



BSI Standards Publication

Safety of packaging machines

Part 4: Palletizers and depalletizers and associated equipment

National foreword

This British Standard is the UK implementation of EN 415-4:2025. It supersedes BS EN 415-4:1998, which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee MCE/3/3, Packaging machines.

A list of organizations represented on this committee can be obtained on request to its committee manager.

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© The British Standards Institution 2025
Published by BSI Standards Limited 2025

ISBN 978 0 539 16228 8

ICS 55.200

Compliance with a British Standard cannot confer immunity from legal obligations.

This British Standard was published under the authority of the Standards Policy and Strategy Committee on 31 December 2025.

Amendments/corrigenda issued since publication

Date	Text affected

English Version

Safety of packaging machines - Part 4: Palletizers and depalletizers and associated equipment

Sécurité des machines d'emballage - Partie 4 :
Palettiseurs et dépalettiseurs et équipement associé

Sicherheit von Verpackungsmaschinen - Teil 4:
Palettierer und Depalettierer und zugehörige
Ausrüstungen

This European Standard was approved by CEN on 4 November 2024.

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EUROPEAN COMMITTEE FOR STANDARDIZATION
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CEN-CENELEC Management Centre: Rue de la Science 23, B-1040 Brussels

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European foreword

This document (EN 415-4:2025) 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of an identical text or by endorsement, at the latest by June 2026, and conflicting national standards shall be withdrawn at the latest by June 2026.

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

This document supersedes EN 415-4:1997.

EN 415-4:2025 includes the following significant technical changes with respect to EN 415-4:1997:

- palletizers and depalletizers that incorporate industrial robots and multi-stations palletizing systems have been added to the scope;
- safety requirements have been rewritten so they are in line with EN 415-10:2014;
- normative references have been changed to reflect the current B1 and B2 standards;
- the performance level required PLr (specified by EN ISO 13849-1:2023) is specified for the safety-related parts of control systems

This document has been prepared under a standardization request addressed to CEN by the European Commission. The Standing Committee of the EFTA States subsequently approves these requests for its Member States.

For the relationship with EU Legislation, see informative Annex ZA, which is an integral part of this document.

This document is part of the series EN 415, *Safety of packaging machines*, which 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; fill and seal machines;*
- *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;*

— *Part 10: General requirements.*

Any feedback and questions on this document should be directed to the users' national standards body. A complete listing of these bodies can be found on the CEN website.

According to the CEN-CENELEC Internal Regulations, the national standards organisations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Republic of North Macedonia, Romania, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Türkiye and the United Kingdom.

Introduction

This document is of relevance, in particular, for the following stakeholder groups representing the market players with regards to machine safety:

- machine manufacturers (small, medium and large enterprise);
- health and safety bodies (regulators, accident prevention organization, market surveillance, etc.).

Others can be affected by the level of machinery safety achieved with the means of the document by the above-mentioned stakeholder groups.

- machine users/employers (small, medium and large enterprise);
- machine user/employees (e.g. trade unions, organization for people with special needs);
- service providers, e.g. for maintenance.

The above-mentioned stakeholder groups have been given the possibility to participate at the drafting process of this document.

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

This document is a type-C standard as stated in EN ISO 12100:2010.

When requirements of this type-C standard are different from those which are stated in type-A or type-B standards, the requirements of this type-C standard take precedence over the requirements of the other standards for machines that have been designed and built according to the requirements of this type-C standard.

The full set of requirements for machines in the Scope of this document is composed by those given in this document in conjunction with the relevant requirements of EN 415-10:2014.

The Annex ZA of this document will not list the EHSR which are not relevant for this kind of machines or are not covered for any other reason.

NOTE EN 415-7:2006+A1:2008 is currently being revised with a new title: “Cartoning and Case-packing machines”.

1 Scope

This document is applicable to the following groups of machines, auxiliary equipment and their combinations:

- palletizers;
- depalletizers;
- auxiliary equipment incorporated in or linked to the operations of palletizers and depalletizers;
- conveying systems which are part of palletizers or depalletizers;
- palletizers combined with functions of machines which are covered by other parts of EN 415, but detailed requirements are only provided for palletizing functions.

The individual machines are described in 3.2. Auxiliary equipment is described in 3.3.

This document deals with safety requirements for machine design, transport, installation, commissioning, operation, adjustment, maintenance and cleaning of palletizers, depalletizers, auxiliary equipment and conveying systems which are part of palletizer or depalletizer. The extent to which hazards, hazardous situations and events are covered is indicated in Annex A.

Exclusions:

This document is not applicable to the following machines:

- machines that were manufactured before the date of publication of this document by CEN;
- conveyors that connect palletizers and depalletizers with machines that are not in the scope of this document.

Conveyors in the scope of this document also fall in the scope of EN 619:2022, however, this document describes the additional or specific hazards for conveyors fitted into palletizers and depalletizers and so the requirements of this document take precedence over the requirements of EN 619:2022.

