device.

4.3.2.6 Conveyor

On fully automatic machines there is a crushing hazard between the transported product and fixed machine parts, between incoming product and product located on the rotary table as well as between the transported product and the transporting equipment (e.g. rollers).

4.3.2.7 Top sheet feeder

See 4.5.2.

4.3.3 Specific hazards on rotary arm machines and ring machines

4.3.3.1 General

The hazards described in 4.2 and in this clause are specifically associated with a rotary arm machine (see 3.2.2.3) and a ring machine (see 3.2.2.4).

4.3.3.2 Rotating mechanism

Crushing and shearing hazards exist between rotating rotary arm with film fixture and fixed machine parts, between the vertically moving rotary arm or travelling ring and the product or transporting equipment. These hazards can still exist after the machine has been stopped due to the stored energy in the compressed air system.

Ring machines present crushing and shearing hazards between the rotating film reel assembly and fixed machine parts, between the rotating film assembly and product, between the rotating film reel assembly and conveyor, between the tilting ring and the product, between the tilting ring and conveyor and between product and conveyor.

An impact hazard is generated by the rotary movement of the rotary arm or film fixture of the ring. On diagonal ring machines there is an impact hazard while the travelling ring is tilting.

Connections can work loose due to a wrong installation. If the rotary arm, travelling ring or film fixture is installed incorrectly this can result in injuries due to ejected machine parts. If the travelling ring has been installed incorrectly this can generate a crushing hazard caused by the travelling ring falling down.

4.3.3.3 Film reel assembly

See 4.3.2.3.

4.3.3.4 Lifting mechanism

See 4.3.2.3.

4.3.3.5 Film clamp

See 4.3.2.4.

4.3.3.6 Hold-down device

See 4.3.2.5.

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4.3.3.7 Top sheet feeder

See 4.5.2

4.3.4 Specific hazards on curtain stretching machines and banding and curtain machines for applying shrink film

4.3.4.1 General

The hazards described in 4.2 and in this clause are specifically associated with curtain stretching machines (see 3.2.3) and banding and curtain machines for applying shrink film (see 3.2.5.2).

Danger of bodily injury can exist if the product tilts over or parts of the product fall down due to acceleration or film tension.

4.3.4.2 Film reel assembly

See 4.3.2.3.

4.3.4.3 Top sheet feeder

See 4.5.2.

4.3.4.4 Sealing and cutting device

A crushing hazard exists between the sealing bars and between the lifting frame for the top sheet (horizontal banding machine) or for the top film (vertical banding machine) and the product. This hazard can still exist after the machine has been stopped due to the stored energy in the compressed air system. An impact hazard exists due to the transported product and the movement of the sealing/cutting devices.

4.3.5 Specific hazards on hood application machines and hood stretching machines

4.3.5.1 General

The hazards described in 4.2 and in this clause are associated with hood application machines (see 3.2.5.4) and hood stretching machines (see 3.2.4).

4.3.5.2 Hood application

A crushing hazard exists between the moved product and the machine frame, between the moved product and the transporting equipment, between the lifting device and fixed machine parts, between the lifting device and the transporting equipment. Crushing and shearing hazards can exist between the vertically moved lifting frame and cross girders of the machine frame as well as between lifting frame and product. If the power supply fails or is switched off, a crushing and impact hazard exists due to uncontrolled lowering of the lifting frame, especially when changing the film.

4.3.5.3 Tube film reel assembly

See 4.3.2.3.

4.3.6 Specific hazards on a semi automatic self driving pallet stretch wrapping machine

The hazards described in 4.2 and in this clause are specifically associated with a semi automatic self driving pallet wrapping machine (see 3.2.2.5).

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An impact hazard is presented by the semi automatic self driving pallet stretch wrapping machine. Crushing, entanglement and drawing-in hazards may be present between mobile machine and product, mobile machine (including wheels) and floor, between the contact wheel (which guides the machine around the product by holding contact with it) assembly and the pallet or mobile machine and between the mobile machine and fixed or heavy parts in the vicinity (e.g. parts of the building, machines, pallets), due to the motion of the mobile machine.

Impact or crushing hazards may be presented by the loss of stability of the machine.

4.3.7 Specific hazards on a mobile pallet stretch wrapping machines

The hazards described in 4.2 and in this clause are specifically associated with a mobile pallet stretch wrapping machine (see 3.2.2.6).

On mobile stretching machines a crushing and impact hazard exists due to instability of the machine (see 4.2.1.4). Other hazards see 4.3.2.3.

4.4 Specific hazards on pallet shrinking systems

4.4.1 General

The hazards described in 4.2 and in this clause are specifically associated with a pallet shrinking system.

4.4.2 Hazards common to most shrinking systems

4.4.2.1 Thermal hazards

A burn hazard is generated by the surfaces of the shrinking systems, heating elements, flames of gas operated shrinking systems or by the shrink film immediately after the shrinking process when the temperature exceeds the burn threshold for the expected contact duration. Danger of burns can still exist after the heating has been switched off due to slow cooling down.

If the product cannot be moved out of the shrinking zone, e.g. because of energy loss of the conveying system, there is a risk the product will be overheated even after the power supply to the heating has been disconnected. This may damage the product or cause bursts, or spillage of product. In tunnels where the heating medium is air there may be a risk of fire.

4.4.2.2 Gas heating elements

Fire and explosion hazards can be generated,

— by burners of gas heated shrinking systems that do not ignite or work properly after the cycle has started;

— by gas heated shrinking systems when unburned gas escapes.

Generation of carbon monoxide by incomplete combustion may result in intoxication or suffocation.

4.4.2.3 Hazards associated with materials and other substances

Inhalation of gases, vapours, mist or dusts can generate dangers to health. This can be caused by product deposits, release of substances from products or films during the shrinking process, or in case of gas operated shrinking systems, by insufficient combustion or uncontrolled escape of gases. Accumulation of combustion gases can generate a suffocation hazard. A fire hazard exists in case of failure of the control due to overheating of the product if too high temperatures exist due to the failure of the temperature controls.

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4.4.2.4 Hazards generated by noise

Open gas flames or extract ventilation systems can generate noise.

4.4.3 Specific hazards on shrinking frames and shrinking hoods

4.4.3.1 General

The hazards described in 4.2 and in this clause are specifically associated with a shrinking frame and a shrinking hood (see 3.2.6.1).

4.4.3.2 Shrinking frame or hood

On shrinking frames and shrinking hoods crushing and shearing hazards can exist between the vertically moved shrinking hood/shrinking frame and the conveyor, between the vertically moved shrinking hood/shrinking frame and the product as well as between vertically moved parts of the shrinking hood/shrinking frame and fixed machine parts or between moved counterweights and fixed machine parts/substructure. The hazards can still exist after having switched off the power supply due to stored energy.

An impact hazard can be generated by the transported product and the vertically moved shrinking hood/shrinking frame or vertically moved counterweights. Concerning for instance pneumatically driven shrinking hoods/shrinking frames; the impact hazard can still exist after having switched off the power supply due to stored energy.

4.4.3.3 Drives

A drawing-in hazard exists on drive and tail sprockets of chain drives of the vertical drive mechanism of the shrinking hoods/shrinking frames as well as on guide or deflection rollers of the counterweight suspension.

4.4.3.4 Hazards generated by the failure of the power supply

Power failure can generate a fire hazard if the shrinking hood/shrinking frame cannot be moved when the heating is switched on or when there is stored heat. In addition, a crushing, shearing or impact hazard can exist due to uncontrolled lowering of the shrinking hood or shrinking frame or counterweights.

4.4.3.5 Hazards generated by the failure of the control circuit

Failure of the control can generate a fire hazard if, with the heating switched on, the movement of the shrinking hood/shrinking frame is stopped or if there are increased temperatures in the heating system due to a failure of the temperature control.

4.4.4 Specific hazards on shrinking ovens

4.4.4.1 General

The hazards described in 4.2 and in this clause are specifically associated with a shrinking oven (see 3.2.6.2).

This clause describes the hazards on shrinking ovens.

4.4.4.2 Automatic doors

Crushing, shearing and impact hazards can be generated by power driven inlet and outlet doors. In case of lifting doors a crushing hazard exists between door and transporting equipment. Due to stored energy the hazards can still exist after the power supply has been switched off. Power failure can generate a crushing hazard due to power driven lifting doors falling down.

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There is a risk of persons being enclosed inside the shrinking oven with the consequence of burning and mechanical hazards.

4.4.4.3 Thermal hazards

There can be a danger of burns in the shrinking chamber, on the inside of open inlet and outlet doors as well as on the outer surfaces of shrinking ovens if the temperatures exceed the burn threshold for the expected contact duration. The danger of burns can still exist after the heating has been switched off due to slow cooling down.

4.4.4.4 Hazards associated with materials and other substances

A fire hazard can exist if the product remains in the shrinking chamber after having switched off the shrinking oven. If the product cannot be discharged from the shrinking chamber, there can be a fire hazard due to stored heat, even if the heating is switched off. See also 4.2.5.

4.4.5 Specific hazards on shrinking columns

4.4.5.1 General

The hazards described in 4.2 and in this clause are specifically associated with a shrinking column (see 3.2.6.3).

4.4.5.2 Turn table

A crushing or shearing hazard can exist between the immobile product and the rotating shrinking device. An impact hazard is presented by the transported or rotating product or on the rotating shrinking device. In case of power failure, a fire hazard can exist if the rotation of the product or of the shrinking device is stopped while the heating is switched on.

4.4.5.3 Hazards associated with materials and other substances

See 4.4.4.4.

4.5 Auxiliary machines

4.5.1 General

The hazards described in 4.2 and in this clause are specifically associated with auxiliary machines.

4.5.2 Top sheet feeder

4.5.2.1 General

The hazards described in 4.2 and in this clause are specifically associated with a top sheet feeder (see 3.2.7.1).

4.5.2.2 Film reel assembly

See 4.3.2.3. Crushing or shearing hazards are presented by the film roll lifting and feed devices. Due to stored energy these hazards exist still after switching off the power.

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4.5.2.3 Top sheet applicator

Crushing or shearing hazards are present at the telescopic/tensioning frame. Due to stored energy these hazards exist still after switching off the power.

4.5.2.4 Film clamp

See 4.3.2.4.

4.5.3 Product centralising machines

The hazards described in 4.2 and in this clause are specifically associated with product centralising machine (see 3.2.7.2).

A crushing hazard exists between the lateral pushing mechanism and the product. A crushing and shearing hazard exists between moved parts of the centralising mechanism and fixed parts of the machine. For hazards generated by conveyors or a rotary table see 4.2.9.3 and 4.3.2.2.

5 Safety requirements and measures for pallet wrapping machines

5.1 General

This clause details safety requirements and measures appropriate for eliminating or minimizing the hazards, hazardous situations and events described in Clause 4.

Safety requirements that are appropriate for most pallet wrapping machines are listed in 5.2 and safety requirements that are specific to particular types of pallet wrapping machines are listed in 5.3 to 5.5.

Where a machine has hazards that are not described in Clause 4, the manufacturer shall identify appropriate methods of eliminating hazards or minimizing risks by referring to European Standards that are relevant to that hazard.

5.2 General requirements for pallet wrapping machines

5.2.1 General

The following requirements apply to all pallet wrapping machines where the equivalent hazard exists.

5.2.2 Requirements to eliminate mechanical hazards

5.2.2.1 Safeguarding of moving parts

5.2.2.1.1 General

When selecting the most appropriate safeguarding method for each part of a pallet wrapping machine, preference shall be given to eliminating mechanical hazards by design e.g. by limiting the force, power or movement of moving parts. See 5.2.2.1.2.

Where mechanical hazards cannot be eliminated by design, these hazards shall wherever possible be safeguarded using guards that comply with EN 953. The choice of guards shall be guided using Annex A of EN 953:1997+A1:2009.

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5.2.2.1.2 Safety by design

Moving parts can be considered safe by design if the force exerted by the moving parts does not exceed 75 N, the pressure they exert against an object is less than 25 N/cm² and their energy is less than 4 J and the parts do not have sharp edges that may cause cutting or puncturing injuries. If the hazardous movement is automatically reversed within 1 s when resistance is detected, the movement can be considered as safe if the force does not exceed 150 N, the pressure does not exceed 50 N/cm² and the energy is less than 10 J and the parts do not have sharp edges that may cause cutting or puncturing injuries.

