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OHUTUSNÖUDED KOMPAKTKOORMATE MEHAANILISE
KÄITLEMISE SEADMETELE

Continuous handling equipment and systems - Safety requirements for equipment for mechanical handling of unit loads



ESTI STANDARDI EESSÕNA

NATIONAL FOREWORD

See Eesti standard EVS-EN 619:2022 sisaldab Euroopa standardi EN 619:2022 ingliskeelset teksti.	This Estonian standard EVS-EN 619:2022 consists of the English text of the European standard EN 619:2022.
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EUROPEAN STANDARD
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EN 619

March 2022

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Supersedes EN 619:2002+A1:2010

English Version

Continuous handling equipment and systems - Safety
requirements for equipment for mechanical handling of
unit loads

Équipements et systèmes de manutention continue -
Prescriptions de sécurité pour les équipements de
manutention mécanique des charges isolées

Stetigförderer und Systeme -
Sicherheitsanforderungen an mechanische
Fördereinrichtungen für Stückgut

This European Standard was approved by CEN on 14 February 2022.

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European foreword

This document (EN 619:2022) has been prepared by Technical Committee CEN/TC 148 "Continuous handling equipment and systems - Safety", the secretariat of which is held by AFNOR.

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of an identical text or by endorsement, at the latest by September 2022, and conflicting national standards shall be withdrawn at the latest by September 2022.

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 619:2002+A1:2010.

This document has been prepared under a Standardization Request 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.

This document forms part of a series of five standards the titles of which are given below:

- EN 617, *Continuous handling equipment and systems — Safety and EMC requirements for the equipment for the storage of bulk materials in silos, bunkers, bins and hoppers;*
- EN 618, *Continuous handling equipment and systems — Safety and EMC requirements for equipment for mechanical handling of bulk materials except fixed belt conveyors;*
- EN 619, *Continuous handling equipment and systems — Safety requirements for equipment for mechanical handling of unit loads;*
- EN 620, *Continuous handling equipment and systems — Safety requirements for fixed belt conveyors for bulk material;*
- EN 741, *Continuous handling equipment and systems — Safety requirements for systems and their components for pneumatic handling of bulk materials.*

The Annexes C, D and E are normative, the Annexes A, B, F and ZA are informative.

Significant technical changes between this European standard and the previous edition:

- 1) standard adapted to CEN Guide 414:2017;
- 2) extension of Scope: telescopic conveyor, sorter, vertical switch conveyor, check-in conveyor, reclaim conveyor, rail guided floor track conveyors;
- 3) introduction of area concept;
- 4) preventing of access across the load entry/exit points in dependence of different areas;
- 5) the maximum speeds depending on the mass and on the different areas has been specified;
- 6) requirements for noise reduction and determination of noise test code;

- 7) list of required performance levels for safety related parts of control systems;
- 8) verification of safety requirements and/or measures has been improved;
- 9) figures in the annexes have been added/updated;
- 10) safety requirements/measures for the single types of conveyors have been described more detailed.

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, Turkey and the United Kingdom.

Introduction

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

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

- machine manufacturers (small, medium and large enterprises);
- health and safety bodies (regulators, accident prevention organizations, 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 enterprises);
- machine users/employees (e.g. trade unions, organizations for people with special needs);
- service providers, e.g. for maintenance (small, medium and large enterprises);
- consumers (in case of machinery intended for use by consumers).

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.

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.

List of abbreviations

ESPE	Electro-Sensitive Protective Equipment (AOPD and AOPDDR)
AOPD	Active Opotoelectronic Protective Device (e.g. light barriers)
AOPDDR	Active Opotoelectronic Protective Device responsive to Diffuse Reflection (e.g. laser-scanner)
UL	Unit Load
EMC	Electro Magnetic Compatibility
PL _r	Performance Level required
VTD	Vertical Transfer Device
DCV	Destinated Coded Vehicle
TC	Transfer Car
OHC	Overhead Conveyor

1 Scope

This document deals with requirements for machine design, transport, installation, commissioning, operation, adjustment, maintenance and cleaning to minimize the hazards listed in Annex F. These hazards can arise during the operation and maintenance of continuous handling equipment and systems when carried out in accordance with the specifications given by the manufacturer or his authorized representative. This document deals with safety related technical verification during commissioning.

This document applies to mechanical handling devices as defined in Clause 3, singly or combined to form a conveyor system, and designed exclusively for moving unit loads continuously on a predefined route from the loading to the unloading points, possibly with varying speed or cyclically. In general, it also applies to conveyors which are built into machines or attached to machines if not stated otherwise in a machine specific standard.

Safety requirements and/or measures in this document apply to equipment used in all environments. However, additional risk assessments and safety measures need to be considered for uses in severe conditions, e.g.

- freezer applications,
- high temperatures,
- corrosive environments,
- strong magnetic fields,
- potentially explosive atmospheres,
- radioactive conditions and loads the nature of which could lead to a dangerous situation (e.g. molten metal, acids/bases, especially brittle loads, explosives),
- operation on ships and earthquake effects and
- contact with foodstuff.

This document does not cover hazards during decommissioning.

This document does not apply to conveying equipment and systems used underground or in public areas and to aircraft ground support equipment. In public areas only baggage carousels and check-in conveyors for airports are dealt with in this document.

NOTE Aircraft ground support equipment is covered by the standards of CEN/TC 274.

This document is not applicable to continuous handling equipment and systems manufactured before the date of its publication.

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 81-20:2020, *Safety rules for the construction and installation of lifts — Lifts for the transport of persons and goods — Part 20: Passenger and goods passenger lifts*

EN 341:2011, *Personal fall protection equipment — Descender devices for rescue*

EN 614-1:2006+A1:2009, *Safety of machinery — Ergonomic design principles — Part 1: Terminology and general principles*

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

EN 818-4:1996+A1:2008, *Short link chain for lifting purposes — Safety — Part 4: Chain slings — Grade 8*

EN 818-5:1999+A1:2008, *Short link chain for lifting purposes — Safety — Part 5: Chain slings — Grade 4*

EN 842:1996+A1:2008, *Safety of machinery — Visual danger signals — General requirements, design and testing*

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

EN 1492-1:2000+A1:2008, *Textile slings — Safety — Part 1: Flat woven webbing slings made of man-made fibres for general purpose use*

EN 1492-2:2000+A1:2008, *Textile slings — Safety — Part 2: Roundslings made of man-made fibres for general purpose use*

EN 1492-4:2004+A1:2008, *Textile slings — Safety — Part 4: Lifting slings for general service made from natural and man-made fibre ropes*

EN 1837:2020, *Safety of machinery — Integral lighting of machines*

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

EN 13414-1:2003+A2:2008, *Steel wire rope slings — Safety — Part 1: Slings for general lifting service*

EN 13414-3:2003+A1:2008, *Steel wire rope slings — Safety — Part 3: Grommets and cable-laid slings*

EN 13557:2003+A2:2008, *Cranes — Controls and control stations*

EN 60204-1:2018, *Safety of machinery — Electrical equipment of machines — Part 1: General requirements (IEC 60204-1:2016)*

EN 60529:1991,¹ *Degrees of protection provided by enclosures (IP code) (IEC 60529:1989)*

EN 60947-5-5:1997,² *Low-voltage switchgear and control gear — Part 5-5: Control circuit devices and switching elements — Electrical emergency stop device with mechanical latching function (IEC 60947-5-5:1997)*

EN IEC 61000-6-2:2019, *Electromagnetic compatibility (EMC) — Part 6-2: Generic standards — Immunity standard for industrial environments (IEC 61000-6-2:2016)*

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

¹ As impacted by EN 60529:1991/A1:2000, EN 60529:1991/A2:2013, EN 60529:1991/corrigendum May 1993, EN 60529:1991/A2:2013/AC:2019-02 and EN 60529:1991/AC:2016-12.