This document does not consider the following hazards:

- the use of palletizers and depalletizers in a potentially explosive atmosphere;
- the health, safety or hygiene hazards associated with the products that are contained in the unit load handled by palletizers and depalletizers except for the spillage of hazardous substances caused by the malfunction of a machine.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN 415-1:2014, *Safety of packaging machines — Part 1: Terminology and classification of packaging machines and associated equipment*

EN 415-7:2006+A1:2008, *Safety of packaging machines — Part 7: Group and secondary packaging machines*

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 415-10:2014, *Safety of packaging machines — Part 10: General Requirements*

EN 795:2012, *Personal fall protection equipment — Anchor devices*

EN 1005-3:2002+A1:2008, *Safety of machinery — Human physical performance — Part 3: Recommended force limits for machinery operation*

EN 13155:2020+A1:2025, *Crane — Safety — Non-fixed load lifting attachments*

EN 60204-1:2018, *Safety of machinery — Electrical equipment of machines — Part 1: General requirements*

EN IEC 61496-1:2020, *Safety of machinery — Electro-sensitive protective equipment — Part 1: General requirements and tests*

EN IEC 61496-2:2020, *Safety of machinery — Electro-sensitive protective equipment — Part 2: Particular requirements for equipment using active opto-electronic protective devices (AOPDs)*

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 7010:2020, *Graphical symbols — Safety colours and safety signs — Registered safety signs (ISO 7010:2019, Corrected version 2020-06)*

EN ISO 10218-1:2025, *Robotics — Safety requirements — Part 1: Industrial robots (ISO 10218-1:2025)*

EN ISO 10218-2:2025, *Robotics — Safety requirements — Part 2: Industrial robot applications and robot cells (ISO 10218-2:2025)*

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

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

EN ISO 13850:2015, *Safety of machinery — Emergency stop function — Principles for design (ISO 13850:2015)*

EN ISO 13851:2019, *Safety of machinery — Two-hand control devices — Principles for design and selection (ISO 13851:2019)*

EN ISO 13855:2024, *Safety of machinery — Positioning of safeguards with respect to the approach of the human body (ISO 13855:2024)*

EN ISO 13856-2:2013, *Safety of machinery — Pressure-sensitive protective devices — Part 2: General principles for design and testing of pressure-sensitive edges and pressure-sensitive bars (ISO 13856-2:2013)*

EN ISO 13857:2019, *Safety of machinery — Safety distances to prevent hazard zones being reached by upper and lower limbs (ISO 13857:2019)*

EN ISO 14122-2:2016, *Safety of machinery — Permanent means of access to machinery — Part 2: Working platforms and walkways (ISO 14122-2:2016)*

EN ISO 14122-3:2016, *Safety of machinery — Permanent means of access to machinery — Part 3: Stairs, stepladders and guard-rails (ISO 14122-3:2016)*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in EN 415-1:2014, EN 415-10:2014, Clause 3, EN ISO 12100:2010, Clause 3 and the following apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

- ISO Online browsing platform: available at <https://www.iso.org/obp/>
- IEC Electropedia: available at <https://www.electropedia.org/>

3.1 Definitions

3.1.1

palletize

place one or more products on a pallet, a similar support or on the floor

3.1.2

depalletize

separate a palletized load into individual products

3.1.3

layer

arrangement of products in a horizontal plane

3.1.4

layer pad

layer sheet

intermediate layer

sheet of material used to stabilize a pallet load

[SOURCE: EN 415-1:2014, 3.15.39]

3.1.5

layer pattern

disposition of the products in a layer

3.1.6

pallet

rigid horizontal platform designed to be handled by pallet trucks, forklift trucks or other appropriate handling equipment, and used as a base for assembling, loading, storing, handling, stacking, transporting, or displaying goods and loads

Note 1 to entry: The pallet may be constructed with, or fitted with, a superstructure.

3.1.7

pallet load

arrangement of products placed on a pallet or slip sheet

3.1.8

porous vacuum plate

plate made of porous material which holds a product by means of a vacuum

3.1.9

row

horizontal line of products

3.1.10

slip sheet

thin flat piece of material used to support a pallet load

3.1.11

stack

vertical column of products or pallets

3.1.12

integrator

entity who designs, provides, manufactures or assembles an integrated manufacturing system and is in charge of the safety strategy, including the protective measures, control interfaces and interconnections of the control system

Note 1 to entry: The integrator may be a manufacturer, engineering company or the user.

3.1.13

integrated palletizing system

assembly of machines designed to palletize or depalletize pallet loads

3.1.14

ESPE

electro-sensitive protective equipment

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

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

3.1.15

AOPD

active opto-electronic protective device

device whose sensing function is performed by opto-electronic emitting and receiving elements detecting the interruption of optical radiation generated, within device, by an opaque object present in the specified detection zone for a light beam device, on the axis of the light beam

3.1.16

AOPDDR

active opto-electronic protective device responsive to diffuse radiation

device, whose sensing function is performed by optoelectronic emitting and receiving elements, that detect the diffuse reflection of optical radiation generated within the device by an object present in a detection zone specified in two dimensions

3.1.17**personnel key**

key which is released from a trapped key interlocking device (typically an access lock used in conjunction with whole body access) and retained by a person to prevent a hazardous situation, e.g. unexpected start-up (ISO/TS 19837:2018)

3.2 Definitions of palletizers and depalletizers**3.2.1 General**

This clause describes the working principles of typical configurations of palletizers and depalletizers. Variations of these typical assemblies also exist.

3.2.2**semi-automatic stripper plate palletizer**

palletizer in which an operator forms the products into the layer pattern on a stripper plate manually, then the operator starts the automatic layer transfer intentionally

3.2.3**automatic low-level palletizer or depalletizer**

palletizer in which layers of packages are formed at one level, usually a low level, transferred by pushing onto a stripper plate which raises or lowers to the appropriate level and transfers the layers onto the pallet while the pallet remains at one level

3.2.4**automatic high-level palletizer or depalletizer**

palletizer in which layers of packages are formed at one level usually a high level and transferred onto the pallet which is raised and then lowered as the pallet load forms

Note 1 to entry: A depalletizer operates in reverse.