Moving parts can also be made safe by design by ensuring sufficient distance between moving and fixed parts and between one moving part and another using the dimensions indicated in EN 349.

Rotating parts, handles or hand-wheels can be considered safe by design provided they are not spoked, have no projections and are smooth. Rotating shaft ends can be considered safe by design provided they are smooth, have no protruding parts and do not protrude from the machine more than ¼ of their diameter or 20 mm whichever is the smaller.

The measures indicated above may not be effective in all circumstances. However subsequent clauses of this standard indicate situations where these measures are known to be effective. Where the measures indicated above are not effective, moving parts should be safeguarded by complying with 5.2.2.1.3 to 5.2.2.1.7.

5.2.2.1.3 Fixed and interlocked guards

Moving parts which cannot be made safe by design shall be safeguarded by fixed or interlocked moveable guards complying with EN 953 and dimensioned and positioned using Table 2 or 4 of EN ISO 13857:2008.

Where open topped distance guards are used they shall be dimensioned and positioned in accordance with Table 2 of EN ISO 13857:2008 and be at least 2 000 mm high from the floor.

The gap, for cleaning, under such distance guards shall be no greater than 240 mm, and the reach distance under the guard to the nearest danger zone shall be at least 850 mm.

Where it is foreseeable that persons will try to put their lower limbs into a machine, guards shall be dimensioned and positioned in accordance with EN ISO 13857.

The design of the guards and the number, size and position of access doors in guards shall ensure that the machine can be operated, cleaned, size changed and maintained easily and safely.

The guards shall be sufficiently robust to retain product or packs that are ejected or fall down and be designed so that fallen or ejected products and packs can be retrieved safely.

Guards that are required to be opened or removed frequently, e.g. access doors for operation, maintenance, cleaning and setting purposes, shall be moveable and interlocked with the machine’s control system. The interlocking devices shall comply with 5.2.2.1.6.

If guards are made of mesh, they shall prevent people reaching danger zones by being positioned according to Table 4 of EN ISO 13857:2008.

5.2.2.1.4 Apertures in guards

Apertures in guards for product entry or discharge shall be positioned and dimensioned to prevent access to danger zones within the machine when standing on the floor or access level and reaching into the aperture.

For these apertures one of the safeguarding methods described in Annex B shall be used.

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5.2.2.1.5 Presence in the danger zone

On machines where the design of guards allows people to be inside the safeguarded area, measures shall be taken to prevent the machine being started while a person is inside the safeguarded area; for example, one of the following methods may be used:

a) positioning the machine's controls in a location where there is a clear view of the interior of the machine or

b) where it is not possible to see the interior of the machine from the control panel, one - or a combination of the following:

   — the provision of close circuit television to give a view of the interior of the machine from the control panel or

   — where access is made through an interlocked door, the design shall ensure that the door cannot close accidentally and initiate hazardous movement of the machine, e.g. using a trapped key system as defined in Annex E of EN 1088:1995+A2:2008 or

   — where it is foreseeable that access may be gained to the danger zone through apertures safeguarded by electro-sensitive protection equipment (ESPE) or through access doors which are not within a distance of 5 m of the operator panel there shall be a control for resetting the ESPE or interlocking system of the access door positioned outside the danger zone near the aperture or access door, but not reachable from within the danger zone. This shall be in addition to the reset function on the machine control panel. Furthermore a sign discouraging access through the aperture safeguarded by an ESPE shall be fitted at the aperture or

   — interlocking devices for automatic detection of persons within the danger zone using devices such as pressure sensitive mats complying with EN 1760-1, floor or volume scanning Active Opto-electronic Protective Devices responsive to Diffuse Reflection (AOPDDR) complying with IEC 61496-3.

5.2.2.1.6 Interlocking devices associated with guards

Moveable guards shall be interlocked with devices that comply with 4.2 of EN 1088:1995+A2:2008 and shall be installed as indicated in Clauses 5 and 6 of that standard. Safety related parts of interlocking systems shall comply with 5.2.8.2.

5.2.2.1.7 Stopping time

Unless otherwise specified in this standard, the machine controls shall ensure that hazardous movements stop before any danger zones can be reached after opening an interlocked guard. Typically this will mean that movement shall stop within 1 s of a guard being opened.

If this requirement cannot be achieved, the guards shall be fitted with guard locking devices which prevent access to the danger zone until the hazardous movement has stopped. The guard locking device shall comply with 4.2.2 of EN 1088:1995+A2:2008 and shall be installed according to 5.5 of that standard.

5.2.2.1.8 Operations with open guards

The design objective shall be for all machine adjustments, maintenance, repair, cleaning and servicing to be carried out while the machine is isolated from all power sources or from outside the danger zones.

However if this objective cannot be achieved for technical reasons, operations with open guards are permissible where hazardous movements of moving parts may take place, when initiated by an operator using a hold-to-run control device, but only if all of the following requirements are fulfilled:

a) the design of the guards and control system shall minimise the risks of injury to the operator and other persons in the vicinity of the machine;

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b) a hold to run control device shall be positioned in such a way that the operator has a clear view of all the parts of the machine where movement is taking place;

c) the hold to run function shall only be available after a lockable mode selection device, e.g. a key operated switch, is operated. Operation of this device shall prevent the machine from operating in automatic mode;

d) if it is necessary to carry out powered movements with certain interlocked guards open, all other interlocked guards which would allow access to danger zones and are not within a clear view of the operator shall continue to be interlocked as during normal operation;

e) wherever possible the control system shall ensure that movements initiated by the hold to run control are limited e.g. step by step, or at a reduced speed or with reduced power;

f) the movement shall stop as quickly as possible, at least within 0,5 s after the hold to run control has been released;

g) release of the hold to run control button shall lead to a safe stop and prevent unexpected start up. See 5.2.3.1.4;

h) an emergency stop actuator complying with 5.2.3.1.8 shall be mounted next to the hold to run controls.

5.2.2.2 Pneumatic and hydraulic equipment

All pneumatic components and piping shall conform to the requirements of EN ISO 4414. All hydraulic components and piping shall conform to the requirements of EN ISO 4413.

Where safety functions are controlled through hydraulic or pneumatic systems, these circuits shall comply with the requirements of 5.2.3.1.4, and 5.2.8.2. Unexpected start-up shall be prevented using the measures described in EN 1037.

A separate means of isolation shall be provided for each type of energy, which is readily identifiable and accessible. Isolation valves shall be clearly labelled to indicate the method of operation of the valve and shall have the facility to be locked in the off position as described in 5.4.7.2.1 of EN ISO 4413:2010 and in 5.2.8 of EN ISO 4414:2010.

Where the machine is designed to pack agri-foodstuffs or other products where contamination is a significant risk, the design shall ensure that hydraulic oil or pneumatic lubricating oil cannot come into contact with the product.

5.2.2.3 Requirements to prevent slip, trip and fall hazards

5.2.2.3.1 Measures to minimize slip hazards

The design of the machine shall minimise the risk of liquids or solids spilling onto traffic routes, work stations or means of access around the machine. Where spills cannot be prevented the manufacturer shall supply a means of containment for the spill e.g. drip trays and describe the most appropriate method for removing the spillage in the instructions for use.

5.2.2.3.2 Measures to minimize trip hazards

The design of the machine should avoid assemblies at low level that are likely to pose a trip hazard. Where this is not possible, the manufacturer shall provide railings or some other form of barrier, which guides people away from the trip hazard.

The manufacturer shall describe, in the instructions for use, how cables and pipes associated with the machine should be supported so they do not create a trip hazard.

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5.2.2.3.3 Measures to minimize fall hazards

Where reasonably practicable the design of the machine shall allow it to be operated, cleaned and maintained from floor level. If this is not reasonably practicable the following requirements shall apply:

a) where a means of access is required for operation or cleaning or routine maintenance of the machine the manufacturer shall provide a means for safe access with the machine;

b) where access is required for any other purpose above floor level, the manufacturer shall specify the appropriate safe means of access and the related installation requirements in the instructions for use.

Permanent means of access shall comply with 5.2 of EN ISO 14122-1:2001. Stairs, ladders or platforms that form this permanent means of access shall conform to EN ISO 14122-2, EN ISO 14122-3 and EN ISO 14122-4.

5.2.2.4 Stability of machines

5.2.2.4.1 Stability during operation

The machine shall be designed and constructed so that it is stable during normal use and foreseeable abnormal situations.

The manufacturer shall state in the instruction handbook if the machine shall be anchored to the floor or to another machine before use and give detailed information about the methods and means of anchorage.

On machines fitted with wheels, at least two wheels shall be fitted with locking devices to ensure that the machine does not move unexpectedly when it is in use.

If it is foreseeable that someone will stand on the machine, the manufacturer shall design the machine or its fixings to ensure stability in this situation.

5.2.2.4.2 Stability while being moved

The manufacturer shall provide information in the instruction handbook on how to move the machine safely.

Machines fitted with wheels shall be designed so that they are stable when they are placed on a 10° slope in any orientation.

5.2.2.5 Moveable guards

Moveable guards and guards that move under power, gravity or stored energy shall comply with EN 953 and shall not give rise to any additional risk (see 5.2.2.1.2).

5.2.3 Electrical requirements

5.2.3.1 Electrical equipment

5.2.3.1.1 General

Electrical equipment shall comply with EN 60204-1. In the places where EN 60204-1 provides various options, the options stated below shall be used.

5.2.3.1.2 Supply disconnecting device

The machine shall be equipped with a readily identifiable and accessible supply disconnection device which complies with 5.3.2 of EN 60204-1:2006.

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5.2.3.1.3 Excepted circuits

Some circuits, e.g. machine lighting circuits, do not need to be disconnected by the supply disconnection device. Circuits that do not have to be disconnected are listed in 5.3.5 of EN 60204-1:2006. Those circuits that are not disconnected by the main supply disconnecting device shall each have their own supply disconnecting device, and be fitted with the labels and warning symbols described in 5.3.5 of EN 60204-1:2006.

5.2.3.1.4 Prevention of unexpected start up

Devices to prevent unexpected start up shall be selected from 5.4 of EN 60204-1:2006 and shall be designed so that they can be locked in the off position or disconnected state. The design of the controls shall comply with EN 1037.

The control system shall be designed so that it does not start unexpectedly e.g. under the following conditions:

a) as a result of a signal generated by a sensor (except when in automatic mode) and

b) by closing an interlocked guard (unless it is a control guard) and

c) by restoring the power supply after an interruption.

5.2.3.1.5 Protection against electric shock

Electric shock by direct contact shall be prevented by choosing one of the methods described in 6.2 of EN 60204-1:2006 and electric shock by indirect contact shall be prevented by choosing one of the methods described in 6.3 of that standard.

5.2.3.1.6 Degree of protection

The protection level for electrical enclosures shall be selected on the basis of the environment in which the machine will be used and the anticipated cleaning method for the machine and its environment. See 11.3 of EN 60204-1:2006. Examples of suitable protection levels as defined by EN 60529 are given in Table 1 and Table 2.

Table 1 —Degree of protection for dusty environments

Dusty environment	Required degree of protection (EN 60529)
Non conducting dusts	IP 5X
Conducting dusts	IP 6X

NOTE Other measures will be needed if the equipment is expected to be working in a potentially explosive atmosphere.

Table 2 — Degree of protection for different cleaning methods using water

Method of cleaning	Required degree of protection (EN 60529)
Cleaning without water	IP X3
Cleaning with damp cloth	IP X4
Cleaning with low pressure water	IP X5
Cleaning with medium pressure water	IP X6

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If fluids other than water are used for cleaning, these IP ratings may not be appropriate and additional protective measures may be necessary.

If fluids other than water are used to clean the machine, the level of protection provided by an electrical enclosure may reduce in the course of time. The manufacturer shall take this into account by choice of materials, by construction and in the maintenance instructions.

5.2.3.1.7 Safety related stop function

Safety related stops shall be stops of category 0 or 1 as defined in 9.2.2 of EN 60204-1:2006.

5.2.3.1.8 Emergency stop

Unless otherwise specified in the sub-clauses 5.3 to 5.5, machines shall be provided with an emergency stop button located on each control station. The emergency stop function shall comply with 9.2.5.4.2 of EN 60204-1:2006. It shall function as a category 0 or category 1 stop according to 9.2.2 of EN 60204-1:2006. The emergency stop device shall comply with EN ISO 13850.