² As impacted by EN 60947-5-5:1997/A1:2005, EN 60947-5-5:1997/A11:2013 and EN 60947-5-5:1997/A2:2017.

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) (IEC 61496-2:2020)*

EN IEC 61496-3:2019, *Safety of machinery — Electro-sensitive protective equipment — Part 3: Particular requirements for active opto-electronic protective devices responsive to diffuse Reflection (AOPDDR) (IEC 61496-3:2018)*

EN IEC 61800-1:2021, *Adjustable speed electrical power drive systems — Part 1: General requirements — Rating specifications for low voltage adjustable speed DC power drive systems (IEC 61800-1:2021)*

EN IEC 61800-2:2021, *Adjustable speed electrical power drive systems — Part 2: General requirements — Rating specifications for low voltage adjustable speed AC power drive systems (IEC 61800-2:2021)*

EN ISO 3266:2010,³ *Forged steel eyebolts grade 4 for general lifting purposes (ISO 3266:2010)*

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 4871:2009, *Acoustics — Declaration and verification of noise emission values of machinery and equipment (ISO 4871:1996)*

EN ISO 7010:2020,⁴ *Graphical symbols — Safety colours and safety signs — Registered safety signs (ISO 7010:2019, Corrected version 2020-06)*

EN ISO 7731:2008, *Ergonomics — Danger signals for public and work areas — Auditory danger signals (ISO 7731:2003)*

EN ISO 11201:2010, *Acoustics — Noise emitted by machinery and equipment — Determination of emission sound pressure levels at a work station and at other specified positions in an essentially free field over a reflecting plane with negligible environmental corrections*

EN ISO 11688-1:2009, *Acoustics — Recommended practice for the design of low-noise machinery and equipment — Part 1: Planning (ISO/TR 11688-1:1995)*

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

EN ISO 13732-1:2008, *Ergonomics of the thermal environment — Methods for the assessment of human responses to contact with surfaces — Part 1: Hot surfaces (ISO 13732-1:2006)*

EN ISO 13849-1:2015, *Safety of machinery — Safety-related parts of control systems — Part 1: General principles for design (ISO 13849-1:2015)*

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

³ As impacted by EN ISO 3266:2010/A1:2015.

⁴ As impacted by EN ISO 7010:2020/A1:2020.

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

EN ISO 13854:2019, *Safety of machinery — Minimum gaps to avoid crushing of parts of the human body (ISO 13854:2017)*

EN ISO 13855:2010, *Safety of machinery — Positioning of safeguards with respect to the approach speeds of parts of the human body (ISO 13855:2010)*

EN ISO 13856-1:2013, *Safety of machinery — Pressure-sensitive protective devices — Part 1: General principles for design and testing of pressure-sensitive mats and pressure-sensitive floors (ISO 13856-1:2013)*

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 13856-3:2013, *Safety of machinery — Pressure-sensitive protective devices — Part 3: General principles for design and testing of pressure-sensitive bumpers, plates, wires and similar devices (ISO 13856-3:2013)*

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 14118:2018, *Safety of machinery — Prevention of unexpected start-up (ISO 14118:2017)*

EN ISO 14119:2013, *Safety of machinery — Interlocking devices associated with guards — Principles for design and selection (ISO 14119:2013)*

EN ISO 14120:2015, *Safety of machinery — Guards — General requirements for the design and construction of fixed and movable guards (ISO 14120:2015)*

EN ISO 14122-1:2016, *Safety of machinery — Permanent means of access to machinery — Part 1: Choice of fixed means and general requirements of access (ISO 14122-1:2016)*

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)*

EN ISO 14122-4:2016, *Safety of machinery — Permanent means of access to machinery — Part 4: Fixed ladders (ISO 14122-4:2016)*

ISO 4309:2017, *Cranes — Wire ropes — Care and maintenance, inspection and discard*

ISO/TS 19837:2018, *Safety of machinery — Trapped key interlocking devices — Principles for design and selection*

3 Terms and definitions

For the purposes of this document, the following terms and definitions and those given in EN ISO 12100:2010 apply.

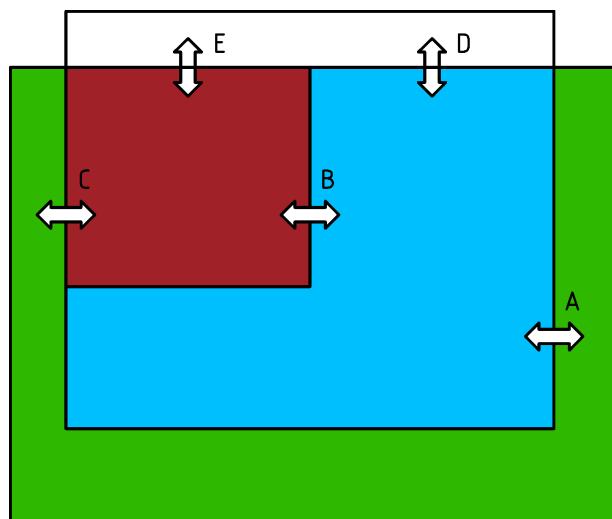
ISO and IEC maintain terminological databases for use in standardization at the following addresses:

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

3.1

area concept

subdivision of the locations in a company with defined boundaries



Key

A	entry /exit point from working place / traffic area to restricted area
B	entry /exit point from restricted area to danger area
C	entry /exit point from working place / traffic area to danger area
D	entry /exit point from public area to restricted area
E	entry /exit point from public area to danger area
White area	public area of passenger terminal (airport, harbour)
Green area	working place / traffic area
Blue area	restricted area
Red area	danger area

Figure 1 — Area concept

3.1.1

working place (green area)

place where people (e.g. pick or pack personnel) are working in a common manner (inspection, maintenance and cleaning are excluded)

3.1.2

traffic area (green area)

area accessible without opening or removing a guard or activating a safety device

3.1.3**restricted area (blue area)**

enclosed area where only qualified persons have access to do maintenance, trouble shooting and repairing work

3.1.4**danger area (red area)**

area where persons can be exposed to danger during operation of the machine

3.1.5**public area (white area)**

only area where public has access to

Note 1 to entry: By the evaluation of risks it must be taken in account that also people in weak personal condition or children may have access, too.

3.2**mobile conveyor**

conveyor with wheels which may be moved by hand on the floor

3.3**conveying level**

upper surface of the carrying elements of e.g. roller conveyors, carrying chain conveyors, plate conveyors or belt conveyors

3.4**traction element**

power driven parts of a conveyor which move the loads directly or indirectly e.g. belts, chains, straps, wire ropes

Note 1 to entry: Traction elements can also be carrying elements, e.g. the chain of a carrying-chain conveyor.

3.5**carrying element**

parts of a conveyor which carry the loads, e. g. rollers, carrying chains, belts

3.6**lifting element**

element (belt, wire rope, chain, screw-drive, gear, cylinder) to lift the load holding device of overhead conveyors or the lifting carriage of vertical transfer devices

3.7**belt conveyor**

conveyor with one or more endless belt(s) acting as a carrying and traction element

Note 1 to entry: The belt is supported by rollers or slides on a surface (Figure A.1).