3.2.5**pick and place palletizer or depalletizer (gantry type)**

palletizer in which products are gripped, lifted, transferred to the loading position and then lowered onto the pallet load with linear movements and a rotation of the end effector

3.2.6**pick and place palletizer or depalletizer (column type)**

pick-and-place palletizer in which the product lifting device is supported on a column and can move up and down the column or rotate around the column

Note 1 to entry: A rotation of the end effector may also exist.

Note 2 to entry: Column palletizers can pick up products one at a time, or in groups. Products are typically conveyed to the machine at low level but sometimes at high level.

3.2.7**stack palletizer**

palletizer which creates stacks of packages, e.g. crates which are then transferred to the pallet as a group

3.2.8**robot palletizer and depalletizer**

palletizer or depalletizer which uses an industrial robot to perform some or all sequential operations for palletizing or depalletizing products

Note 1 to entry: Robot palletizers can pick up products one at a time, or in groups. In some installations the robot also positions the pallet or the layer pads.

3.2.9

case-packer-palletizer

machine which combines the operations of case-packing and palletizing in one machine

3.2.10

linear multi-station palletizing system

palletizer in which two or more pallet or pallet loads are positioned in a row on the ground for palletizing or depalletizing and pallets and pallets loads are delivered to and removed from the machine using an industrial truck

Note 1 to entry: The industrial truck can be a conventional forklift truck, a manually operated pallet truck or remote-controlled self-propelled work equipment.

3.3 Definition of auxiliary equipment

3.3.1 General

This clause describes the working principle of typical types of auxiliary equipment used in palletizers and depalletizers.

3.3.2

mechanical gripping head

assembly of mechanical components which hold products, a set of products, an empty pallet or layer pads using one of the following methods:

- a) positive support, e.g. the product is supported by a plate or hooks
- b) friction between fingers or plates and the load
- c) friction between the products that make up the load
- d) friction or positive support by inflatable elements

3.3.3

vacuum gripping head

gripping head which uses vacuum to hold products or layer pads

Note 1 to entry: The mechanism will typically comprise several suction cups or a porous vacuum plate.

3.3.4

magnetic gripping head

gripping head which uses electromagnetic force to lift products made from magnetic material, e.g. tin-plated mild steel cans

3.3.5

gripping head with roller curtain

mechanism comprising a set of free running rollers supported by two chains which receives and supports a layer of products; the mechanism is then lifted and moved over a pallet where the roller curtain is retracted leaving the products on the pallet

3.3.6

pallet stacker/unstacker

machine which dispenses pallets from a stack or accepts single pallets and places them in a stack

3.3.7

pallet changer

machine which removes a pallet load from a pallet so that it can be placed on another pallet

3.3.8

pallet grouping and/or ungrouping machine

assembly of pallet conveyors which stores, sorts and delivers pallets or pallet loads to several loading stations

3.3.9

layer pad inserter or remover

machine or attachment which places layer pad onto layers of products or the pallet as the pallet load is formed or removes layer pad as a pallet load is dismantled

Note 1 to entry: The layer pad magazine can be inside the safeguarded zone or in a separate control zone.

3.3.10

pallet checker

machine that checks the quality of a pallet

3.3.11

pallet load checker

machine which checks the quality of a pallet load

3.3.11.1

pallet size/weight checker

machine that checks the weight or dimensions of a pallet load

4 Safety requirements

4.1 General requirements

4.1.1 General

All machines in the scope of the standard shall comply with the following requirements.

Where a machine has hazards, which are not on a typical machine and so are not described in Annex A, the machine shall be designed according to EN 415-10:2014.

4.1.2 Risk from moving parts – inherently safe design – physical aspects

The requirements of 5.2.1.1 of EN 415-10:2014 shall apply.

NOTE Annex B (informative) of EN 415-10:2014 provides maximum values for force and pressure of inherently safe design.

4.1.3 Safeguards

Where hazards from moving parts cannot be eliminated by design, access to these hazards shall be prevented by fixed or interlocked guards.

When there is a risk of falling loads outside the safeguarded area, protection by means of ESPE devices alone is not permitted.

ESPE can be used to protect pallet load infeed or discharge openings in guards or to monitor the interior zone.

4.1.4 Fixed or interlocked movable guards

The requirements of 5.2.1.2, 5.2.1.3 and 5.2.1.4 of EN 415-10:2014 shall apply.

Where interlocking devices are connected in series, the influence of fault masking and its influence on the diagnostic coverage DC and the safety performance (PL/SIL) shall be considered.

4.1.5 Operator access to hazard zone

4.1.5.1 General

On machines without pallet conveyors where the hazard zone is small enough or simple enough for the operator to check that no one is inside the hazard zone from a single control station outside the guards, it is acceptable for pallet loads and operators to use the same access opening in the guards.

On machines where it is not possible to have a clear view of the hazard zones from the reset device the requirements of 5.16.2.2, 5.16.2.3 and 5.16.2.4 of EN 415-10:2014 shall apply.

4.1.5.2 Access over a conveyor

Where approach to the hazard zone is foreseeable over a belt or slat band conveyor, the maximum distance between the pallet load and the columns supporting the AOPD or the guards on both sides of the slat band or belt conveyor shall be not greater than 180 mm to prevent an operator from passing through the gap when the AOPD is muted.

Where fixed or interlocking guards extend over a conveyor or a tunnel guard at the entry or exit of the machine, the design shall prevent climbing over the guard, e.g. by an additional guard or measures to prevent standing on the tunnel or conveyor. Additional guards shall be dimensioned by considering the tunnel or conveyor as a plane of access 2 000 mm high from the floor or the access platform.