On machines with electronic drives, the actuation of an emergency stop control device may, contrary to the requirements of 9.2.5.4 of EN 60204-1:2006, initiate a category 2 stop as defined by 9.2.2 of EN 60204-1:2006 provided that the requirements of 5.2.8.3 are satisfied.

Sufficient emergency stop actuators shall be provided so that a person has to walk no further than 5,0 m to find an emergency stop actuator.

5.2.3.2 Electrostatic phenomena

On pallet wrapping machines where hazards may arise from the generation of static electricity, the manufacturer shall provide sufficient earth bonding or static elimination equipment to ensure that hazardous levels of static electricity do not occur.

5.2.4 Thermal hazards

The external temperature of exposed parts of the machine, e.g. guards, control panels and electric motors, shall not exceed a temperature that will cause an injury from burning. For bare metal the temperature shall be no higher than 65 °C for contact times less than 1 s. See EN ISO 13732-1 for details of the burn thresholds for other materials or longer contact times.

Where the machine includes parts with a temperature greater than the burn thresholds described in EN ISO 13732-1, the manufacturer shall minimise the risk of accidental contact e.g. by fitting insulation or safeguarding against unintentional contact and by fitting the warning sign No. 5041 "Caution, hot surface" of IEC 60417DB-12M:2002 on the outside of the machine or adjacent to the hot parts (see Figure 20 — Warning sign "Caution, hot surface"). The size, shape and colour of the warning sign shall comply with Table 2 of EN 61310-1:2008.

If having taken these measures, there is a residual risk of touching hot surfaces this shall be stated in the instruction handbook together with the measures which can be taken to avoid burn injuries, e.g. wearing gloves or other personal protection equipment.

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Figure 20 — Warning sign "Caution, hot surface"

5.2.5 Noise reduction

The main sources of noise on pallet wrapping machines are:

a) drive mechanisms;

b) vacuum pumps;

c) compressed air exhaust;

d) products (e.g. glass bottles and cans) hitting against each other;

e) packaging materials, e.g. unreeling film;

f) mechanisms hitting against each other, e.g. during the welding process.

Pallet wrapping machines shall as far as is reasonably practicable be designed to reduce noise at its source.

Measures to eliminate or reduce noise at source include the following:

i) installing acoustic absorptive materials on the inside of machinery casings or encasing power transmission components in acoustic absorptive material;

ii) designing mechanisms so that they do not hit against each other;

iii) use of damping materials on vibrating or impacted metal surfaces;

iv) fitting air exhausts with silencers;

v) using rubber rollers;

vi) use of vibration isolators;

vii) fitting partial or full acoustic enclosures;

viii) reducing the running speed of the machine or auxiliaries;

ix) use of helical instead of straight cut gears;

x) using timing belts instead of chains.

Additional design measures can be found in EN ISO 11688-1.

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The criterion for assessing the efficiency of noise reduction measures is the actual noise emission values of the machine and not the nature of the reduction measure itself.

5.2.6 Measures to control hazards generated by products and materials

5.2.6.1 Measures to control hazards generated by products

Where a machine is designed or specified to pack products that are hazardous to health or safety, the manufacturer shall:

1) identify the nature of the hazard and methods for controlling the hazard;

2) design a safe system for handling the product and minimising the risk of damaging hazardous products e.g. by limiting the force or torque, or by fitting shear pins or sensors

   a) if hazardous substances are likely to be discharged from the machine the manufacturer shall design the machine in accordance with EN 626-1 and EN 626-2;

   b) if the machine is intended to handle a combustible product, the manufacturer shall design the machine following the principles of EN 13478;

   c) if harmful biological substances are likely to be discharged from the machine the manufacturer shall design the machine in accordance with EN 626-1 and EN 626-2;

   d) on machines where the hazard is from falling or ejected packs or products, the manufacturer shall provide guards that will contain these packs or products;

3) supply any necessary ancillary equipment e.g., dust, aerosol or fume extraction or monitoring devices;

4) provide information on how to install the ancillary equipment and operate, clean and maintain the machine without risks to health or safety.

If the manufacturer is unable to obtain information about the products that will be packed by the user, the manufacturer shall state clearly in the instructions for use the intended use of the machine including the products that may be packed and the products that shall not be packed with the machine. The manufacturer shall give clear information about the hazards arising from products that are not allowed to be packed by the machine.

Where there is a risk of impact or crushing by ejected products, e.g. by falling from stacks or by tilting over, the manufacturer shall reduce this risk e.g. by a sensor control or alignment of the product before initiating the wrapping process or by holding the product by hold down devices initiating the wrapping process.

5.2.6.2 Measures to control hazards generated by packaging materials

Where a machine is designed or specified to use packaging materials that are hazardous to health or safety, the manufacturer shall:

1) identify the nature of the hazard and methods for controlling the hazard;

2) design a safe system for handling the packaging material using relevant standards, for example:

   a) on machines using materials that can give off fumes hazardous to health, e.g. polyester limit the temperature of heating devices so that fumes are not generated, e.g. below 250 °C. If this cannot be done provide fume extraction equipment as described in 3);

   b) on machines using packaging materials that produce excessive amounts of dust provide dust extraction equipment as described in 3);

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c) on machines using materials with sharp edges, which can cause cut injuries guard exposed edges on the machine against accidental contact and recommend the use of gloves when handling the material in the instructions for use;

d) on machines using materials that catch fire if overheated, the design of the control system shall minimise the risk of the packaging material catching fire. This may involve designing the control system so that the heated sealing devices do not remain in contact with the packaging material when the machine is stopped;

e) on machines handling glass containers the design shall ensure that people are protected from broken or flying glass;

f) on machines using packaging materials that can generate electrostatic charges provide suitable earth bonding and static elimination equipment;

3) supply any necessary ancillary equipment e.g., dust, or fume extraction equipment designed in accordance with EN 626-1 and EN 626-2;

4) provide information on how to install the ancillary equipment and operate, clean and maintain the machine without risks to health or safety.

5.2.7 Ergonomic design principles

5.2.7.1 Operating the machine

Controls and control panels shall be positioned according to the requirements of EN 614-1. The indicators and actuators shall comply with EN 894-1, EN 894-2, EN 894-3, EN 61310-1 and EN 61310-3. Indication lights fitted to the machine shall comply with the requirements of 10.3.2 and 10.3.3 of EN 60204-1:2006.

5.2.7.2 Loading packaging materials

The position of mechanism such as magazines for blanks and reel unwind mechanisms shall be carefully designed to avoid bad posture or excessive effort that can cause injury. The design shall comply with EN 614-1, EN 614-2 and EN 1005-3 and further information is given in EN 1005-2 and EN 1005-4.

Examples for prevention of skeletal or muscular injuries are:

a) film reel assemblies which move automatically to a favourable loading position;

b) provision of suitable lifting or transport aids.

5.2.7.3 Loading or unloading products

On machines that are fed or unloaded by hand, the design of the hand feeding area shall use the ergonomic design principles indicated in EN 1005-3 to minimise the risk of muscular or skeletal injuries.

Examples for prevention of skeletal or muscular injuries are:

a) limitation of the weight of the product (in case of manual feeding);

b) provision of suitable lifting aids.

5.2.7.4 Cleaning the machine

The parts of the machine, which shall be reached for cleaning or retrieving fallen packs and products, shall be easily accessible. This may involve designing the machine so it can be cycled to a position where cleaning can be carried out without the risk of injury.

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5.2.7.5 Maintenance

The design of the machine shall minimise the risk of physical strain when carrying out maintenance.

5.2.7.6 Moving the machine

The manufacturer shall provide instructions on how to move the machine safely in the instruction handbook. Where machines are equipped with wheels the manufacturer shall ensure that the machine can be moved without the need for excessive effort.

5.2.8 Requirements to prevent hazards caused by failures

5.2.8.1 Power supplies

The design of the machine shall ensure that the interruption and re-establishment after an interruption of the machine's power supplies does not lead to a dangerous situation.

Where the failure of a power supply can lead to packs or products falling down e.g. from a vacuum pick and place mechanism, the design of the machine shall ensure that the falling items do not cause injuries e.g. by guarding the area where the items might fall.

The uncontrolled lowering or falling of mechanisms can be prevented for example by:

a) a self-locking construction;

b) automatically acting fall restraint devices;

c) back up power supplies or compressed air vessels.

5.2.8.2 Safety related parts of control systems

Unless stated otherwise in this standard or indicated by the risk assessment of safety related parts of the control system, which should include an assessment of the contribution that the safety related parts of the control system make to risk reduction, the following minimum requirements apply:

a) on the hydraulic/pneumatic control system, the safety-related parts shall comply with at least category 1 of EN ISO 13849-1:2008;

b) non-programmable electrical and electronic safety-related parts shall comply with at least category 1 of EN ISO 13849-1:2008;

c) electro sensitive protective equipment (ESPE) shall conform with EN 61496-1:2004 type 2 or type 4, depending on the risk assessment, and shall be positioned in accordance with EN ISO 13855, to ensure that any hazardous movement has been stopped before the operator reaches the danger zone;

d) computers, programmable logic control and other programmable devices used to perform safety functions shall be designed and specified in accordance with EN 61508-1, EN 61508-2 and the software for these devices shall be written in accordance with EN 61508-3. Applications in machinery shall comply with at least SIL 1 of EN 62061:2005.

NOTE In a large number of machine specific standards ("C" type standards in CEN) risk estimation has been carried out to select a required category in accordance with 6.2 of EN ISO 13849-1:2008 for safety-related parts of machine control systems. Presently, it is noted that, for simplification, the following relationships are used: required category 1 to required SIL 1, required category 2 to required SIL 1, required category 3 to required SIL 2 and required category 4 to required SIL 3.

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e) Hydraulic and pneumatic two-hand controls, shall comply with type III A, and electric/electronic two-hand controls shall comply with type III B of EN 574:1996+A1:2008 and type III of EN 60204-1:2006. Two-hand-controls shall be positioned in accordance with EN ISO 13855, to ensure that any hazardous movement has been stopped before the operator reaches the danger zone.

5.2.8.3 Motor drive systems

5.2.8.3.1 General

Where hazardous movement of machinery is controlled by servo, rectifier, inverter or similar electronic drive systems, the design of the safety related parts of the control system shall prevent unexpected start up when the hazardous movement is not safeguarded during short term interventions e.g. the removal of damaged packs or materials during normal operation.

Where the safety related pulse blocking, monitoring or control functions are achieved with non-programmable electrical or electronic control systems, they shall comply with the requirement of category 3 of EN ISO 13849-1:2008. Where computers, programmable logic controls or other programmable control devices are used to implement this safety function, the safety integrity level shall be SIL2 as defined by EN 62061:2005.

The following are examples of methods of preventing hazards from moving parts for short duration interventions.

5.2.8.3.2 Galvanic disconnection

The power supply to the electrical actuators that create hazardous movement is removed by hardwired means that achieve galvanic disconnection when the interlocked guards are opened.

The positioning of the main contactor in the power circuit before or after the drive shall take full account of electromagnetic compatibility and dc switching constraints as well as the need to ensure any stored energy if the drive is discharged before the safe state is achieved.

The switching of the main contactor shall be monitored by a system complying with category 2 of EN ISO 13849-1:2008. Any malfunction of the contactor shall lead to a stop complying with to 5.2.3.1.8 and, where the drive cannot stop in less than 0,5 s, to mechanical braking.

NOTE An example of this is an interlocking guard with guard locking, where a guard remains locked following a stop command until the servomotor achieves its set point. Once the set point has been achieved the guard is unlocked by the control system and the motor drive then achieves or maintains a safe condition through galvanic disconnection by a main contactor when the guard is opened.

5.2.8.3.3 Safe pulse blocking

In safe pulse blocking the power supply remains connected to the motor, but the drive is preventing movement by inhibiting the generation of pulses to the drive power semiconductor while the guards are open.

Safe pulse blocking shall be achieved by galvanic disconnection of the power supply of either the pulse amplifier or the opto coupler of each power semiconductor once the drive has come to a standstill.

5.2.8.3.4 Position monitoring

In position monitoring both the power supply and the control signal remain connected to the motor, but the movement or position of the motor is monitored to ensure that it remains in a safe position. If aberrant movement is detected while the guards are open, the power supply to the motor is disconnected by galvanic disconnection.