Note 2 to entry: The carrying belt may also be made of flexible elements.

3.8**roller conveyor**

conveyor with rollers as carrying elements

3.8.1

gravity roller conveyor

roller conveyor in which the rollers can rotate freely (Figure A.5)

3.8.2

driven roller conveyor

conveyor where the movement of the roller is powered (Figure A.6)

3.9

carrying-chain conveyor

conveyor with chains as traction and carrying elements (Figure A.2), with or without tappets attached to the chains

3.10

underfloor chain conveyor

conveyor with chain(s) as traction element(s) located under floor level (Figure A.25)

3.11

plate conveyor

conveyor with plates as carrying elements for holding loads (Figure A.3)

3.12

rail bound conveyors

conveying system driving on one or more hanging or floor mounted rails (Figures A.4, A.7, A.8, A.26)

3.12.1

circular overhead conveyor

conveyor hanging on overhead tracks and attached directly to the traction equipment (Figure A.4)

Note 1 to entry: This traction equipment may be chains, ropes or separate trolleys driven by pusher dogs (power and free system).

3.12.2

self-propelled overhead conveyor

individually driven overhead conveyor with carrying elements or load handling device (Figure A.7)

3.12.3

rail guided floor track conveyor

system consisting of vehicles moving independently in a floor mounted closed rail system (Figure A.26)

Note 1 to entry: There may be one or more rails, with or without track switches.

Note 2 to entry: For transfer the unit loads are taken from a conveyor and are conveyed laterally and delivered to another conveyor or to another device.

3.12.4

transfer car

mechanically guided car for transferring unit loads which is taken from a conveyor or another device, pushed laterally and delivered to another conveyor or to another device (Figure A.8)

Note 1 to entry: Lateral handling device can be e.g. a conveyor, a telescopic fork, a shuttle.

3.13**vertical transfer device**

device with raising or lowering movements of more than 200 mm in the path of conveyors in which unit loads can be transferred from one defined level to one or more defined levels by a lifting carriage (Figure A.9)

Note 1 to entry: These are not to be considered as service lifts according to EN 81-3.

3.14**lifting carriage**

part of a vertical transfer device moving vertically having a carrying element on it

3.15**horizontal transfer device**

permanently installed unit in the path of conveyors which diverts the unit loads at nearly the same conveying level in a direction deviating from the original conveying direction e.g. turntable or diverting conveyors

3.15.1**turntable**

table with conveyor turning the unit loads around the vertical axis (Figure A.10)

3.15.2**diverting conveyors**

conveyor with lifting system to deviate the load from the forward to the lateral direction (Figure A.19)

3.16**qualified person**

designated person, suitably trained and qualified by knowledge and practical experience, and provided with the necessary instructions to enable the required task to be carried out safely

3.17**load handling device**

part of an overhead conveyor carrying the load and enabling the movement of the load (Figure A.7b))

3.18**non-fixed load lifting attachment**

attachment which can be fitted directly or indirectly to the connecting element of an overhead conveyor by the operator without affecting the integrity of the conveyor

3.19**tote conveyor**

conveyor with totes as transported items, which are conveyed by friction or gravity (e.g. by belt-, roller-, carrying-chain conveyor) (Figure A.15)

3.20**nip guard**

fixed guard inserted at a nip point to directly safeguard that point

3.21**unit load**

single item or number of items, or bulk material which is arranged and restrained so that the load can be stored, picked up and moved between two locations as a single mass

3.22

telescopic conveyor (boom conveyor)

conveyor with variable length

Note 1 to entry: There are different types of telescopic conveyors, e.g. belt type or roller type.

3.22.1

height adjustable telescopic conveyor

height of one or both ends of the telescopic conveyor is adjustable

3.22.2

telescopic conveyor with platform

telescopic conveyor fitted with platform attached to the last extendable section (Figure B.8)

3.23

sorter

device discharging unit loads to multiple defined destinations

3.23.1

loop sorter

sorter in form of a closed horizontal loop (Figure A.20) typically equipped with tilt tray system (Figure A.11) or cross belt system (Figure A.12)

3.23.2

line sorter

sorter in form of a closed vertical loop (Figures A.13 and A.21)

3.23.3

destination coded vehicles

vehicles moving independently in a rail system with cross belts or trays as carrying elements (Figure A.14)

3.23.4

induction unit

Several flat belt conveyors and one triangular belt conveyor arranged one behind the other to place the items on the sorter trays

3.24

vertical switch conveyor

device whereby one or more conveyors change angle of inclination for the purpose of sorting of unit loads from the flow (Figure A.24)

Note 1 to entry: These devices may be provided to merge multiple flows into one flow or divert one flow to multiple flows.

3.25

destination

discharge point of sorters (Figure A.22)

Note 1 to entry: Discharges can be driven and non-driven conveyors, chutes, destination bins, containers or bags.

3.25.1**chute**

unit load slide in almost a straight line

Note 1 to entry: Common examples are sliding plate / roller output or combination.

3.25.2**spiral chute**

curved sliding plate forming a spiral downwards (Figure A.23)

3.26**check in conveyor**

handling equipment feeding the baggage from the public area to a non-public area (Figure A.17)

3.27**(reclaim) baggage carousel**

flat or tilted link belt forming a closed loop (Figure A.18)

3.28**(reclaim) baggage conveyor**

conveyor line consisting in driven or non-driven elements

3.29**rated load**

maximum load which the machine has been designed to carry, excluding the mass of operator(s) and any part of the machine

3.30**drawing-in point**

point which occurs on the in-running side at the line of contact between the conveyor belt and rotating pulley and in certain cases between belt and an idler or point which occurs on the in-running side of a moving part (e.g. the conveyor belt, surface of a roller) passing a fixed part of the machine

4 Safety requirements and/or protective/risk reduction measures

4.1 General

Machinery shall comply with the safety requirements and/or protective/risk reduction measures of this clause. In addition, the machine shall be designed according the principles of EN ISO 12100:2010 for relevant but not significant hazards which are not dealt with by this document.

4.1.1 Area concept

An area concept as defined in 3.1 can be implemented if appropriate (e.g. for complex conveying systems).

4.1.2 Restricted area

The restricted area shall be designed in a way that personnel do not misuse the restricted area as a shortcut between any traffic area or working place. No working place shall be located in the restricted area except working places strictly related to maintenance or fault clearing.

The restricted area shall be guarded according to EN ISO 14120:2015 with the following additional requirements:

- Access doors from any working place or traffic area to the restricted area shall be fitted with self-closing means and designed to be locked and be opened from the restricted area without the use of keys or tools in order to avoid the personnel to be trapped.

Interlocking is not required for access doors to restricted areas, but they shall be designed in a way that they can be opened from outside only with a key or similar means and they shall close automatically from any position.

- In deviation to 4.2.1.1.1 open topped distance guards between traffic and restricted areas shall be at least 1,4 m high from the floor or the access platform. Walls with same properties may be fitted.
- At the entrance of the restricted area and at any control station a free standing area of at least 1,0 m × 1,0 m shall be provided in order to allow the personnel to close the door and have a clear view of the continuous handling system. Walkways shall be fitted between all these standing areas. The standing areas and walkways shall be defined and be identifiable and they shall be fitted with lighting system with a minimum of 100 lx.
- The local control panel shall be designed in order to preclude any other control system of the crossing continuous handling system except the emergency stop.