On chain or roller conveyor the clearance between the outer edge of the pallet load to fixed parts shall be not greater than 230 mm as specified in EN 415-10:2014, 5.2.1.3.13.

4.1.5.3 Separation of hazard zones

Where a machine has more than one safeguarded zone, for example separate control zones for the pallet magazine, layer pad mechanism and palletizer, the equipment covered by these different control zones shall be separated by safeguards.

Where two or more palletizers or depalletizers are installed next to each other they shall be separated by safeguards and the following shall apply:

- 1) where objects are possibly dropped or ejected and present hazard, interlocking guards shall prevent access as long as the hazard exists;
- 2) a means to reset and activate the adjacent zone shall be available in every zone from where the adjacent zone cannot be reached;
- 3) a means to reset and activate the adjacent zone which the operator has left from the zone where the operator stays shall be provided.

The reset device for these AOPD devices shall be located where there is a clear view of the zone to be reset adjacent to the AOPD. Where there is no one position from which there is a clear view of the hazard zones, two or more reset devices shall be used, so that by moving from one reset device to the next reset device, the operator resetting the system has a view of the two zones. One or more of these reset devices can be located within the hazard zones, however, the last reset device to complete the resetting sequence shall be located outside the hazard zones where it cannot be reached from inside the hazard zone;

- 4) Where zones are equipped with interlocking devices which provide a personnel key for the operator to take into a zone, the control system shall ensure that it is not possible to reset the AOPD and restart an adjacent zone unless all guards are closed and the personnel key has been used for resetting in the zone of access (see 3.1.17).

4.1.6 Apertures in guards

4.1.6.1 Minimum distance between ESPE and the nearest hazard zone

The minimum distance between ESPE and the nearest hazard zone shall comply with EN ISO 13855:2024.

For the calculation of the minimum distance of an AOPD or AOPDDR for access over a conveyor the approach speed K according to EN ISO 13855:2024 for walking may be reduced to 800 mm/s when all the following conditions are fulfilled:

- a) for chain conveyors or belt conveyors:
 - the minimum distance between the centre of the chains or belts is 550 mm;
 - the belts or chains are not wider than 100 mm;
 - obstacles are used between the chains or belts to slow down the approach speed;
- b) for roller conveyors:
 - the minimum clearance between rolls is 120 mm;
 - the frames are not wider than 40 mm;

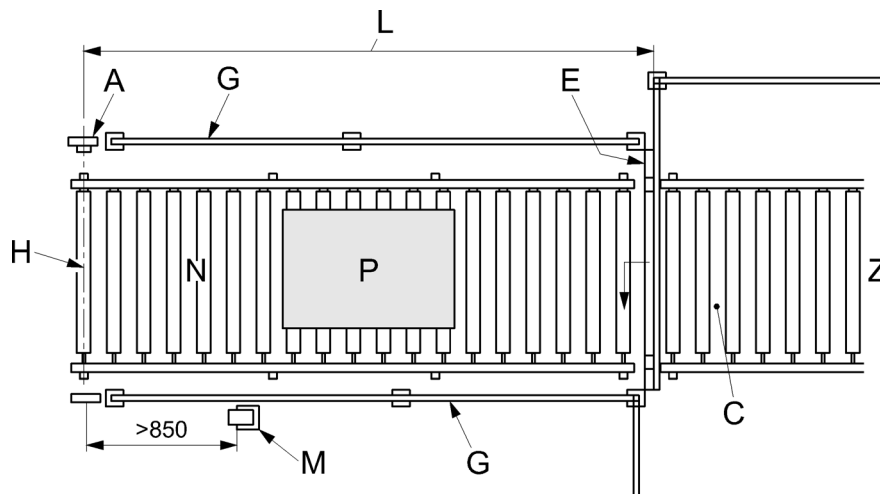
- there are no filler plates between the rollers.

4.1.6.2 Alternative safeguarding measures

The following alternative measures to the ones in 5.2.1.3 and 5.2.1.4 of EN 415-10:2014 using a combination of safeguarding devices shall apply.

The feeding zone of the product shall be safeguarded by a combination of fixed and interlocked guards and ESPE (see Figure 1) performing the following functions:

- 1) when the pallet enters the intermediate area the outer safeguard (A) is triggered and switched to off;
- 2) before the pallet (P) can get conveyed through the inner safeguard (E), the outer safeguard (A) shall be manually reset and thus release the movement of the pallet. While the pallet (P) is passing the inner safeguard (E) and the outer safeguard (A) is still in the OFF-state or actuated, the palletizer shall stop all hazardous movements. This condition shall be maintained until manually reset;
- 3) after the passage of the pallet (P), the inner safeguard (E) will be automatically reset only if the outer safeguard (A) has been manually reset;
- 4) the manual reset device of the outer safeguard shall be mounted outside the hazard zone, in a position where it cannot be reached from the hazard zone or the intermediate area and is in a position where there is a clear view of the hazard zone.