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Where position monitoring is used the control system shall ensure that any aberrant movement is detected and halted before the movement can create a hazard and any stored energy in the drive controller is discharged.

5.2.8.3.5 Mechanical brake

The motor is fitted with a mechanical brake that is applied automatically when the interlocked guards are open and prevents the motor from moving even if power is supplied to the motor and pulses are generated.

The braking torque of the mechanical brake shall be greater than the maximum torque that the drive can generate.

5.2.8.3.6 Limitation of use

The methods of preventing the unexpected start-up of drives described above are only suitable for short duration machine interventions and are not a substitute for safe isolation procedures.

The manufacturer shall ensure that the instruction handbook emphasises this point and indicates how the drive shall be isolated for other interventions e.g. maintenance or cleaning.

5.2.9 Hygienic design requirements

When a packaging machine is designed or specified to pack agri-foodstuffs or other products where hygiene is an issue, the manufacturer shall:

1) identify the level of hygienic design appropriate for the product. When the machine manufacturer is unable to find this information, he shall define the limitation of use for the machine and clearly state this in the instructions for use; e.g. “This machine has been designed to pack agri-foodstuffs with the following attributes: ...”;

2) following the requirements of EN 1672-2 design a safe system for handling the product. Design features will include:

   a) use of appropriate contact materials;

   b) measures to prevent lubricating oils coming into contact with the product e.g. fitting filters to compressed air exhausts;

   c) food and splash areas (as defined in Clause 3 of EN 1672-2:2005+A1:2009) which are free from crevices and ledges;

   d) food and splash areas that can be easily cleaned and inspected for cleanliness;

3) describe appropriate cleaning and disinfecting procedures for the machine in the instructions for use.

5.2.10 Requirements for mechanisms used on most pallet wrapping machines

5.2.10.1 Cutting devices

The hazards presented by cutting devices described in 4.2.9.1 shall be prevented or reduced by complying with the following requirements:

a) the device shall be safeguarded with fixed or interlocked guards complying with 5.2.2.1 and;

b) the design shall ensure that the cutting device cannot move unexpectedly due to stored energy and;

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c) the design shall minimise the risk of injury during film threading or size changing e.g. by designing the cutting mechanism so that the cutting surfaces are protected when the machine stops and;

d) the cutting tools shall be designed or provided with auxiliary devices so that they can be installed and removed from the machine without any danger. Auxiliary devices may include handles, clamping devices, gripping or holding tools.

5.2.10.2 Sealing devices

The hazards presented by sealing devices described in 4.2.9.2 shall be prevented or reduced by complying with the following requirements:

a) the device shall be safeguarded with fixed or interlocked guards complying with 5.2.2.1 and

b) the design shall ensure that the sealing device cannot move unexpectedly due to stored energy.

Where sealing mechanisms are heated, the hazards described in 4.2.9.2 shall be prevented or reduced by complying with the following requirements:

i) thermal hazards shall be reduced as described in 5.2.4. It is acceptable for power to remain connected to heating elements while guard doors are open provided the instructions detail those circuits that will remain connected and the parts of the machine that can cause burn injuries and

ii) the design of the control system shall minimize the risk of the packaging material catching fire. This may involve designing the control system so that the heated sealing devices do not remain in contact with the packaging material when the machine is stopped and

iii) to minimise the risk of electric shock if the electrical insulation of heating elements breaks down, use methods indicated in 5.2.3.1.5 or the heating circuit voltage shall not exceed 50 V AC or 110 V DC and

iv) where the fumes given off by heated packaging material could be hazardous to health the design shall comply with 5.2.6.2.

5.2.10.3 Conveyors

5.2.10.3.1 Pallet chain conveyors

Pallet chain conveyors shall comply with the relevant safety requirements of EN 619. Where fixed or interlocked guards are used to safeguard danger zones on conveyors they shall comply with 5.2.2.1.3.

5.2.10.3.2 Roller conveyors

Roller conveyors shall comply with the relevant safety requirements of EN 619. Where fixed or interlocked guards are used to safeguard danger zones on conveyors they shall comply with 5.2.2.1.3.

Where low level conveyors are likely to be used as a means of access to the machine, e.g. for maintenance or cleaning of the machine, the design of the conveyor shall minimise the risk of slipping, tripping or falling e.g. by fitting non-slip plates between the rollers. These measures shall not create new hazards, e.g. drawing-in. The gap between rollers and plates shall not be greater than 5 mm.

5.2.10.4 Drive systems

Where drive systems cannot be designed safe as described in 5.2.2.1.2, they shall be safeguarded as described in 5.2.2.1.3 to 5.2.2.1.8.

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5.3 Safety requirements for pallet wrapping machines

5.3.1 General

The requirements and measures detailed in 5.2 and described in this clause apply to a pallet wrapping machine where the equivalent hazards exist.

5.3.2 Rotary table machines and spiral pallet wrapping machines

5.3.2.1 Rotary table

5.3.2.1.1 Manual and semi automatic machines

All the following points shall be fulfilled:

- The design of the machine shall ensure that the distance between the outer edge of the product and any machine parts is not less than the minimum gap to avoid crushing of the whole body stated in Table 1 of EN 349:1993+A1:2008.
- To prevent the crushing hazard between the rotated product and fixed parts or other obstructions in the vicinity of the machine, the manufacturer shall give detailed information in the instruction manual, to achieve minimum gaps in accordance with EN 349 for the whole body.
- To prevent any impact, the turntable shall be sufficiently large to ensure that the product does not overhang the turntable.
- To minimise the risk of the product/parts of the product being ejected, acceleration and speed of the rotary table shall be limited or adjustable according to the expected friction forces. Alternatively the product shall be fixed by a hold down device complying with 5.3.2.5. The instruction manual shall give detailed information about positioning the product on the rotary table and, if necessary, limitation of acceleration and speed.
- The instruction handbook shall state the use of foot protection.
- The rotary table shall not be freely rotatable during loading and uploading. When not driven, rotation of the table shall be prevented by the resistance in the table drive or a mechanical brake shall be provided.
- The construction shall ensure that there are no protruding parts or gaps on the rotary table which can present an entanglement hazard. If this is not possible the machine shall be safeguarded in accordance with 5.2.2.1.
- The circumferential speed of the table shall not exceed 1,1 m/s.

A guard ring shall be fitted around the rotary table and the gap between the rotary table and the guard ring or the ramp, if fitted, shall not exceed 5 mm. Provisions shall be made to allow the ramp to be fixed to the machine correctly and associated information shall be given in the instruction manual.

On machines with ramps for loading the pallet e.g. with a low lift platform truck, the angle of inclination of the access ramp shall not exceed 5°.

On rotary table machines with apertures in the table for loading the pallet e.g. with a pallet truck, the guard ring shall be sloped at the in-running side with an angle not greater than 30° and the surface shall be smooth during the lifetime of the machine. In addition an ESPE, complying with 5.2.8.2, shall be positioned at the aperture which stops the rotation if an obstacle is detected. See Figure 21.

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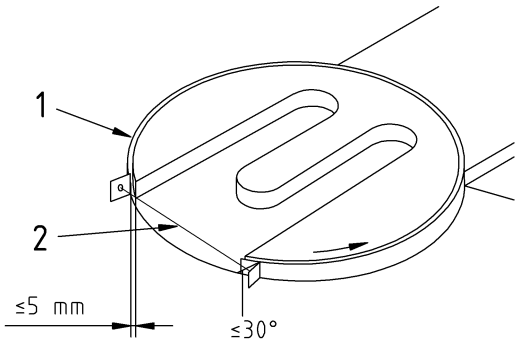

Key

1 rotary table frame

2 additional ESPE

Figure 21 — Semiautomatic or manual rotary table machines with apertures in the table

On manual machines the distance between the operating panel and the rotary table shall be at least 1 200 mm.

On semi automatic machines:

a) an acoustic signal shall warn the operator and persons in the vicinity of the machine of impending start-up. The time between the signal and the start of the machine shall ensure that persons can leave the danger zone. The instruction handbook shall detail the actions which are required when the warning signal sounds;

b) the start of the wrapping process shall only be possible if a height sensor detection detects a product on the table and the film is in a stretched condition at the same time;

c) a warning notice shall be fitted visible from the operator's position warning of starting the machine while other persons are in close proximity to the machine. This shall also be stated in the instruction handbook.

5.3.2.1.2 Automatic machines

Automatic machines shall be safeguarded in accordance with 5.2.2.1.

During transport and wrapping the product shall be secured by a hold down device complying with 5.3.2.5, if there is a risk of the product falling.

5.3.2.2 Film reel assembly and film feeding

The hazards presented by film reels described in 4.3.2.3 shall be minimised by complying with the following requirements;

a) the design of the film reel support assembly shall ensure that the film reel does not move uncontrollably during all modes of operation of the machine. To prevent loosening of the film reels, they shall be secured in the fixture using a positive fastening element, e.g. a cotter pin or locknuts and

b) the drawing-in hazard on machines with high mass reels shall be prevented by safeguarding according to 5.2.2.1 or by the methods described in e) and

c) where the film edge presents a cutting hazard the film path shall be enclosed with fixed or interlocked guards complying with 5.2.2.1.3 and

d) the design shall ensure that, if the film is threaded manually, the power is removed and

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e) where film rollers cannot be made safe by design using the measures indicated in 5.2.2.1.2 they shall be enclosed in fixed or interlocked guards complying with 5.2.2.1.3. Drawing in at or between feed or control rollers shall be prevented by safeguards, e.g. by a length of angled section material. The maximum distance between the safeguard and the roller shall not exceed 4 mm (see Figure 22) and

f) where the film braking or compensating mechanism cannot be made safe by design using the measures indicated in 5.2.2.1.2 it shall be safeguarded by fixed or interlocked guards complying with 5.2.2.1.3.

As an alternative the film reel assembly shall be safeguarded by an interlocked guard, complying with 5.2.2.1.3, enclosing the whole assembly within the complete length of travel of the film reel assembly. The aperture for the film exit shall be dimensioned according to Table 4 of EN ISO 13857:2008.

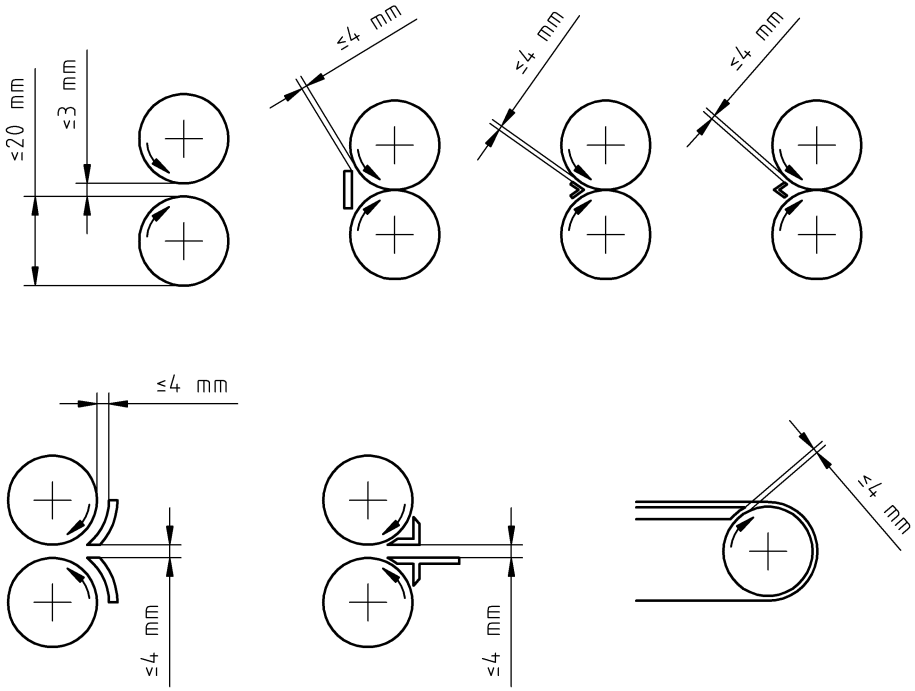

Figure 22 — Methods for safeguarding of film rollers

5.3.2.3 Lifting mechanism

To prevent the lifting mechanism from uncontrolled lowering during operation e.g. by loss of the energy supply, a self locking drive or other methods to this effect shall be used if the machine is not safeguarded (e.g. semi automatic machines).