The requirements for conveyors in the restricted area are the same as in the traffic area unless otherwise specified in this document.

4.2 Protection against mechanical hazards

Typical mechanical Hazards of conveying systems are shown in Annex B (Figures B.1 to B.9).

4.2.1 General requirements for protection against moving parts

The minimum gaps to avoid crushing of parts of the human body shall comply with EN ISO 13854:2019.

The minimum safety distances to prevent hazard zones being reached by upper and lower limbs shall comply with EN ISO 13857:2019, Table 1 and Table 4 unless otherwise specified in this document.

The moving parts shall be safeguarded by guards or by sensitive protective devices if at least one of the above paragraphs is not fulfilled.

Electro-sensitive Protective Equipment (ESPE) and interlocking devices shall be applied as described in EN ISO 13855:2010. For calculation of the minimum distance of an AOPD or AOPDDR for access over a conveyor the approach speed parameter K according to EN ISO 13855:2010 for walking on roller or chain conveyors may be reduced to 800 mm/s.

Where at apertures of entry/exit points the height of the protective structure is less than 1,0 m, the horizontal safety distance to the hazard (e.g. crushing or shearing points) shall be at least 1 400 mm.

NOTE The protection of aperture can be realized e.g. by fitting a tunnel or a fixed guard.

4.2.1.1 General requirements for guards and sensitive protective devices

4.2.1.1.1 Guards

Guards shall fulfil the requirement of EN ISO 14120:2015.

Unless otherwise specified in other parts of this document open topped distance guards shall be at least 2 000 mm high from the floor or other access platform.

NOTE This measure is against climbing over a guard without using available means.

By exception of EN ISO 13857:2019, 4.4 it may be possible to have a gap between the guard and the floor e.g. for cleaning or removing unit loads, less than or equal to 240 mm. In that case the safety distance to the nearest danger points shall be at least 850 mm.

4.2.1.1.2 Interlocking devices associated with movable guards

Interlocking devices and guard locking devices associated with movable guards shall comply with EN ISO 14119:2013.

If a trapped-key interlocking device is provided it shall comply with ISO/TS 19837:2018.

If a key dependent system is provided the following requirements shall be met:

A key operated mode selector shall be fitted to the control panel of each machine to prevent unauthorised operation. With the key mode selector in the “off” position, all dangerous movements of the machine in this area shall be prevented. It shall not be possible to remove the key from this mode selector in the “on” position.

For machines having a manual mode, this key allows the operator to take control of the machine. In the case of automatic machines this key, in conjunction with the operating mode selector, allow operation of the machine for commissioning, troubleshooting or any other work where the machine needs to be operated by manual control.

To prevent danger due to a change from manual to automatic control, or vice versa, one or more key operated mode selector, or alternative means providing the same level of safety, shall be provided for each automated machine. The mode selectors are associated with the safety concept of limited access forcing special procedures:

- Enter the danger zone for manual drive: 1 – 2 – (3) - 4
- Leaving the danger zone for automatic drive: (3) – 2 – 1 – 4

(3) Only if the machine has a manual mode

Description of the steps:

- 1) mode selector AUTOMATIC/MANUAL/OFF: The key shall be possible to be removed only in manual or off-position;
- 2) door of the guard can be opened only with key from the outside; the door always can be opened from the inside; the door is interlocked;
- 3) mode selector at machine with the positions AUTOMATIC/MANUAL; key that can be removed only in position AUTOMATIC (preselection of automatic mode);
- 4) start of the machine (e.g. start push button).

When a mode selector is actuated, powered motion shall cease. The machinery shall then remain in a stationary condition. Separate start devices at the external control position, located if possible in the direct sight of the machine and on the machine, shall be provided to be actuated and thus restart the machine.

The key for the doors shall be the same key or permanently connected to the key for the main mode selector or the operating mode selector on the machine.

With a door in the guard open, movement of the machine in the corresponding machine danger area shall be prevented. Restarting can only take place at the machine or from the control station outside the enclosure with the door closed. Unexpected start-up shall be prevented in accordance with EN ISO 14118:2018.

4.2.1.1.3 Sensitive protective devices

Pressure sensitive devices shall comply with EN ISO 13856-1:2013, EN ISO 13856-2:2013 and EN ISO 13856-3:2013 depending on which applies.

Electro sensitive devices shall comply with EN IEC 61496-1:2020, EN IEC 61496-2:2020 and EN IEC 61496-3:2019 depending on which applies.

Where apertures extend from floor or other even planes of access the active optoelectronic protective device (AOPD) shall comprise at least three beams in a vertical plane, positioned at a distance of 300 mm, 700 mm and 1 100 mm from the floor or other planes of access. Where apertures extend above a conveyor, the AOPD shall comprise at least two light beams positioned at a distance of 400 mm and 900 mm from the upper edge of the conveyor (see Figures D.4 and D.5).

The muting sensor can detect the load or the transport unit (e.g. the pallet).

The gap "d" between the column of the ESPE and the conveyor shall not exceed 0,1 m (see Figure D.5).

4.2.1.1.4 Shearing/crushing between load and a fixed adjacent object

Shearing and crushing hazards may be considered as avoided if the static force to keep the load stationary or deflected is less than 150 N.

For clearances a from 120 mm to below 500 mm between conveyed unit loads and fixed adjacent objects or guards crushing and shearing points are intended to be prevented,

- if the guards have a maximum inclination of 45° to the horizontal in conveying direction (see Figures C.19 and C.20) or
- by means impeding persons to stand at the danger point, e.g. by sloping plates or guards with a minimum inclination "α" of 45° or
- foam blocks with a minimum height "h" of 0,5 m (see Figures C.21 and C.22).

The minimum distance between the beginning of the impeding means and the shearing/crushing point with the load in the most unfavourable position shall be at least 500 mm (dimensions "a" and "b", see Figures C.21 and C.22).

Crushing and shearing hazards between the posts of ESPE and the conveyed load may be considered as avoided if:

- the distance between the posts and the load is at least 120 mm and
- a static force of max. 500 N applied to the post at 1,0 m above the reference floor in conveying direction leads to the activation of the ESPE stopping the conveyor.

NOTE The posts can be e.g. spring loaded or elastic.

In restricted areas shearing/crushing between load and single fixed adjacent objects with a maximum size of "a" = 1,2 m in the conveying direction is considered to be avoided with a minimum distance "b" of 300 mm between the fixed objects and the load (see Figure C.42).

4.2.1.1.5 Crushing between two loads

At working places, relative movements of loads (e.g. at accumulating conveyors) which lead to an approach of the loads to less than 500 mm shall be prevented.

Crushing hazards may be considered as avoided if the static force to keep the load stationary is less than 150 N.

4.2.1.1.6 Drawing-in points

The drawing-in points shall be protected by guards according to 4.2.1.1.1 (see Figures C.11 and C.14).

Alternatively, drawing-in points are considered to be avoided if:

- the drawing-in points are fitted with nip guards which shall be designed to provide a continuous maximum gap "a" of 5 mm between rotating and fixed/rotating components (e.g. fixed components of horizontal or vertical transfer points, feed points, diverting points, horizontal and vertical transfer devices and gates). In addition, the angle " α " between the fixed part and the moving part shall be min. 80° (see Figure C.5), or

NOTE Nip guards are not appropriate for chain-drives.