Key

- A outer safeguarding device
- C conveying device
- E inner safeguarding device
- G fixed guard
- H light beam
- L length of conveyor
- M reset device
- N intermediate area
- P pallet load
- Z hazard zone

Figure 1 — Automatic feed

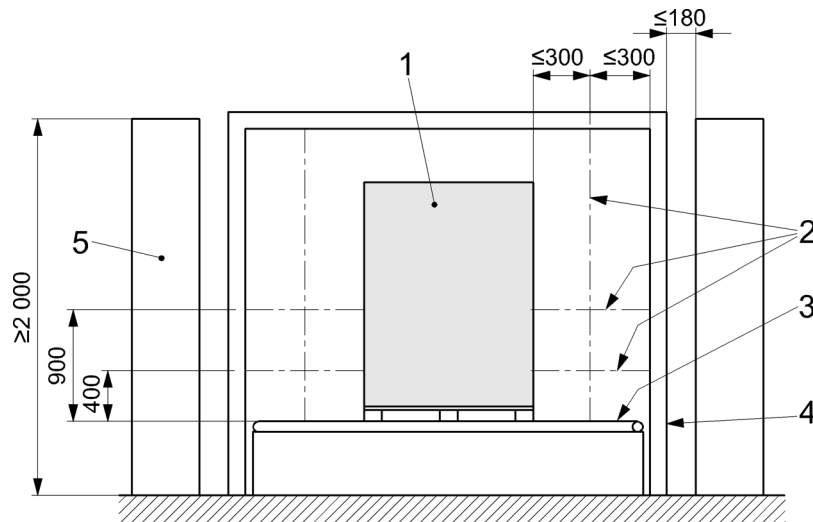
4.1.6.3 Pallet loads with different widths

4.1.6.3.1 Vertical AOPD

Where pallet loads of different width are conveyed through a large aperture, AOPD devices complying with 5.2.1.3.13 of EN 415-10:2014 in combination with additional vertical AOPD or alternatively a vertical AOPDDR (e.g. laser scanner) complying with 5.2.1.3.17 of EN 415-10:2014 shall be applied to detect whole body access while the product is passing and stop the hazardous movements.

- a) Where the widths of the conveyed pallet loads differ less than or equal to 600 mm, the following measures shall apply:
 - 1) vertical AOPD safeguards the aperture while narrow pallet loads are passing;
 - 2) the clearance between the vertical AOPD beams (2) next to the pallet load and the outer edge of the product (see Figure 2) shall not be greater than 300 mm while the product is passing;
 - 3) the clearance between the supports of the horizontal AOPD and the vertical AOPD (see Figure 2) shall not be greater than 300 mm;
 - 4) the clearance between a support of the horizontal AOPD (4) and a fixed guard (5) shall not exceed 180 mm.
- b) Where the difference between pallet load widths is greater than 600, the following measures shall apply:
 - 1) the width of the pallet load shall be transmitted to the safety-related control system (discharge only) or measured by a separate device. The muting of vertical AOPDs respectively the control of the AOPDDR shall be triggered by this information. If the pallet does not arrive at the guarding at the expected time a safety-related stop of the machine shall be initiated;
 - 2) the clearance between the vertical AOPD beams (2) next to the pallet load and the outer edge of the product (see Figure 2) shall not be greater than 300 mm while the product is passing;
 - 3) the clearance between the supports of the horizontal AOPD and the vertical AOPD (see Figure 2) shall not be greater than 300 mm;
 - 4) the clearance between a support of the horizontal AOPD (4) and a fixed guard (5) shall not exceed 180 mm.

Dimension in millimetres

**Key**

- 1 pallet load
- 2 beams of AOPD
- 3 conveyor
- 4 AOPD support
- 5 fixed guards

Figure 2 — Aperture with additional vertical AOPD**4.1.6.3.2 Additional measures**

Where the automatic measures for muting of 4.1.6.3.1 and 4.1.4 cannot be applied due to the large variety of the pallet load width, a manual muting of the ESPE may be used and the following requirements shall apply.

- 1) the device shall be a key actuated hold to run device;
- 2) the device shall be mounted outside the hazard zone, in a position where it cannot be reached from inside the hazard zone and in a position where there is a clear view of the hazard zone;
- 3) the device shall mute the ESPE and only start the pallet load conveyor and, the muting control system shall have the same performance level as the ESPE control system and shall provide a visual or acoustic signal indicating that the muting function is active;
- 4) the muting shall stop if the conveyor stops for any reason, if the hold to run device is released or the time taken for the pallet load to move through the ESPE is 2 s longer than the normal time for a pallet load to move this distance;
- 5) an emergency stop device complying with EN ISO 13850:2015 shall be positioned next to the ESPE muting device.

4.1.7 Prevention of unexpected lowering of machine components

4.1.7.1 Strength of mechanical components

Mechanical components which support a load shall be designed and constructed in such a way as to withstand the static overload without permanent deformation or patent defect.

A static test coefficient of 1,5 shall apply.

In addition, the following components which support a load shall have the working coefficients as listed below when using only 1 element.

—	rope	5
—	chain	4
—	belt	5
—	textile fibre	7
—	toothed belt	5

Other components of lifting mechanisms shall be designed according to good engineering practices.

NOTE EN 13001-1:2015 and EN 13001-2:2021 provide useful information.

Where two or more components are used, the minimum working coefficient of each component shall be not less than the factors stated above divided by the number of components the factor shall not be less than 2.

4.1.7.2 Requirements to prevent the unintended lowering of lifting mechanisms

The following measures shall be applied to prevent the unintended lowering of lifting mechanisms during access to all areas where intervention is necessary during operation, adjustment, maintenance of the machinery:

- 1) mechanical components:
 - a) mechanisms using chains, ropes, toothed belts or textile straps shall have a slack rope detection device which stops movement when a slack rope is detected;
 - b) an automatic tensioning device shall be fitted which maintain contact between the belt or chain and its pulley or sprockets;
- 2) if hydraulic cylinders are used, they shall be equipped with an automatic device to limit unintentional lowering to less than 100 mm even in the event of rupture of the hoses in the hydraulic supply line. Mounting a rupture protection valve directly on each hydraulic cylinder, is one mean of meeting this requirement;
- 3) If pneumatic cylinders are used, they shall each be equipped with a rod blocking device, a separate blocking device or a pressure blocking valve effective even if the power supply fails.