To prevent the lifting mechanism from uncontrolled lowering during maintenance these operations shall be possible at the lowest position of the lifting mechanism or provisions shall be made for fixing the mechanism positively e.g. by a bolt.

On semi automatic machines the movable film reel assembly shall be fitted with pressure sensitive edges complying with EN 1760-2 mounted on the lower side of the assembly or a pressure sensitive plate or mat complying with EN 1760-1 shall be installed under the film reel assembly which stops – and, if necessary, reverses – the hazardous movements when an obstacle is detected. Alternatively a hold-to-run actuator positioned at a distance of at least 1 200 mm of the outer edge of the device and where there is a clear view to the danger zone, shall be used.

As an alternative the lifting mechanism shall be safeguarded by an interlocked guard, complying with 5.2.2.1.3, enclosing the whole assembly within the complete length of travel of the lifting mechanism.

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5.3.2.4 Film clamp

When film clamps cannot be made safe by design according to 5.2.2.1.2, they shall be safeguarded by fixed and interlocked guards complying with 5.2.2.1.3.

5.3.2.5 Hold down device

For measures against uncontrolled lowering of the hold down device see 5.2.3.1.4.

Falling down of the hold down device shall be prevented by electrical and mechanical position limiters.

Maintenance shall be possible at the lowest position of the hold down device or it shall be possible to fix the hold down device positively, e.g. by a bolt.

On automatic machines, the hold down device shall be safeguarded by guards according to 5.3.2.1.2.

On manual and semi-automatic machines, where the hold down plate is not behind guards, the crushing hazard between the hold down plate and product shall be minimised by

— fitting a layer of resilient material, e. g. foam, at least 50 mm thick to the lower surface of the hold down plate such that the pressure is reduced to a maximum of 25 N/cm² at maximum pressing force or

— the detection of an obstacle between product and plate (e.g. by detecting tilting of the plate) shall result in a safe stop. A failure in the detection system shall also lead to a safe stop. The detection shall be performed by safety related parts complying with 5.2.8.2 and the values stated in 5.2.2.1.2 shall not be exceeded until the distance of the hold-down plate from the product is 4 mm or less. After the stop there shall be a means to ensure that a trapped person can be released, e.g. by automatic reversal of the movement.

— moving the hold-down device using a hold-to-run actuator positioned at least 1200 mm from the outer edge of the device and where there is a clear view to the danger zone.

The minimum distance between hold down plate and turntable shall not be less than 500 mm.

5.3.2.6 Conveyor

See 5.2.10.3.

5.3.2.7 Top sheet feeder

See 5.5.2

5.3.3 Rotary arm machines and ring machines

5.3.3.1 Rotary arm

Automatic rotary arm machines shall be safeguarded complying with 5.2.2.1 and the product shall be fixed by a hold down device complying with 5.3.2.5.

5.3.3.2 Semiautomatic rotary arm machines

Where the machine is not enclosed by guards the impact and crushing hazard presented by the rotary arm shall be minimised as follows:

At the lower end of the rotary arm, forward in sense of rotation, there is mounted a flexible shackle with a reflector. The shackle rotates with the arm with a maximum distance of 20 mm to the floor/ground plane. On the upper side of the arm there is mounted an ESPE complying with 5.2.8.2c). Dimensions of the shackle and

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its distance to the hazardous parts of the arm shall comply with EN ISO 13855. When the shackle hits an obstacle the light beam is interrupted by deflection of the shackle and a safety stop of the machine is initiated.

The interlocking device may also be a pressure sensitive bar complying with EN 1760-2 which is mounted in front of the rotary arm and is as high as the rotary arm.

The machine shall stop when an obstacle is detected and the values stated in 5.2.2.1.2 shall not be exceeded by the interlocking system or other machine parts.

5.3.3.3 Film reel assembly

See 5.3.2.2.

5.3.3.4 Lifting mechanism

See 5.3.2.3.

5.3.3.5 Film clamp

See 5.3.2.4.

5.3.3.6 Hold down device

See 5.3.2.5.

5.3.3.7 Top sheet feeder

See 5.5.2

5.3.4 Banding machines and curtain stretching machines

5.3.4.1 General – Falling product

Where hazards are presented by falling product, the manufacturer shall provide means to hold the product safely and/or the acceleration of the conveyor shall not exceed values which can cause product falling. See also 5.2.6.

5.3.4.2 Film reel assembly

See 5.3.2.2.

5.3.4.3 Top sheet feeder

See 5.5.2.

5.3.4.4 Sealing and cutting device

See 5.2.10.1 and 5.2.10.2.

5.3.5 Hood application machines and hood stretching machines

5.3.5.1 Hood application mechanism

Hood application machines and hood stretching machines shall be safeguarded complying with 5.2.2.1.

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5.3.5.2 Tube film reel assembly

For measures at the tube film reel assembly with tube opening mechanism and tube placement mechanism see 5.3.2.2.

5.3.6 Semi automatic self driving pallet stretch wrapping machine

An interlocked flexible bumper shall be fitted to the front side of the mobile machine. The contact force while activating the bumper shall not exceed 140 N. The bumper shall detect the presence of an object e.g. a person, so that the machine can be stopped within 0,5 s. The detection capability of the bumper shall cover any position of approach in a forward direction likely to cause significant injury, especially while the machine is turning around a corner. The interlocking system required to stop the mobile machine shall comply with 5.2.8.2.

The distance between the bumper and the floor shall not exceed 15 mm. The bumper shall have a shape that prevents stepping between the bumper and the machine frame which would e.g. cause an impact hazard and a drawing-in hazard at the front wheels. Apertures and related distances to the danger zones shall comply with the appropriate table(s) of EN ISO 13857.

The wheels of the stretch wrapping machine shall be positioned within the outer envelope of the machine and be safeguarded. The distance between wheels and guard/machine frame shall be at least 25 mm. The distance of the machine frame in front of the wheels to the floor shall not exceed 15 mm.

The force exerted by the contact wheel or other machine parts shall not exceed 140 N within the stopping time. For measures against loss of stability see 5.2.2.4. For prevention of hazards by the film reel assembly see 5.3.2.2 and for the lifting mechanism see 5.3.2.3.

The maximum speed of the semi automatic self driving pallet stretch wrapping machine shall not exceed 1,33 m/s.

5.3.7 Mobile stretch wrapping machine

Rotary arm:

At the lower end of the rotary arm, forward in sense of rotation, there is mounted a flexible shackle with a reflector. The shackle rotates with the arm with a maximum distance of 20 mm to the floor/ground plane. On the upper side of the arm there is mounted an ESPE complying with 5.2.8.2c). Dimensions of the shackle and its distance to the hazardous parts of the arm shall comply with EN ISO 13855. When the shackle hits an obstacle the light beam is interrupted by deflection of the shackle and a safety stop of the machine is initiated.

The machine shall stop when an obstacle is detected and the values stated in 5.2.2.1.2 shall not be exceeded by the interlocking system or other machine parts.

For measures against loss of stability see 5.2.2.4. If swivel arms are used for stabilisation, the machine shall only be able to operate when the arms are in the correct position.

5.4 Safety requirements for shrinking systems

5.4.1 General

The requirements and measures detailed in 5.2 and described in this clause apply to a pallet shrinking system where the equivalent hazards exist.

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5.4.2 Common requirements for shrinking systems

5.4.2.1 Thermal hazards

For thermal hazards arising from hot surfaces or heat sources of the shrinking systems see 5.2.4.

Thermal hazards by hot surfaces of the product leaving the shrinking system shall be avoided by a cooling system or the dimensions of the safeguards so that the temperature does not exceed the limits given in EN ISO 13732-1 when contact is possible.

Surfaces which are designed to be handled shall not exceed 43 °C.

If necessary cooling systems shall be incorporated to ensure that the burn threshold is not exceeded by the package or by parts of the conveying system.

Where it is necessary to prevent fire or overheating of the conveyor, a run-down function shall be implemented which keeps the conveyor running for a pre-determined period after the heating system has been switched off.

Other methods to that effect and the same efficiency may be taken.

The temperature control shall be performed by an automatic system which in case of failure shall cut off the power to avoid over-heating.

The instruction handbook shall provide information to enable all setting, clearing and maintenance tasks to be performed safely especially in cases where the procedures involve opening or removing guards which give access to hot parts.

These instructions shall suggest the use of personal protective equipment when persons could be exposed to hot parts.

Heat sources:

The contact with hot air equipment or flames shall be prevented by distance or safeguarding against unintentional contact.

Where their use is not possible, clearly visible pictograms shall be fitted as closely as possible to the danger zones in order to warn about danger of burns (see 5.2.4 and Figure 20 — Warning sign "Caution, hot surface").

It shall only be possible to activate the heating when a product is detected by a product detection sensor system which distinguishes between product and a person.

The instruction handbook shall contain an exact description of the thermal danger zones as well as corresponding warnings.

5.4.2.2 Gas operated systems

The following requirements shall be fulfilled on gas operated shrinking systems:

a) all components of the gas equipment shall be suited for the used type of gas, operation parameters (e.g. pressure) and environmental conditions and shall resist all expected mechanical, chemical and thermal loads and comply with the relevant European Standards;

NOTE 1 Due to the great variety of components and the use of different gases and gas supply pressure these standards are not referred to here. A list of possibly useful standards for gas equipment is given in the informative Annex D. It is important that users of this European Standard be aware that more detailed national standards and/or codes of practice may exist in the CEN member countries (e.g.: the allowable supply pressure can be different).

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b) the machine shall be equipped with a main cut-off device for the gas supply;

c) wherever possible fixed pipes shall be used for conducting gas and connections shall be designed leak proof. Union pieces shall be secured against loosening e.g. by vibrations;

d) where hoses are necessary, these shall be as short as possible, usually not longer than 400 mm. Hoses shall be fitted with a suitable leakage detection safety device which switches off the gas supply in case of leakage;

e) hoses which are moved during the shrinking process shall be designed for the expected mechanical load;

f) connections shall be protected against unacceptable heating, e.g. by hot exhaust gases;

g) the machine shall be equipped with a gas pressure governor with overpressure safety device with trigger (pick-up) pressure equivalent to the supply pressure of the machine and which is installed directly after the main cut-off device. On controllers working with accessory energy: Unacceptable variation or loss of energy shall lead to an automatic shut down of the gas using equipment;

h) flash back or lift off of the gas flame shall be prevented;

i) accumulation of gas shall be prevented by

— a flame supervision device that cannot be bypassed

NOTE 2 See relevant standards for further information on requirements for this device.

— on systems with several burners these shall be arranged in a way that a mutual ignition is ensured and at least one burner shall be fitted with a flame failure controller that cannot be bypassed and with a permanent operating ignition system which shall be monitored. In case of a failure a safety cut-off of all burners shall be initialised;

j) it shall not be possible to enclose gas in liquid state of aggregation in piping between shut-off devices;

k) in case of using LPG it shall not be possible that liquid gas gets unintentionally to the burner(s);

l) burners which are operated with forced air supply shall be shut off in case of loss of pressure or breakdown of the air supply;

m) in case of disturbances of the motion of the burners in relation to the product (or vice versa) the gas supply shall be shut off automatically;

n) the percentage of carbon monoxide in the undiluted combustion gas shall not exceed 0,1 Vol.%;

o) de-airing of the system or relief of gas e.g. by safety valves shall be able without a risk of fire or explosion (e.g. by piping the gas to the open where no fire or explosion hazard exists);

p) if a significant fire hazard cannot be excluded, the shrinking systems shall be fitted with an integrated automatic fire extinguishing system which is suitable for extinguishing gas fires and burning loads. In case of detecting a fire the main gas supply shall be switched off automatically. For risk assessment see EN 13478;

q) the build-up of explosive atmosphere shall be prevented, e.g. by monitoring of the gas supply and exhaust air which leads to a shutdown of the gas supply in case of disturbances. Loss of any supply energy of monitoring or control systems of the gas equipment shall lead to a shutdown of the gas supply;

r) if it is not possible to eliminate an explosion hazard, the machine shall meet the requirements stated in the standards for equipment to be used in potentially explosive atmosphere;

s) especially, the manufacturer shall clearly state in the instruction manual

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— the residual risks due to the gas equipment;

— all required operation parameters;

— the necessary information for connection to the gas supply including indication of the kind of gas for which the machine has been designed and requirements to the gas supply system (e.g. pressure, required gas supply to prevent under-cooling and icing);

— detailed information for set up (including information about protection against mechanical, thermal or chemical damage), installation, putting out of action and use;

— detailed information for trouble shooting and maintenance especially safety measures if escape of gas is possible;

— detailed information about actions in case of fire or other dangerous situations (e.g. leakage);

— requirements and intervals for maintenance and checks including the required qualification of the personnel;

— information about extraction of combustion gases and ventilation of the installation room to prevent accumulation of gas, the rise of hazardous explosive atmosphere, the rise of combustion gas which is hazardous to health and lack of oxygen;

— detailed information about materials or goods which are not allowed to be shrunk.