- for diameters "c" of rotating parts up to 0,2 m a safety distance "b" to fixed or other rotating parts of at least 50 mm is maintained unless otherwise specified in this document (see Figure C.6), or
- pop up rollers are designed to provide an opening with a gap "a" of at least 50 mm when leaving his position (see Figure C.7), or
- at roller conveyors driven by motor rollers, in which torque transmission from roller to roller takes place with any kind of belt, a force of 100 N acting on the belt in conveying direction creates a clearance "a" of at least 20 mm (see Figure C.10), or
- the belt of belt conveyors can yield (leave the carrying and return idlers) to produce a clearance of at least 50 mm at the drawing-in point with a maximum force of 150 N.

4.2.1.1.7 Entanglement points

Main shafts propelling roller conveyors shall be protected by guards. This is not necessary if the force to stop the dangerous movement does not exceed 50 N (see Figure A.27).

4.2.1.2 Maximum speed for risk due to movement of unit loads

Table 1 and Table 2 specify maximum allowed speeds considering that contact with the unit load does not cause significant hazards at the indicated speed. In case of specific characteristics of the unit load e.g. sharp edges, a specific analysis shall be performed.

For higher speeds safeguarding of the conveyor is required.

The speed limitation of roller, belt, plate and carrying chain conveyors is no safety related function if the speed cannot be exceeded by more than 50 % by design.

NOTE ISO/TS 15066:2016 could provide advice for specific analysis.

Table 1 — Maximum allowed speed in the different areas for unit loads inside the width of the conveyor

Area type	UL mass > 100 kg	UL mass > 50 – 100 kg	UL mass > 35 – 50 kg	UL mass > 1 – 35 kg	UL mass ≤ 1 kg
Working place	0,5 m/s	1 m/s	1,5 m/s	2 m/s	No limits specified
Traffic area	0,6 m/s	1 m/s	2 m/s	2,5 m/s	No limits specified
Restricted area	1 m/s	2 m/s	5 m/s	6 m/s	No limits specified

Table 2 — Maximum allowed speed in the different areas for unit loads exceeding the width of the conveyor by max. 150 mm on each side

Area type	UL mass > 100 kg	UL mass > 50 – 100 kg	UL mass > 35 – 50 kg	UL mass > 1 – 35 kg	UL mass ≤ 1 kg
Working place	0,5 m/s	1 m/s	1 m/s	1,5 m/s	No limits specified
Traffic area	0,6 m/s	1 m/s	1,5 m/s	2 m/s	No limits specified
Restricted area	1 m/s	1,5 m/s	2 m/s	2,5 m/s	No limits specified

For loads exceeding the width "c" of the conveyor by more than "a" = 150 mm the clearance "b" between unit load and floor shall be at least 500 mm or less than 30 mm (see Figure C.34).

4.2.2 Conveyors in assembly-lines on which persons may travel in horizontal direction

Belt and plate conveyors, as well as assembly pallets moved by floor mounted conveyors, on which persons travel to perform their duties shall be designed so that the conveying speed is matched to the job to be performed and:

- conveying speed of 0,3 m/s is not exceeded and
- conveyors arranged more than 0,2 m above floor level are fitted with guard rails except access/egress routes.

4.2.3 Measures for protection against unintended movement

Conveyors which create hazards due to reverse movement shall be designed so that unintended reversing is prevented.

Reverse movement can be prevented e.g. by:

- mechanical braking systems; or
- anti-run-back devices.

On inclined chain conveyors, the chain strands shall be guided so that they cannot bunch in the case of chain breakage or reversing, e.g. by a blocking device.

For conveyors assembled with wheels which are intended to be moved by hand, at least two wheels shall be fitted with locking devices to ensure that the conveyor does not move unexpectedly when it is in use.

4.2.4 Strength calculation

4.2.4.1 Strength of non-fixed load lifting attachments

The safety factors in relation to the static load for the calculations for non-fixed load lifting attachments shall be 2 referring to permanent deformation and 3 referring to breakage.

4.2.4.2 Strength of ropes, chains and belts for lifting purposes

The minimum tensile strength of a belt at maximum rated load and auxiliary loads for all types of belts shall be at least 5 times the maximum static load that can occur at any belt. If they are intended to carry persons or if people are staying under the load, the overall safety factor shall be 10 (2×5 in a redundant system, 1×10 in a system with safety-catching device).

The minimum tensile strength of steel wire ropes and chains at maximum rated load and auxiliary loads for all types of ropes or chains shall be at least 4 times the maximum static load that can occur in each rope or chain. If they are intended to carry persons or if people are staying under the load, the overall safety factor shall be 8 (2×4 in a redundant system, 1×8 in a system with safety-catching device).

4.2.5 Stability against overturning for mobile conveyors

Machines fitted with wheels shall be designed so that they do not move or tilt in a static test while they are placed on a 5° slope independent of its orientation.

4.2.6 Protection against falling or ejected objects

Conveyors shall be designed to prevent persons from being injured by falling conveyed loads, e.g. by side guards and/or under guards such as rope nettings, wire mats, plates or barriers.

4.2.7 Prevention of sharp edges, sharp angles and rough surfaces

Sharp edges, sharp angles and rough surfaces shall be avoided as described in 6.2.2.1 c) of EN ISO 12100:2010.

4.2.8 Preventing access to danger areas across the load entry/exit points or stopping the dangerous movement (Figure 1: B or C)

Access to the danger area is considered to be prevented if the following requirements are met (see Figure D.15):

- a) the gaps "a" between two conveyors or between the conveyor and the fixed adjacent objects are not greater than 120 mm. For gaps greater than 120 mm fixed guards (1) and nets (4), mats, sloping plates (5) or roof type profiles as described in 4.2.10 are provided along the conveyor (2) to prevent passing beside or between the conveyors. The minimum angle " α " of the sloping plate to the horizontal is at least 45° . The length "c" of the means to prevent access along the conveyors shall be at least 1,2 m. If the conveying height is less than 0,3 m, the length of the means shall be at least 2,0 m, and
- b) the gaps "d" below the conveyor are not greater than 240 mm and
- c) the conveyors are fixed firmly in place and
- d) an access for troubleshooting or maintenance shall be provided

and one of the following measures is fulfilled:

- 1) sensitive protective devices according to 4.2.1.1.3 are provided; the activation of the protective device shall stop the dangerous movement.

NOTE 1 Additional measures for preventing from falling can be necessary.

- 2) the distance "a" between the conveying level and the top of the opening is max. 500 mm high (see Figure D.16);
- 3) tunnels are provided and the distance "a" between the conveying level and the top of the opening is:
 - max. 0,6 m high with a tunnel length a of at least 0,8 m;
 - max. 0,8 m high with a tunnel length a of at least 1,0 m;
 - max. 1,0 m high with a tunnel length a of at least 1,2 m

(see Figure D.14);

- 4) conveying height is 1,0 m high or more (see Figure D.17); conveyors and any other installation (e.g. guards) are designed to prevent people climbing to the aperture. The next crossover passageway shall be at least 2,0 m away from the aperture for conveyors designed to prevent walking on as described in the second paragraph of 4.2.9. For other conveyors the distance shall be at least 5,0 m;
- 5) carrying chain and twin belt conveyors are equipped with a pressure sensitive protecting device marked in warning colours black/yellow (see Figure D.11) and:
 - a fixed guard parallel to carrying chain conveyors and twin belt conveyors is provided and
 - the centre distance between the chains and belts shall be at least 0,85 m and
 - the chain and belt width shall be less than 40 mm;

NOTE 2 Additional measures for preventing from falling can be necessary.