The manufacturer shall describe the safe procedures and measures which shall be used following a breakdown of the above components or mechanisms or an activation of the above safety devices. This shall include how to move the lifting assembly, safe access and safe removal of load as well as the necessary maintenance instructions.

4.1.7.3 Mechanical locking system for lifting units

4.1.7.3.1 Application of methods

On machines where whole body access under lifting mechanisms is intended, 4.1.7.3.2 shall apply.

On machines where whole body access is possible, 4.1.7.3.3 or 4.1.7.3.4 shall apply.

4.1.7.3.2 Mechanical restrain devices

Unexpected lowering of the mechanisms shall be prevented by at least one automatic mechanical restrain device which works in a positive mode. These devices shall be driven into their locking position when a safety-related stop has been generated, for example using spring force and a sensor(s) shall detect that these devices have engaged.

On semi-automatic machines where the lifting assembly is accessible without opening guards the mechanical restrain devices shall be driven into their locking position after every stop.

The mechanical restrain device(s) shall be capable of supporting the lifting assembly and 150 % of the maximum load. See Figures 3 and 4 for examples of mechanical restrain devices which lock a pallet or layer transfer lifting assembly.

After the mechanical restrain has reached the locking position, the lifting mechanism shall move not more than 100 mm (see Figure 3).

The mechanical restrain devices shall be activated if any of the energy supplies are lost.

4.1.7.3.3 Self-locking gearbox

Where the lifting mechanism is supported by a self-locking gearbox for example a worm and gear gearbox, it is not necessary to fit mechanical restraint devices.

4.1.7.3.4 Mechanical brake

Lifting mechanisms shall be fitted with at least one mechanical brake which is capable of supporting the lifting mechanism and 150 % of the maximum load, and the following shall apply:

- a) where malfunction of this brake stops the machine automatically, it shall only be possible to restart the machine after corrective action has been taken and the control system has been reset manually;
- b) where malfunction of this brake does not stop the machine automatically, these brakes shall be monitored by the machine's control system and any aberrant movement shall lead to a safety-related stop of the machine and a visual warning on the machine's control panel that is not safe to go under the lifting assembly.

Reset and restart after these stops shall only be possible in a maintenance mode which is protected by a key or code. The monitoring shall be performed every time when the brakes are used. Where brakes are not used during the process they shall be monitored when they are activated for a safety stop.

The instruction for use shall describe the safe procedures and measures that shall be used following this malfunction or alarm. This shall include how to move the lifting assembly to a safe position, prevention of any movement of the lifting assembly, safe access and safe removal of load as well as maintenance of the brakes.

The failure of any sources of power shall not prevent the brakes being activated.

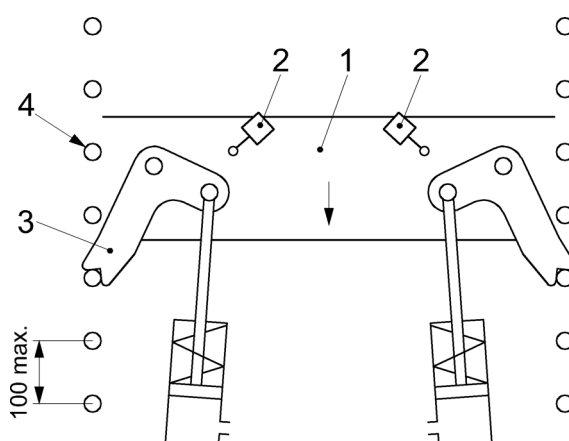
Where holding brakes are used, mechanical locking systems for maintenance and long-term interventions as described in 4.1.7.3.5 shall also be fitted.

4.1.7.3.5 Locking system for maintenance and long-term interventions

For maintenance or long-term interventions under the lifting mechanism one of the following measures shall be used:

- a) an automatic mechanical restrain device that comply with 4.1.7.3.2. Typical devices are back stops, rotating pins or pin and with perforated bar which limit the falling of the mechanism to 100 mm. The devices shall be applied automatically and be effective at least 150 % of the maximum working load of the lifting mechanism and a sensor shall detect that the device has engaged (see Figures 3 and 4);
- b) one or more manually activated mechanical restrain devices which can be operated from a safe position outside the footprint of the lifting assembly. The manually operated mechanical restrain devices shall be equipped with interlocking devices to prevent the machine from starting while the mechanical restrain devices are supporting the lifting assembly. These mechanical restrain devices shall be capable of supporting the lifting assembly and 150 % of its maximum load;
- c) one or more mechanical restrain devices, e.g. bars, which can be inserted into the assembly without having to work under the lifting assembly and can be locked in position. The instruction shall specify the safe procedure for inserting and removing these devices. These restrain devices shall be capable of supporting the lifting assembly and 150 % of its maximum load.

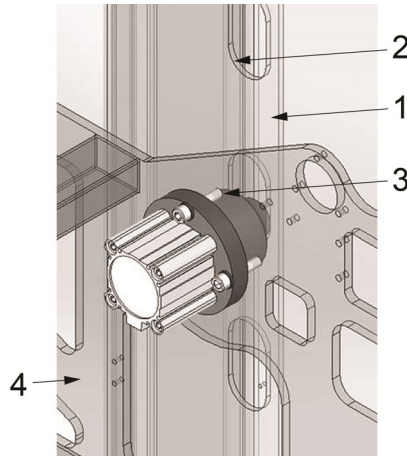
Examples of locking systems are given in Figures 3 and 4.