NOTE 3 Further information on gas systems can be found e.g. in the standards listed in Annex D.

5.4.2.3 Materials and other substances

In case of thermal treatment of films, information shall be given on safe material to be used or on hazards generated by decomposition products. If noxious decomposition products are likely to arise in hazardous quantities, provision for safe extraction of these products shall be made.

Fire and explosion hazards shall be prevented as far as possible by taking appropriate measures. For fire hazards EN 13478 shall be taken into consideration. Explosion hazards shall be prevented by measures which,

— prevent the build up of dangerous amounts of explosive atmosphere or substances;

— prevent the ignition of potentially explosive atmosphere or substances;

— limit the environmental consequences of possible explosions to a non-hazardous amount.

These measures may include deployment of extraction and ventilation devices or installation of suitable automatic fire extinguishing systems.

Overheating of flammable or explosive products shall be avoided by the following means:

a) when the machine stops for more than a pre-determined time (depending on the product), the heating power shall be switched off and the heater shall move away from the product or material or a barrier shall be inserted in order to avoid overheating;

b) a run out function shall be incorporated to enable all product to be discharged before the conveyor stops;

c) in the event of an emergency e.g. loss of main power the belt shall move by a power reserve (e.g. pneumatic or electric battery) to enable all products to be discharged before the conveyor stops;

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d) alternatively, once power has been isolated the shrinking system shall be capable of being opened manually to enable removal of product using personal protective equipment or to allow the rapid dissipation of heat. The manufacturer shall provide suitable aids for removing product from the shrinking zone;

e) to prevent fire hazard a high temperature sensor and associated high temperature cut-off shall be installed independently from thermostatic control to minimise the risk of the product catching fire.

Where there is still a risk of fire, the manufacturer shall fit automatic carbon dioxide sprayers or other suitable fire extinguishing equipment to the machine.

See also 5.2.6.

5.4.2.4 Noise

See 5.2.5.

5.4.3 Shrinking frames and shrinking hoods

5.4.3.1 Shrinking frame or hood

For prevention of access to hazardous zones including the working zone of flames see 5.2.2.1.3 to 5.2.2.1.8.

To prevent the frame from uncontrolled lowering during maintenance these operations shall be possible at lowest position of the frame or provisions shall be made for fixing the mechanism form-fit (in a positive mode), e.g. by a bolt.

To prevent the frame from uncontrolled falling, a self locking drive or other methods to this effect shall be used.

On semi automatic machines the motion of the frame shall be initiated by a hold-to-run actuator positioned in a distance of at least 1 200 mm of the outer edge of the device and where there is a clear view to the danger zone.

5.4.3.2 Drives

Drives and counterweights shall be guarded complying with 5.2.10.4.

5.4.3.3 Failures in the power supply

See 5.2.8.1.

5.4.3.4 Failures in the control circuit

See 5.2.8.2.

5.4.4 Shrinking ovens

5.4.4.1 Automatic doors

Crushing and shearing between automatic doors and conveyors or other fixed parts shall be prevented by design complying with 5.2.2.1.2. If this is not possible the doors shall be guarded complying with 5.2.2.1.3 to 5.2.2.1.8.

Automatic doors that give access to hazardous moving parts when opened shall be interlocked complying with 5.2.2.1.6.

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The doors shall be designed so that persons who are enclosed in the chamber can unlock the doors and to stop any hazardous movements from inside. The emergency stop shall comply with 5.2.3.1.8.

In case of failures of the transport system or of the automatic doors, e.g. as a result of energy loss, an acoustic and optical warning signal shall warn the operator of the failure and it shall be possible to unlock the doors manually.

5.4.4.2 Thermal hazards

See 5.4.2.1.

On continuous shrinking ovens without automatic doors a warning sign according to 5.2.4 and Figure 20 shall be fitted near the inlet and outlet aperture. The openings shall be closed by a flexible curtain to limit the escape of heat but allow products to pass unhindered. The heaters inside tunnel shall be guarded against unintentional contact.

5.4.4.3 Hazards associated with materials or other substances

See 5.4.2.3.

5.4.5 Shrinking columns

5.4.5.1 Turntable

For prevention of access to hazardous zones including the working zone of flames see 5.2.2.1.3 to 5.2.2.1.8.

5.4.5.2 Hazards associated with materials or other substances

See 5.4.2.3.

5.5 Auxiliary machines

5.5.1 General

The requirements and measures detailed in 5.2 and described in this clause apply to auxiliary machine used with pallet wrapping machines where the equivalent hazards exist.

5.5.2 Top sheet feeder

For prevention of access to hazardous zones see 5.2.2.1.3 to 5.2.2.1.8.

For safeguarding the film reel assembly and the sheet feeding system see 5.3.2.2.

5.5.3 Pallet / product centralising

For prevention of access to hazardous zones see 5.2.2.1.3 to 5.2.2.1.8.

6 Verification of safety requirements and measures

6.1 General

A manufacturer or supplier, who wishes to claim conformity to this standard, shall first verify that the machine fulfils the safety requirements and measures.

The following verification procedures shall be adhered to for each machine unless stated otherwise hereafter.

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NOTE For verification of gas systems see relevant standards.

6.2 Visual inspections with the machine stopped

6.2.1 Mechanical parts

Check that mechanical components are securely fixed and all unnecessary sharp edges have been removed.

6.2.2 Pneumatic systems

Check that pneumatic components and piping conform to the safety requirements of EN ISO 4414 and are correctly installed.

6.2.3 Hydraulic systems

Check that hydraulic components and piping conform to the safety requirements of EN ISO 4413 and are correctly installed.

6.2.4 Electrical systems

Check that the electrical equipment and installation is in compliance with the technical documentation described in Clause 17 of EN 60204-1:2006.

6.2.5 Guards

Check that all guards are in place and securely fixed. Check that all interlocking devices are fitted and working correctly.

6.2.6 Design requirements

Check for each type of machine, that the design features stipulated in Clause 5 have been incorporated.

Check for each type of machine, that the appropriate design requirements for the packaging materials being used and the product being packed have been followed.

6.3 Measurements with the machine stopped

6.3.1 Guards

For every type of machine, check that the relationship between the size of any apertures in the guards and their distance from the nearest danger zones conform to the requirements detailed in this standard in particular 5.2.2.1.3.

6.3.2 Electrical testing

The tests as described in Clause 18 of EN 60204-1:2006 shall be performed on every machine before it is dispatched.

6.4 Visual inspections with the machine running

6.4.1 Guards

Check with the machine running that the guards conform to the safety requirements.

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6.4.2 Interlocking devices

Check the operation of all emergency stop and interlocking devices. Check that following the operation of an emergency stop or interlocking device, that all hazardous movements cease and that the machine does not restart without resetting the emergency stop device or the interlocking devices and without an intentional start command.

6.4.3 Dissipation of stored energy

Check for each type of machine that stored energy e.g. from pneumatic systems or mechanisms that can move under gravity is either dissipated automatically before accessing danger zones or can be made safe by the use of a means provided for this purpose.

6.5 Measurements with the machine running

6.5.1 Measurement and declaration of noise emission

For every type of machine measure the noise emission values in the manner described in EN 415-9.

6.5.2 Temperature

For every type of machine, with the machine fully warmed up, check that the temperatures of the external surface are not higher than the burn threshold limits for the foreseeable contact times and materials shown in EN ISO 13732-1 (see 5.2.4). Identify all areas within the machine's guards which are greater than the burn thresholds so that they can be recorded in the instruction handbook and the warning sign shown in Figure 20 — Warning sign "Caution, hot surface", 5.2.4 can be fitted.

6.6 Verification procedures

Verification procedures for each safety requirement detailed in Clause 5 are shown in Table 3.

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Table 3 — Verification procedures for safety requirements identified in 5.2 and 5.3

Safety requirement	Visual inspection	Functional test	Measurement	Calculation
General Requirements				
5.2.2.1	X	X	X	X
5.2.2.2	X	X	X	
5.2.2.3	X	X		
5.2.2.4	X	X	X	
5.2.2.5	X	X	X	
5.2.3	X	X	X	
5.2.4	X	X	X	
5.2.5	X	X	X	
5.2.6	X	X	X	
5.2.7	X	X	X	
5.2.8.1	X	X	X	
5.2.8.2	X	X	X	
5.2.8.3	X	X	X	X
5.2.9	X	X	X	
5.2.10.1	X	X	X	
5.2.10.2	X	X	X	
5.2.10.3	X	X	X	
5.2.10.4	X	X	X	
Pallet wrapping Machines				
Rotary table machines and spiral wrapping machines				
5.3.2.1.1	X	X	X	
5.3.2.1.2	X	X	X	
5.3.2.2	X	X	X	

Safety requirement	Visual inspection	Functional Test	Measurement	Calculation
5.3.2.3	X	X	X	
5.3.2.4	X	X	X	
5.3.2.5	X	X	X	
5.3.2.6				
Rotary arm machines and ring machines				
5.3.3.1 and 5.3.3.2	X	X	X	
5.3.3.3	X	X	X	
5.3.3.4	X	X	X	
5.3.3.5	X	X	X	
5.3.3.6	X	X	X	
Banding machines and curtain stretching machines				
5.3.4.1	X	X	X	
5.3.4.2	X	X	X	
5.3.4.3	X	X	X	
Hood application and hood stretching machines				
5.3.5.1	X	X	X	
5.3.5.2	X	X	X	
Self driving pallet stretch wrapping machine				
5.3.6	X	X	X	
Mobile stretch wrapping machine				
5.3.7	X	X	X	X

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Table 3 *(continued)*

Safety requirement	Visual inspection	Functional test	Measurement	Calculation
Shrinking systems				
5.4.2.1	X	X	X	
5.4.2.2	X	X	X	X
5.4.2.3	X	X	X	
5.4.2.4	X	X	X	
Shrinking frames and shrinking hoods				
5.4.3.1	X	X	X	
5.4.3.2	X	X	X	
5.4.4.3	X	X	X	
Shrinking ovens				
5.3.4.1	X	X	X	
5.4.4.2	X	X	X	
5.4.4.3	X	X	X	
Shrinking columns				
5.4.5.1	X	X	X	
5.4.5.2	X	X	X	
Auxiliary machines				
Top sheet feeder				
5.5.2	X	X	X	
Pallet / product centralising				
5.5.3	X	X	X	

7 Information for use

7.1 Marking

Machines shall be marked with the following information:

a) name and address of the manufacturer or his authorised representative established in the European Economic Area;

b) mandatory marks, if appropriate (e.g. CE mark, Ex symbol for equipment which can be used in a potentially explosive atmosphere);

c) designation of series or type, if any;

d) year of construction;

e) serial number (if any);

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f) electrical markings as indicated in Clause 16 of EN 60204-1:2006 for full details;

g) rating information required for lifting equipment, if appropriate e.g. carrying capacity, safe working load, load limit, centre of gravity, gross weight;

h) the business name and full address of the authorised representative (where applicable);

i) the designation of the machinery.

For marking gas equipment see Clause 9 of EN 203-1:2005+A1:2008.

7.2 Signals and warning signs

The machine shall be equipped with the signs and pictograms required in Clause 5. Signs and pictograms shall be selected from those illustrated in Clause 5, EN 61310-1 and ISO 7000 wherever possible. Where other signs or pictograms are used, they shall be selected so they cannot be confused with the signs or pictograms described in these standards.

7.3 Instruction handbook

7.3.1 General

The instruction handbook shall contain all of the information listed in 6.4.5 of EN ISO 12100:2010 where the equivalent hazard exists. In addition and in particular the instruction handbook shall contain the following information that is specific to pallet wrapping machines.