- 6) guards as gates, roller shutter gates (see Figure D.3) swinging doors (see Figures D.7 and D.8) or sliding doors are provided. The guards shall withstand a minimum force of 300 N on area of 200 mm × 200 mm in the most unfavourable position without losing the protective function. The closed position of the guards shall be interlocked. The interlocking of the guards can be muted to allow the load to pass;
- 7) the access over and between gravity roller conveyors is considered to be prevented, if each of the following requirements are met over the length "a" of at least 2,0 m (independent from the height of the conveyor) (see Figure D.10):
 - a) the roller length "b" is 0,85 m minimum (see Figure D.19) and a gap between rollers in conveying direction is 0,12 m maximum;
 - b) the frame width "a" of the conveyor shall not exceed 40 mm or the possibility of walking on the frame of the conveyor is minimized by the design of its surface, e.g. by profiles according 4.2.10 (see Figure D.1);
 - c) the distance "e" between two gravity roller conveyor tracks (distance from roller to roller) is not greater than 80 mm (see Figure D.19) or the entry between the tracks shall be prevented by the use of roof-type profiles (see Figure D.19) or separating plates (see Figures D.9, D.10).

For distances of 500 mm or more between the roller conveyors instead of single roof-type profiles or plates, nettings in combination with roof-type profiles on the frames of the roller conveyors can be fitted.

4.2.9 Preventing access across the load entry/exit points to restricted areas (Figure 1: A)

Access across the load entry/exit points to the restricted area is considered to be prevented, if the requirements of 4.2.8 are met. The sensitive protective device between traffic area or working place and restricted area may lead to just an acoustic and/or visual alarm instead of stopping movement.

In addition, access to restricted areas over roller conveyors, carrying chain conveyors and twin belt conveyors is considered to be prevented if the requirements of 4.2.8, a), b), c), d), and 7) b) and one of the following requirements are met:

- a) driven roller conveyors have a roller length of 0,85 m minimum (i.e. width of the conveyor) and a gap between the rollers of at least 0,12 m;
- b) gravity roller conveyors have a roller length of 0,85 m minimum (i.e. width of the conveyor) and a gap between the rollers is 0,12 m maximum;
- c) the chains of carrying chain conveyors have distances of more than 0,85 m and a chain width of less than 40 mm. The area between the chains shall be equipped e.g. with nets or mats (see Figure D.2 Nr. 1);
- d) the belts of twin belt conveyors have distances of more than 0,85 m and a belt width of less than 40 mm. The area between the belts shall be equipped e.g. with nets or mats.

4.2.10 Requirements for separating plates, nets, mats, roof type profiles and sloping plates

Nets or mats fitted to prevent access shall be steel wire rope net or fibre rope net or mats with an opening size between $0,14\text{ m} \times 0,14\text{ m}$ and $0,2\text{ m} \times 0,2\text{ m}$. This net or mat shall be capable of bearing a load of 100 kg applied on an area of $0,1\text{ m} \times 0,25\text{ m}$ at any point of the net or mat without wire or rope breaking. When applying this load, the net or mat shall not come into contact with the floor or parts of the conveyor below.

The angle “ α ” of sloping plates to the horizontal shall be at least 45° (see Figures D.15, D.19).

The roof-type profiles shall meet the following specifications (see Figure D.1 a)):

- minimum height “ b ” of 100 mm to prevent access beside or between the conveyors;
- minimum angle “ α ” of 45° on both sides.

Instead of roof-type profiles L-profiles or upside-down T-profiles with the same minimum height may be provided if no horizontal surface is wider than 40 mm (see Figure D.1 b)).

To meet the requirements of 4.2.8, 7) c) the separating plates shall comply with the following specifications:

- minimum length “ a ” of 2,0 m (see Figure D.9);
- minimum height “ c ” of 2,0 m where appropriate and (see Figure D.10);
- maximum distance “ d ” of 180 mm between plate and load (see Figure D.10).

4.3 Measures for protection against electrical hazards

4.3.1 Electrical equipment

The electrical equipment of conveyors shall comply with EN 60204-1:2018, together with the particular requirements below.

If the conveyor is intended for use in conditions outside the range of EN 60204-1:2018 e.g. ambient temperature, humidity, altitude, corrosive atmosphere, the manufacturer shall take account of this in the design.

4.3.2 Means of disconnection

Where the conveyor is part of a system which is sub-divided into individual sections, each section having a discrete supply, each individual section shall be capable of isolation from the supply to allow work to be carried out.

4.3.3 IP-Degree of protection

Equipment shall be suitable for the intended working environment. Enclosures (cabinets, boxes, compartments) for the electrical equipment shall provide suitable protection. Where enclosures for electrical equipment are indoors, they shall have a minimum degree of protection of IP 22, for motors IP 23 and when outdoors and subject to liquid penetration they shall have a minimum degree of protection of IP 55. The IP-Degrees shall be in accordance with EN 60529:1991¹.

4.4 Safety requirements related to EMC

NOTE Subclause 4.4 is related to the Machinery Directive.

The continuous handling equipment shall have sufficient immunity to electromagnetic disturbances to enable it to operate safely as intended and shall not fail to danger when exposed to the levels and types of disturbances as specified in EN IEC 61000-6-2:2019. The manufacturer of the continuous handling equipment shall design, install and wire the equipment and sub-assemblies taking into account the recommendations of the supplier(s) of the sub-assemblies, to ensure that the effects of electromagnetic disturbances thereon shall not lead to unsafe operation and/or failure to danger.

The following performance criteria shall be used to determine the result (pass/fail) of EMC immunity testing:

- a) for those tests specified in EN IEC 61000-6-2:2019 the performance criteria as specified in EN IEC 61000-6-2:2019 shall apply;
- b) with regard to all the performance criteria specified in EN IEC 61000-6-2:2019 (A, B, etc.), there shall be no loss of performance or degradation of performance which could lead to danger. In particular, the following loss of performance or degradation of performance shall not occur:
 - unexpected start-up (see EN ISO 14118:2018);
 - blocking of an emergency stop command or resetting of the emergency stop function (see EN ISO 13850:2015 and EN 60204-1:2018);
 - inhibition of the operation of any safety/interlocking device, any reduction in fault detection capability of safety related control systems with electronic components according to 4.15, as far as such systems have been chosen for safety/interlocking devices according to the before mentioned clauses.

Information on measures to reduce the effects of electromagnetic disturbances on the continuous handling equipment is given in EN 60204-1:2018.

4.5 Electrostatic charges

Hazards including shock and fire may be caused by electrostatic charges. Protective measures shall be taken by earth bonding of the main structure of the conveyor.

NOTE Provisions for electrostatic hazards can be found in IEC/TS 60079-32-1:2013+A1:2017.

4.6 Hydraulic and pneumatic systems and equipment

4.6.1 Hydraulics

Hydraulic systems and equipment shall be provided in accordance with EN ISO 4413:2010.

4.6.2 Pneumatics

Pneumatic systems and equipment shall be provided in accordance with EN ISO 4414:2010.