Key

- 1 lifting assembly
- 2 sensing device detecting the position of teeth
- 3 pawl
- 4 pins

Figure 3 — Example for locking system with driven back stops



Key

- 1 rail
- 2 slotted hole
- 3 spring actuated pin
- 4 lifting assembly

Figure 4 — Example of locking system with pin and perforated bar

4.1.8 Release from trapping

Requirement 5.2.1.5 of EN 415-10:2014 shall apply.

4.1.9 Machine stability

Requirement 5.2.3 of EN 415-10:2014 shall apply.

4.1.10 Pneumatic and hydraulic equipment

All pneumatic components and piping shall conform to the requirements of EN ISO 4414:2010.

All hydraulic components and piping shall conform to the requirements of EN ISO 4413:2010.

Where control functions are performed by hydraulic or pneumatic systems, these circuits shall comply with the requirements of 5.14 and 5.15 of EN 415-10:2014.

The means of isolation of pneumatic or hydraulic power shall be readily accessible without having to enter the hazard zone. The means of isolations shall be positioned where it will not be damaged and shall be clearly marked and capable of being locked in the off position.

4.1.11 Measures to prevent falls from height

On machines where access at a high level is required, for example to access the product infeed conveyor or layer forming mechanism, for operation cleaning, maintenance or troubleshooting the following requirements shall apply:

- a) preferably the machine shall be designed so that all parts of the machine that require regular access can be reached from floor or other safe level. Where access on high level is foreseeable, 5.2.2.3 of EN 415-10:2014 shall apply;
- b) where the surface of the layer forming or transfer mechanism is higher than 1 200 mm from floor level, so that it is necessary to step on the mechanism for troubleshooting, guardrails shall be provided. Where parts of the machine are designed to prevent falls from height, no guardrails are necessary;

- c) where falling cannot be prevented by design or by fixed guards or handrails, automatic movable handrails shall be provided in preference to recommending the use of personal protective equipment. When automatic movable handrails are used, access to this zone shall only be possible through interlocked guards with guard locking which prevent access to the zone until the automatic movable handrails have moved to their guarding position.

NOTE See also 4.4.1.

4.1.12 Electrical equipment

Electrical equipment shall comply with 5.5 of EN 415-10:2014. The means of isolation for electric power shall be clearly marked, accessible from outside the hazard zone and capable of being locked in the off position.

4.1.13 Noise reduction

Requirement 5.8 of EN 415-10:2014, EN 415-9:2009 and Annex B (normative) shall apply.

NOTE 1 EN ISO 11688-2:2000 gives useful information to the physics of low-noise design.

NOTE 2 Annex B (normative) provides essential information additional to the noise test code described in EN 415-9:2009.

NOTE 3 Annex B (normative) gives information on how to select the measurement positions and the time interval for different kind of palletizers and depalletizers.

4.1.14 Pallet conveyor crossing points

4.1.14.1 Crossing walkway surface

a) Roller conveyors

Where the clearance between the rollers is more than 20 mm, infill plates shall be fitted between the rollers and the clearance between the infill plates and rollers shall not exceed 4 mm.

b) Chain conveyors

Infill plates shall be fitted between the chains and the clearance between the infill plates and chains shall not exceed 4 mm.

4.1.14.2 Steps either side of the crossing point

Where steps are provided either side of the crossing point, they shall be positioned in line with the crossing point and dimensioned according to EN ISO 14122-3:2016.

Where the height of the conveyor is more than 500 mm the top step either side of the crossing point shall be at the same level as the surface of the walkway and the steps shall be provided with handrails as shown in Figure 5. The handrails shall comply with EN ISO 14122-3:2016. A one-sided handrail shall only be used where the crossing point area is not higher than 1 000 mm.

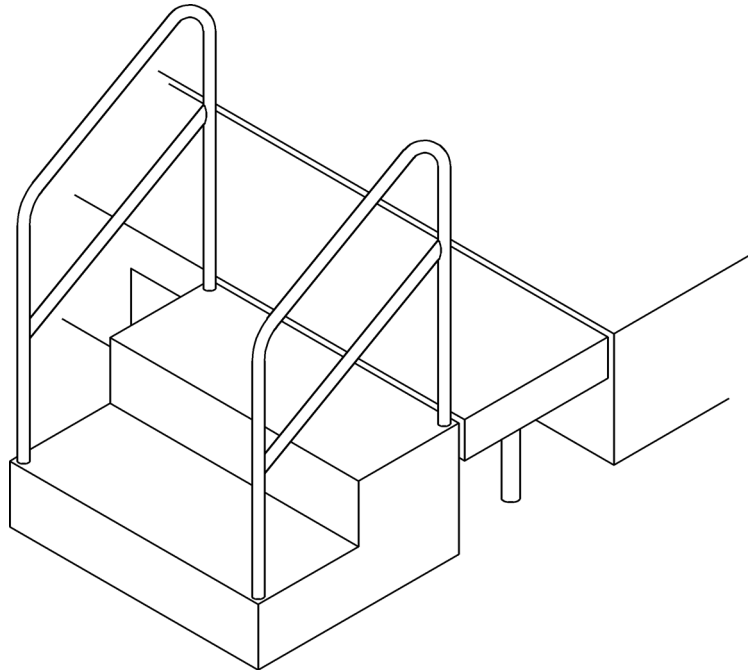


Figure 5 — Example of a conveyor crossing point

4.1.14.3 Conveyor crossing points inside a safeguarded zone

The control system for pallet conveyors within a safeguarded zone shall ensure that they are stopped with a safety-related stop during all operator interventions.