7.3.2 All pallet wrapping machines

1. a repetition of the markings on the machine as stipulated in 7.1;

2. a description of the foreseen use and information about foreseeable misuse of the machine e.g. the function of the machine, the product to be packed, packaging materials, pack sizes and speeds;

3. a drawing indicating the work stations likely to be occupied by operators;

4. details of how high-level areas of the machine can be accessed in safety. The method of installing steps and platforms supplied with the machine and the specification of ladders or other temporary means of access that the user is to provide for other purposes than operation, cleaning or routine maintenance;

5. tests that should be carried out before the machine is used for the first time;

6. explicit instructions on fitting of change parts, fitting of change part guards and adjustment of adjustable guards so that the machine is safe to use following a size or product change;

7. a record of and explanation of the significance of all warning devices, signs and pictograms attached to the machine and the warning signals provided by the machine;

8. details of the control systems including circuit diagrams for the electrical, pneumatic and hydraulic systems. The diagrams shall show the interfaces between all permanently wired parts and programmable devices. Wiring diagrams and documentation of the electrical equipment shall comply with Clause 17 of EN 60204-1:2006;

9. noise emission declaration according to EN 415-9;

10. where appropriate, instructions on how the machine shall be installed to minimise noise;

11. specifications of fluids to be used in the machine e.g. lubricating oil, hydraulic fluid;

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12. details of drainage requirements and any residual spillage risks;

13. a statement indicating whether the machine is or is not suitable for use in a potentially explosive atmosphere.

7.3.3 Machines for use with agri-foodstuffs and pharmaceuticals

Where the machine is intended for use with agri-foodstuffs, pharmaceuticals or other products which can be contaminated if hygienic design principles are neglected, the instruction handbook shall indicate how the machine should be cleaned and disinfected, together with details of appropriate and inappropriate cleaning and disinfecting materials. The instruction handbook shall indicate any limitation for use with these products.

7.3.4 Machines for handling hazardous products

Where the machine is intended for packing hazardous products, the instruction handbook shall indicate how these products can be handled safely and state any limitations for use of the machine with hazardous products e.g. “This machine is not suitable for use with products that can generate explosive atmosphere” or “This machine has been designed to pack products that are/are not …”.

Where harmful dusts, smoke or fumes will be emitted by the machine, the manufacturer shall provide information on a suitable exhausting system for these substances, including the required air speed at the emission point.

7.3.5 Hot surfaces

The instruction handbook shall indicate all parts of the machine that are likely to have a temperature higher than the burn thresholds shown in EN ISO 13732-1.

7.3.6 Machines fitted with wheels

On machines fitted with wheels, the instructions shall state how the machine can be moved safely and how it can be stabilised before use.

7.3.7 Machines incorporating lifting equipment

For machines incorporating lifting equipment, the instruction handbook shall include a statement of the load for which the equipment has been designed, including the maximum working load and the maximum mass of lifting accessories.

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Annex A
(normative)

Noise test code for pallet wrapping machines - grade of accuracy 2 and 3

The relevant noise test code is now given in EN 415-9.

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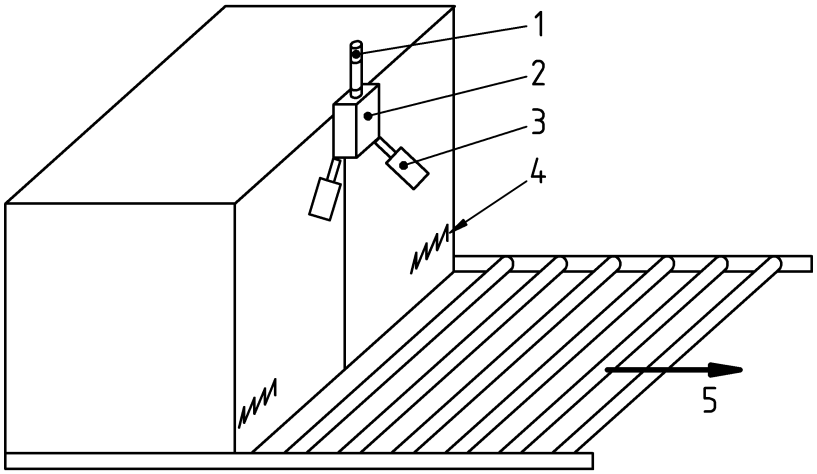
Annex B
(normative)

Methods of safeguarding large apertures

B.1 Interlocked guards with guard locking

In this method access through the aperture is prevented by interlocked guards with guard locking. This method is only suitable for discharge apertures.

The interlocked guards shall comply with 5.2.2.1.3. When a full product is ready to be discharged the machine's controls signal the interlocked guards to unlock, the product then pushes the guards open. The guards are closed by springs but the machine does not restart until the guards are closed and locked (see Figure B.1). It shall not be possible to access the danger zone while the product is passing the aperture. Therefore the fixed side and top guards shall form a tunnel with 900 mm length as a minimum and the distance between these guards and the product shall not exceed 120 mm.



Key

1 pneumatic actuator
2 lock
3 lock detector
4 spring to close the interlocked guards
5 product exit

Figure B.1 — Interlocked guards with guard locking

B.2 Fixed and interlocked guards with ESPE

B.2.1 General

The following methods of safeguarding large apertures in machines use a combination of fixed and interlocked guards and electro-sensitive protection equipment (ESPE). The ESPE used to safeguard an aperture shall comply with 5.2.8.2.

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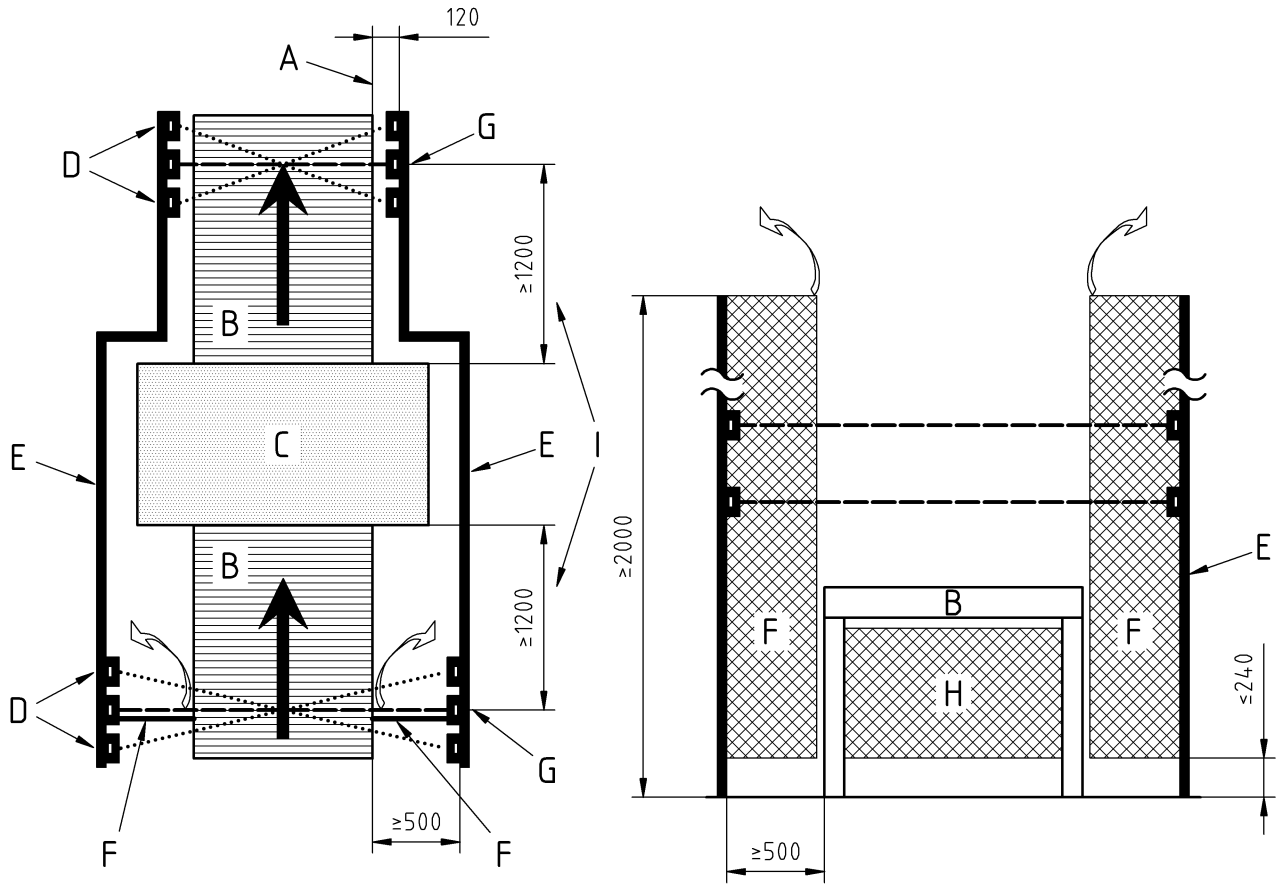
B.2.2 ESPE in a vertical plane

In this method access through the aperture is prevented by electro-sensitive protection equipment (ESPE). This method is suitable for both infeed and discharge apertures.

Dimensions in millimetres



Key

A outer edge of product
B conveyor
C machine
D sensors for muting function
E lateral fence guards
F interlocked guard
G ESPE
H fixed guard
I minimum distance to danger zone if two beams are used

Figure B.2 — Example of a combination of fixed and interlocked guards and ESPE

Access under or around the area safeguarded by the ESPE shall be prevented by fixed or interlocked guards complying with 5.2.2.1.3. This may include guarding under conveyors.

Access between the discharge conveyor or the product and the machine guards shall be prevented by ensuring that the maximum gap between the product and the guards is no greater than 120 mm. Where the mass of the product is such that a significant crushing and shearing hazard between the product and the guards is possible, these guards shall be designed as lateral guards at either side of and in parallel to the discharge conveyor. These side guards shall be at least 900 mm long (see Figure B.2).

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At the infeed aperture the distance between the lateral guards and the product shall not exceed 200 mm except where the mass of the product is such that there is a significant crushing and shearing hazard between the product and the guards. In this case the distance between the fixed guards and the outer edges of the product shall not be less than 500 mm. Access between the guards and the product shall be prevented by interlocked guards that comply with 5.2.2.1.2 and 5.2.2.1.3 (see Figure B.2) and the maximum gap between these guards and the conveyor and the product shall not exceed 120 mm.

The ESPE may be muted while the product is passing the ESPE provided the muting system complies with the requirements of Annex C.

B.2.3 Dynamic cell positioning of ESPE

Dynamic cell positioning distinguishes between people trying to gain access and the moving product/pack by monitoring the sequence of signals from an array of ESPE. Dynamic cell positioning can be used for both infeed and discharge apertures.

At least three ESPE shall be positioned as shown in Figure B.3.

Using three ESPE designated a, b and c, the following sequence is created during the movement of the discharged pack:

$$abc\ ;\ \bar{a}\,bc\ ;\ \overline{ab}\,c\ ;\ \overline{abc}\ ;\ a\,\overline{bc}\ ;\ ab\,\bar{c}\ ;\ abc \qquad \text{(B.1)}$$

On a discharge aperture if the ESPE are interrupted in an incorrect sequence the control system initiates an emergency stop.

On an infeed aperture one of the following additional measures shall be used:

— the time between the detection of each ESPE shall be monitored and any variation in timing or sequence shall initiate an emergency stop;

— the shape of the product shall be detected e.g. by positioning additional ESPE.