4.7 Measures for isolation and energy dissipation

Measures for isolation and energy dissipation shall comply with 6.3.5.4 of EN ISO 12100:2010 and respectively comply with:

- EN 60204-1:2018, 5.3, 5.6 for electrical equipment;
- EN ISO 4413:2010, 5.4.7.2.1 for hydraulic equipment;
- EN ISO 4414:2010, 5.2.8 for pneumatic equipment.

4.8 Protection against thermal hazards

Where any part of the equipment which, on contact with persons, can lead to burns or scalds due to the temperature of hot surfaces exceeding the values defined by EN ISO 13732-1:2008, measures shall be taken to prevent contact with hot surfaces e.g. screens or fixed guards.

4.9 Noise reduction at design stage

When designing a conveyor, information and technical measures to reduce noise at source given in EN ISO 11688-1:2009 shall be taken into account.

Common measures are for example:

- low-noise motors, gears and transmission elements (e.g. belts instead of chains),
- avoiding transmission of vibrations from the motor to the structure of the conveyor,
- rubber-covered rollers,
- noise-reduced load carrying elements (e.g. rubber covered bins or trays)
- enclosures,
- screens,
- silencers.

Other measures with same or better efficiency can be applied.

For the measurement of noise emission see Annex E.

4.10 Means of access

4.10.1 General

Permanent means of access shall comply with EN ISO 14122-1:2016, EN ISO 14122-2:2016, EN ISO 14122-3:2016, EN ISO 14122-4:2016.

The conveyor system shall be designed so that means of access are provided to control stations and work places for operation, inspection, cleaning and maintenance.

Means of access shall be permanent with the following exceptions specified below.

For maintenance and repair permanent access may be replaced by external means of access e.g. moveable platforms, mobile elevating work platforms, scaffolding.

4.10.2 Cross over passageways

The hazards and risks at the crossing points shall be assessed taking account of the speed and frequency of the conveyed loads together with the frequency of use by persons and the position of the crossing point.

The cross over passageway of the conveyor is considered as safe if the time between the possibility to see the moving conveyed goods and its reaching of the passageway is at least 4 s and:

- cross over passageways on roller conveyors have a minimum infill plate width "a" of 0,1 m with an anti-slip covering (e.g. checker plates, expanded metal, grids) having a total width "b" of at least 0,5 m of the roller conveyor section (see Figure C.39), or
- cross over passageways on chain conveyors and twin belt conveyors have anti-slip covering (e.g. checker plates, expanded metal, grids) between the chains having a minimum width "a" of 0,5 m plus 0,3 m to each side of the passage (see Figure C.23), or
- belt, plate or roller conveyors up to a width "a" of 0,8 m are fitted with landings with a minimum depth "b" of 0,3 m on both sides (see Figure C.24).

If the time between the possibility to perceive the moving conveyed goods and its reaching of the passageway is less than 4 s or the width of belt or plate conveyors exceeds 0,8 m one of the following measures is provided to stop conveyors:

- protective devices, e.g. opto-electronic devices or pressure sensitive devices;
- moveable interlocked guards.

It shall be ensured that the conveyor can only be restarted by the voluntary actuation of a control provided for this purpose or automatically with 5 s delay after a start-warning of 3 s.

Alternatively means of access forming a bridge may be provided (see Figure C.25).

By exception of EN ISO 14122-3:2016, 7.2 and 7.4.1:

- self-closing-gates are not mandatory;
- for crossover heights between 0,5 m and 1,0 m a handrail or post may be provided instead of guardrail.

Where there is a risk of shearing and/or crushing the clearance distance between the moved loads and the handrail or post shall be min. 0,3 m (see Figure C.23).

Passageways on conveyors which are provided to be used as escape route shall be equipped and controlled to ensure the necessary width of the escape route.

NOTE National regulations regarding escape routes can apply.

Parts of conveyors which can be hinged to enable passing through shall remain in the raised position so as to avoid unintended fall back, e.g. by mechanical latches, springs or hydraulic counterbalance devices. In the raised position feeding of loads shall be prevented.

4.11 Provisions for maintenance

4.11.1 Work at machines with open guards

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

However, if this objective cannot be achieved for technical reasons, a special operation mode which permits operations with open guards shall be provided subject to all of the requirements below:

- a) a hold-to-run control device shall be provided such as a three-position push button, an electronic hand wheel or a joy stick;
- b) hazards, e.g. presented by moving parts, ejected parts or high temperatures, shall be prevented by additional guards within the accessed area wherever possible and the design of all guards and of the control system shall minimize the risks of injury to the operator;
- c) where necessary a three-position hold-to-run control device shall be provided (see 4.20.11.10). Release of the hold-to-run control button or pressing it further than to the run position shall lead to a safety related stop and prevent unexpected start up;
- d) the hold-to-run function shall only be available after a lockable mode selector complying with 9.2.3.5 of EN 60204-1:2018, e.g. a key operated switch, is operated. The mode selector shall comply with 9.3.6 of EN 60204-1:2018 and its activation shall prevent the machine from operating in automatic mode;
- e) the hold-to-run control device shall be positioned so that the operator has a clear view of all the parts of the machine where the hazardous functions are possible;
- f) if it is necessary to carry out potentially hazardous functions while interlocked guards are open, all other interlocked guards which would allow access to hazard zones and are not within a clear view of the operator shall continue to be interlocked as during normal operation;
- g) the control system shall ensure that hazardous movements or other hazardous functions initiated by the hold-to-run control are limited e.g. step by step, or at a safe reduced speed or with reduced power, pressure and energy. Where electrical power drive systems with adjustable speed are provided these functions shall comply with EN IEC 61800-1:2021 and EN IEC 61800-2:2021;
- h) the hazardous movement or other hazardous functions shall stop as quick as possible.

Cableless control devices shall meet the requirements of EN 13557:2003+A2:2008, Annex C.

4.11.2 Lighting

Integral lighting of machines – if applicable – shall comply with EN 1837:2020.

4.12 Transport of machines

All forces occurring during the intended transportation method shall be taken in account for the construction of the machines.

NOTE Securing forces are described in EN 12195-1:2010, EN 12195-1:2010/AC:2014.

Where tying down points cannot be used without ambiguity they shall be identified adjacent to the points by fitting ISO 7000:2019 symbol 2069 (Figure 2), preferably with contrasting colour:

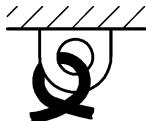


Figure 2 — Tie down point

4.13 Lifting of machines or parts of the plant

Where lifting attachments (e.g. non-fixed load lifting attachments according to EN 13155:2020, chain slings according to EN 818-4:1996+A1:2008 or EN 818-5:1999+A1:2008, textile slings according to EN 1492-1:2000+A1:2008, EN 1492-2:2000+A1:2008, EN 1492-4:2004+A1:2008 depending on which applies and slings according to EN 13414-1:2003+A2:2008 or EN 13414-3:2003+A1:2008) cannot be used for machines or parts of the plant or spare parts, lifting attachment points according to EN ISO 3266:2010³ shall be provided. In accordance with EN 1005-2:2003+A1:2008, Table 1 this is not necessary for loads up to 25 kg intended to be moved by 1 person and for loads up to 40 kg intended to be moved by 2 persons.

Where lifting attachment points cannot be used without ambiguity they shall be identified adjacent to the points by fitting ISO 7000:2019 symbol 1368 (Figure 3), preferably with contrasting colour:



Figure 3 — Lift point

4.14 Ergonomic requirements in machine design

In the case of loading and/or unloading by hand, the design of the conveyor (height, width, speed, etc.) shall be in accordance with ergonomic principles according to EN 614-1:2006+A1:2009.