4.1.14.4 Pallet conveyor crossing points outside a safeguarded zone

4.1.14.4.1 Controls

- a) Control devices shall be provided both sides of the crossing point to stop and restart the pallet conveyor.
- b) Where the speed of the conveyor is greater than 0,3 m/s, ESPE shall be provided either side of the crossing point to automatically stop the conveyor when someone approaches the crossing point. Where these are fitted start buttons shall be provided both sides of the crossing so that the conveyor can be restarted manually.
- c) The control system shall ensure that pallet loads do not stop on the crossing point.

4.1.14.4.2 Marking of the crossing point

The crossing point shall be marked both sides with the pictogram EN ISO 7010:2020, M023 - use footbridge - as shown in Figure 6.



Figure 6 — Mandatory crossing point pictogram

4.1.14.4.3 Avoiding shearing hazards

The shearing hazard between a moving pallet load and any fixed part associated with the crossing shall be avoided by ensuring there is 300 mm gap between the moving pallet load and the fixed part.

Where the distance between a moving pallet load and a fixed part is less than 300 mm, one of the following shall be installed:

- a deterring device no higher than the conveyor, which prevents someone getting closer than 300 mm to the pallet load;
- an ESPE with a minimum $PLr = c$, complying with EN IEC 61496-1:2020 which stops the conveyor if someone is detected in the hazard zone. EN ISO 13855:2024 shall be used to determine the position of the ESPE, considering the part of the body exposed to the hazards;
- a pressure sensitive edge complying with EN ISO 13856-2:2013 shall be attached to the fixed part and shall stop the movement of the pallet load before the values stated in Annex B (informative) of EN 415-10:2014 are exceeded.

4.1.15 Measures to prevent risks from falling products

EN 415-10:2014, 5.10.2.2 shall apply.

NOTE Annex C (informative) presents a method for evaluating the stability of pallet loads.

4.1.16 Emergency stop function

The requirement of 5.14.5 of EN 415-10:2014 shall apply.

4.1.17 Control functions

The requirements of 5.14 of EN 415-10:2014 shall apply.

4.1.18 Safety-related stop functions

The requirements of 5.14.3 and 5.14.4 of EN 415-10:2014 shall apply.

4.1.19 Safety-related stops of variable speed electrical power drive systems

The requirements of 5.14.6 of EN 415-10:2014 shall apply.

4.1.20 Stopping time

The requirements of 5.14.7 of EN 415-10:2014 shall apply. EN ISO 13855:2024 shall be used to calculate the distance from ESPE to the nearest hazard zone.

4.1.21 Unexpected start-up

The requirement of 5.16 of EN 415-10:2014 shall apply.

4.1.22 Requirements for remote control (teleservice)

Where the machine is provided with equipment that allows remote control of the machine, which may affect the function or the safety of the machine, the manufacturer shall provide the equipment required by 5.18 of EN 415-10:2014.

Where the machine is permanently connected to the internet, the machine shall be identified by a unique address. Access shall be authorized and acknowledged by the user at the machine by a suitable procedure (e.g. using a password which can be set and modified by the user of the machine).

This clause does not apply to collecting data or monitoring the machine.

4.1.23 Size or product changing

The requirements of 5.20.6 of EN 415-10:2014 shall apply.

4.1.24 Ergonomic design principles

The requirements in 5.11 of EN 415-10:2014 shall apply.

4.1.25 Measures to prevent reasonably foreseeable misuse

The requirements in 5.19 of EN 415-10:2014 shall apply.

4.1.26 Operations with open guards

The requirements in 5.16.3 of EN 415-10:2014 shall apply.

4.1.27 Stored energy

The requirements in 5.17 of EN 415-10:2014 shall apply.

4.1.28 Laser radiation

The requirement 5.9.2 of EN 415-10:2014 shall apply.

4.1.29 Measures to control hazards generated by substances and materials

The requirement of 5.10.1 and 5.10.2 of EN 415-10:2014 shall apply.

4.1.30 Measures to control hazards generated by packaging materials

The requirement of 5.10.3 of EN 415-10:2014 shall apply.

4.2 Safety requirements for semi-automatic stripper plate palletizer

4.2.1 Ergonomic hazards

The workstation shall be designed according to EN 1005-3:2002+A1:2008 and the force that shall be applied by the operator to push a product on the pattern forming plane shall not exceed 60 N.

The layer forming plane shall be designed so its height can be adjusted to suit the operator, considering the requirements of EN 1005-4:2005+A1:2008. The instructions shall explain how to make this adjustment.

If this is not reasonably practicable, an appropriate platform for the operator shall be provided.

The instruction for use shall explain how to adjust the platform height.

NOTE The force exerted by an operator depends on the weight of the product and the friction coefficient between product and plane. The friction coefficient can be kept as low as possible using a ball table or low friction material.

4.2.2 Moving parts

All moving machine transmission parts which are not in a clear view of the operator shall be safeguarded by fixed or interlocked guards or ESPE complying with 4.1.5.

Moving parts involved in the process like the product infeed and grouping table mechanisms do not need to be safe guarded, provided the operator has a clear view to these mechanisms from the operating position and they can only be operated using a two-hand control device which complies with EN ISO 13851:2019 minimum type IIIB.