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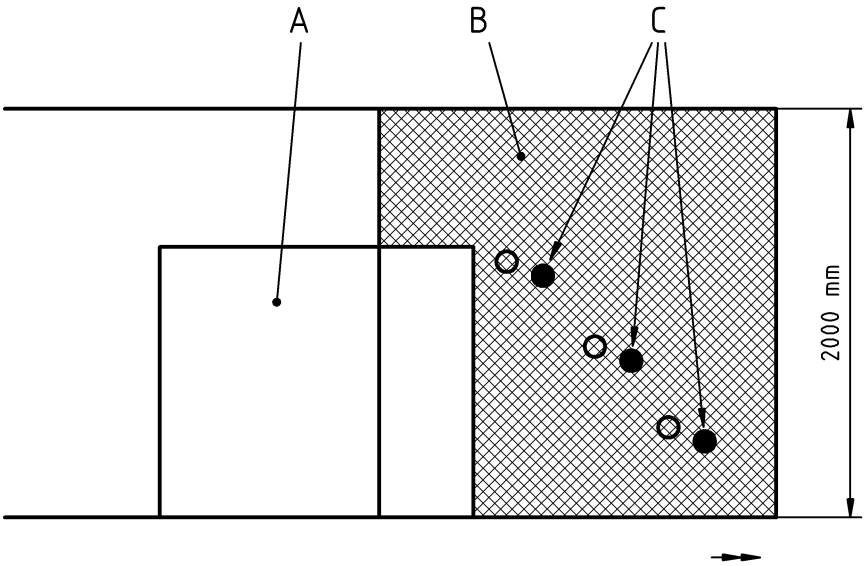
Dimensions in millimetres



Key

A pack
B guard corridor
C ESPE

Figure B.3 — Dynamic cell positioning

B.3 Positioning of ESPE

Apertures that extend from floor level shall be equipped with at least three ESPE light beams, positioned at 400 mm, 800 mm and 1 200 mm from floor level. The minimum reach distance from the ESPE light curtain to the nearest danger zone shall be 900 mm. However if the stopping time of the hazardous movements is greater than 0,4 s a greater distance may be required to ensure that the dangerous movement has stopped before someone reaches the danger zone, see EN ISO 13855.

Apertures which extend above a conveyor shall be equipped with at least two ESPE light beams positioned at 400 mm and 900 mm above the conveyor. The minimum reach distance from the ESPE to the nearest danger zone shall be 1 200 mm. However if the stopping time is greater than 0,6 s a greater distance may be required to ensure that the dangerous movement has stopped before someone reaches the danger zone, see EN ISO 13855. See Figure B.4.

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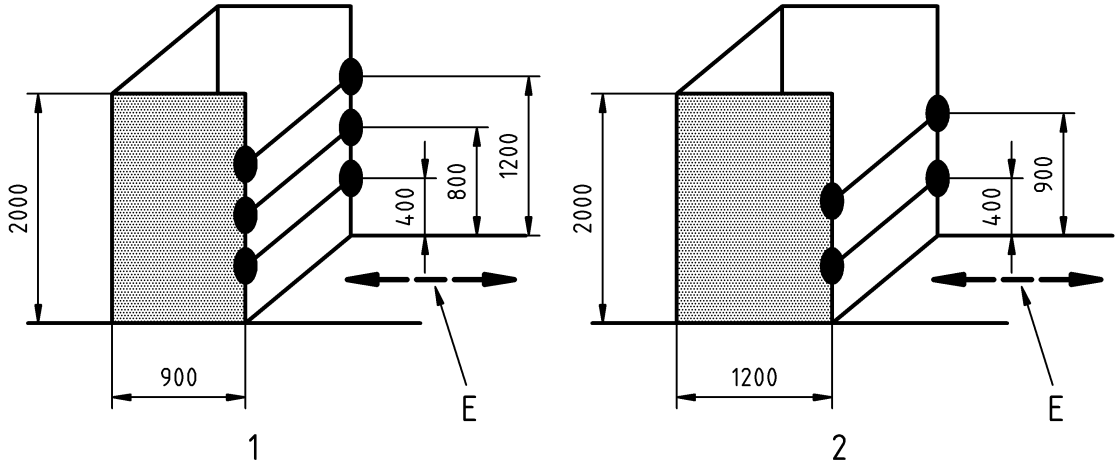
Dimensions in millimetres



Key

1 device with 3 ESPE
2 device with 2 ESPE
E entry and exit

Figure B.4 — Positioning of ESPE

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Annex C
(normative)

ESPE-Muting

The signals from electro-sensitive protection equipment (ESPE) may have to be ignored or “muted” to allow products to enter or exit the machine. Muting is a feature of the control system that disables the safety function of an ESPE during the time a product/pack is passing the ESPE. The muting controls shall comply with 5.2.5 of EN ISO 13849-1:2008 and the following requirements:

— muting shall only be allowed during a time in the operating cycle when safety is obtained by alternative means, for example when a product/pack is obstructing access to the danger zone;

— muting shall be fully automatic and independent of any operator intervention. Manual inhibiting or bypassing of the ESPE is not permitted;

— the initiation of muting shall not rely on a single electrical signal and shall not rely entirely on software signals;

— muting signals that occur in an incorrect sequence shall either not allow a muted condition or lead to an emergency stop;

— the safety function of the ESPE shall be automatically re-activated immediately following the passage of the recognised product/pack through the detection field;

— if the product stops while passing the ESPE, the muting shall be disabled and the controls shall initiate an emergency stop of the machine. A manual control, that only allows operating the required conveyor, shall be provided to permit the product/pack to be removed. Restart of the machine shall only be possible by a voluntary action after a safe condition has been reached.

An example of a muting assembly is shown in Figure C.1.

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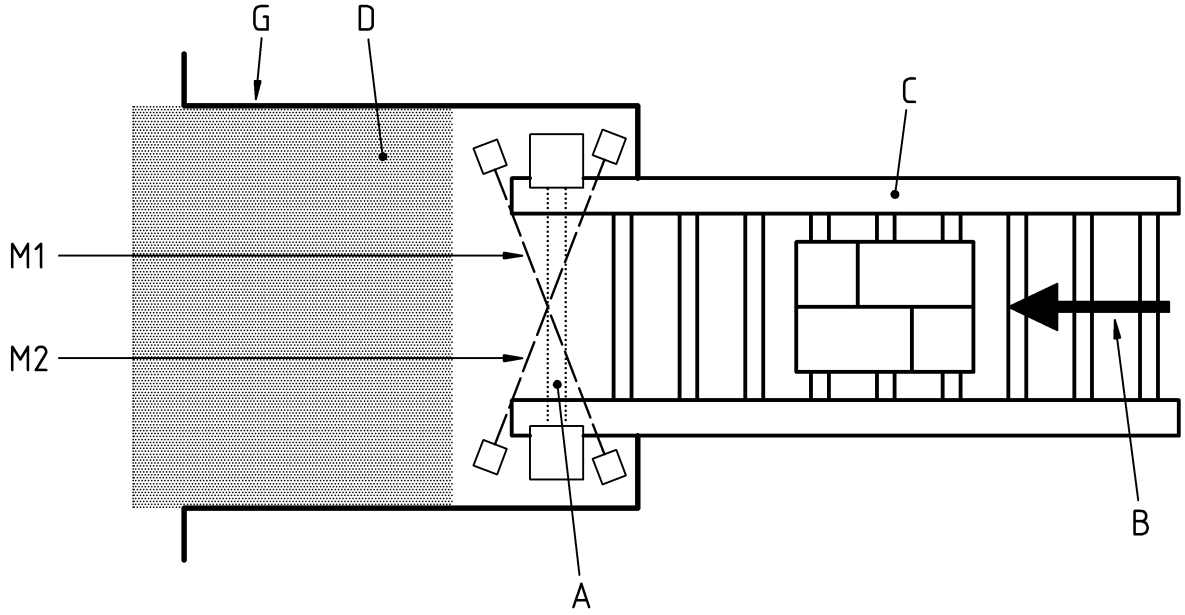

Key

A	main ESPE
B	direction of movement of product
C	product conveyor
D	danger zone
G	guards
M1, M2	muting ESPE

Figure C.1 — Positioning of muting ESPE

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Annex D
(informative)

List of possibly helpful standards for gas equipment

Standard	Title
EN 88-1:2011	Pressure regulators and associated safety devices for gas appliances – Part 1: Pressure regulators for inlet pressures up to and including 50 kPa
EN 88-2:2007	Pressure regulators and associated safety devices for gas appliances – Part 2: Pressure regulators for inlet pressures above 500 mbar up to and including 5 bar
EN 125:2010	Flame supervision devices for gas burning appliances – Thermoelectric flame supervision devices
EN 126:2012	Multifunctional controls for gas burning appliances
EN 161:2011	Automatic shut-off valves for gas burners and gas appliances
EN 257:2010	Mechanical thermostats for gas-burning appliances
EN 298:2012	Automatic burner control systems for burners and appliances burning gaseous or liquid fuels
EN 549:1994	Rubber materials for seals and diaphragms for gas appliances and gas equipment
EN 613:2000	Independent gas-fired convection heaters
EN 676:2003+A2:2008	Automatic forced draught burners for gaseous fuels
EN 1643:2000	Valve proving systems for automatic shut-off valves for gas burners and gas appliances
EN 1854:2010	Pressure sensing devices for gas burners and gas burning appliances
EN 12067-2:2004	Gas/air ratio controls for gas burners and gas burning appliances – Part 2: Electronic types
EN 12864:2001	Low-pressure, non adjustable regulators having a maximum outlet pressure of less than or equal to 200 mbar, with a capacity of less than or equal to 4 kg/h, and their associated safety devices for butane, propane or their mixtures
EN 13611:2007+A2:2011	Safety and control devices for gas burners and gas burning appliances - General requirements
EN 13786:2004+A1:2008	Automatic change-over valves having a maximum outlet pressure of up to and including 4 bar with a capacity of up to and including 100 kg/h, and their associated safety devices for butane, propane or their mixtures

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Annex E
(informative)

Significant technical changes between this European Standard and the previous edition EN 415-6:2006+A1:2009

Clause/Paragraph/Table/Figure	Change
Clause 2 Normative references	The normative references have been updated in this clause and throughout the text.
5.3.2 Rotary table machines and spiral pallet wrapping machines	This sub-clause has been revised.
5.3.6 Semi automatic self driving pallet stretch wrapping machine	This sub-clause has been revised.
Annex A	Annex A has been revised and indicate that the requirements are now included in EN 415-9:2009.
Annex ZA	Now referred to the relationship between this European Standard and the Essential Requirements of EU Directive 2006/42/EC.
Annex ZB	Removed. The content is now in Annex ZA.
Bibliography	The references have been updated.

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Annex ZA
(informative)

Relationship between this European Standard and the Essential Requirements of EU Directive 2006/42/EC

This European Standard has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association to provide a means of conforming to Essential Requirements of the New Approach Directive 2006/42/EC on machinery.

Once this standard is cited in the Official Journal of the European Union under that Directive and has been implemented as a national standard in at least one Member State, compliance with the normative clauses of this standard confers, within the limits of the scope of this standard, a presumption of conformity with the relevant Essential Requirements of that Directive and associated EFTA regulations.

WARNING — Other requirements and other EU Directives may be applicable to the product(s) falling within the scope of this standard.

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[3] EN ISO 11688-1, *Acoustics — Recommended practice for the design of low-noise machinery and equipment — Part 1: Planning (ISO/TR 11688-1)*

[4] EN 61000-6-1:2007, *Electromagnetic compatibility (EMC) — Part 6-1: Generic standards — Immunity for residential, commercial and light-industrial environments (IEC 61000-6-1:2005)*

[5] EN 61000-6-2:2005, *Electromagnetic compatibility (EMC) — Part 6-2: Generic standards — Immunity for industrial environments (IEC 61000-6-2:2005)*

[6] EN 61000-6-3:2007, *Electromagnetic compatibility (EMC) — Part 6-3: Generic standards — Emission standard for residential, commercial and light-industrial environments (IEC 61000-6-3:2006)*

[7] EN 61000-6-4:2007, *Electromagnetic compatibility (EMC) — Part 6-4: Generic standards; Emission standard for industrial environments (IEC 61000-6-4:2006)*

[8] EN 61310-2:2008, *Safety of machinery — Indication, marking and actuation — Part 2: Requirements for marking (IEC 61310-2:2007)*

[9] IEC 60417 DB 12M subscription, *Graphical symbols for use on equipment — 12 months subscription to online database comprising all graphical symbols published in IEC 60417*

[10] EN 1005-2:2003+A1:2008*, Safety of machinery — Human physical performance — Part 2: Manual handling of machinery and component parts of machinery*

[11] EN 1005-4:2005+A1:2008*, Safety of machinery — Human physical performance — Part 4: Evaluation of working postures and movements in relation to machinery*

[12] EN 415-8:2008, *Safety of packaging machines — Part 8: Strapping machines*

[13] EN 60529, *Degrees of protection provided by enclosures (IP code) (IEC 60529)*

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