In deviation to EN ISO 14122-3:2016 at work places the height a of the guard may be reduced to 0,9 m in order to facilitate manual material handling (see Figure C.33).

4.15 Control devices

Control devices shall be designed according to EN ISO 12100:2010, 6.2.11.8 to 6.2.11.12 in accordance with 4.1 of this document.

4.16 Start and restart function

Start and restart devices shall need intentional manual action to be actuated. They shall be positioned within reach of the operator at the operating position and shall be clearly identifiable and visible.

If starting and restarting a conveyor may result in a hazardous condition, an unambiguous auditory danger signal according to EN ISO 7731:2008 and/or visual danger signal according to EN 842:1996+A1:2008 shall be provided, as appropriate. Such signals shall be provided e.g.:

- when accessible conveyors are out of sight of the position of the starting device;
- when it is necessary to warn persons, who may be in the area that a particular conveyor or mechanism is about to start;
- if a conveyor system can be controlled from different points where direct communication is not possible.

This does not apply to systems which operate automatically in an intermittent mode.

Where a conveyor is arranged to feed onto other conveyors, starting shall be coordinated by the use of interlocks. Such interlocks shall ensure correct sequential starting and prevent conveyors being fed which are not in operation or which are already operating fully loaded.

4.17 Stop functions and stop control devices

Stop control devices shall be positioned at all control stations within easy reach of persons and shall be clearly identifiable and visible. The stop function shall be a category "0" or "1"; for operational stop the category may be "2" depending from the design requirements (see 9.2.2 and 9.2.3.3 of EN 60204-1:2018); in this case the stop condition shall be monitored and maintained (see EN ISO 13849-1:2015).

Stop control devices shall not require sustained manual actuating force. After actuation of a stop control device, the appropriate conveyor, or if required the conveyor system, shall come to a stop and then remain in a stationary condition.

The stop function shall be designed to avoid creating hazardous conditions (e.g. dangerous discharge of conveyed material). If the stopping of particular conveyors could cause hazards at other related parts of the installation, stopping shall be suitably controlled (e.g. by time delay or sequencing).

4.18 Emergency stopping

The emergency stop system shall be in accordance with EN ISO 13850:2015 and EN 60947-5-5:1997² for force and deflection.

Emergency stop devices shall be positioned at all control stations and working places including manual loading and unloading points. The distance between the emergency stop and any location within the working place shall not exceed 5 m. For working places in straight assembly lines the distance shall not exceed 10 m.

In addition, emergency stop devices along the conveying system shall be:

- one or more emergency actuators, which shall be installed in such a way that at least one may be reached within 10 m from any point of the equipment; this distance may be doubled in restricted areas for straight (without any changing of direction) belt-, roller-, chain- and overhead conveyors with a transport length of more than 80 m if the conveyor system is stopped at least over this length and/or
- one or more pull-cord operated switches arranged along the installation; or

- the conveyor power supply disconnecting device if the distance from any accessible point of the conveyor to the disconnecting device is 10 m or less.

The minimum height of an emergency stop device from floor level shall be 0,6 m and the maximum height shall be 1,9 m with the following exceptions:

- conveyors with the height lower than 0,6 m (see Figure C.18 a));
- baggage (reclaim) carousels (see Figure C.18 b)).

Emergency stops are not required:

- in areas where the lowest point of the conveyor is min. 2,5 m above walking floor and/or
- in areas only accessible when the machine has stopped (safe guarded by an interlocked gate) and/or
- in areas only accessible in manual mode (safe guarded by an interlocked gate) where the manual controls are equipped with an emergency stop device and/or
- in control rooms of complex systems (even if a Closed Circuit TV-system exists)
- at remote desktop control devices.

4.19 Failure of the power supply

It shall be ensured that in the case of a power supply failure, all movements are stopped. The stopping distance shall be as short as possible but compatible with the safety of the system. Unpowered motion shall be prevented. Further, no reverse movements of conveyed loads shall be possible and the overspeed designed by the manufacturer shall not be exceeded.

In the case of a power supply failure, the infeed of conveyed loads shall be interrupted.

4.20 Particular/additional requirements for specific conveyors

4.20.1 Vertical switch conveyors

Access to the danger zones of a vertical switch conveyor (see Figure A.24) shall be prevented by guards according to 4.2.1.1 whereby at least one side is equipped with an interlocked access door to allow operational intervention. The access in conveying direction shall be prevented according to 4.2.8.

For maintenance purpose, vertical switch conveyors shall be fitted with a device securing the switch mechanism against dropping e.g. by a dead bolt. This mechanism may be engaged manually and shall be of positive locking type (form locked).

4.20.2 Crushing and shearing points between conveyors and conveyed unit loads

4.20.2.1 Crushing and shearing points between roller conveyors and conveyed unit loads

At working places crushing and shearing points at roller conveyors between conveyed unit loads and rollers shall be safeguarded e.g. by panelling the space between the rollers by filling pieces or plate covers which are brought up to the roller so that a gap "a" of 5 mm at the most remains, (see Figure C.15). Shearing and crushing hazards may be considered as avoided if the static force to stop the load is less than 150 N.

In traffic and restricted areas safeguarding may be omitted.

NOTE Loading and unloading points for lift trucks are not working places.

4.20.2.2 Crushing and shearing points between carrying-chain or multi belt conveyors and conveyed unit loads

At working places crushing and shearing points between conveyed unit loads and fixed parts between the chains of carrying-chain conveyors or between the belts of multi belt conveyors shall be safeguarded e.g. by complete panelling of the area above cross beams close below the transport level. Shearing and crushing hazards may be considered as avoided if the static force to stop the load is less than 150 N.

NOTE Loading and unloading points for lift trucks are not working places.

4.20.3 Nip points on belt driven roller conveyors

Nip points on belt driven roller conveyors shall be safeguarded (example see Figure C.13).

4.20.4 Plate conveyors

At working places and in the traffic area, crushing points between the plates (see Figure B.1) shall be safeguarded e.g. by providing a fence or a tunnel.

4.20.5 Underfloor chain conveyors

Underfloor chain conveyors (see Figure A.25) shall be safeguarded in accordance with 4.2.1.1.3. This is not necessary if the following requirements are met:

- the maximum speed does not exceed 0,06 m/s;
- in deviation to 4.18 Emergency stop devices shall be installed in such a way that at least one may be reached within 5 m from any point of the equipment;
- the distance between the frame of the car and the floor shall not exceed 30 mm in driving direction;
- the wheels and the rollers of the car shall be arranged or protected so that foot injuries are prevented. For the necessary space for feet see Figure C.32.

The chain guidance slot in the working and traffic area shall not be wider than 30 mm or be covered. The cover of the chain duct shall be laid flush with the floor.

If pushers of underfloor chain conveyors run above the floor level, the tracks shall be marked clearly.

Transport routes of underfloor chain conveyors shall be marked according to the width of the loaded car profile gauge by clear markings on the floor.

4.20.6 Telescopic conveyors (boom conveyors)

The safety factor against tilting in conveying direction shall be at least 1,5 in the worst condition. In addition, a load of 100 kg at the front of the conveying system shall be taken into account.

With exception of the control of the belt movement of the telescopic conveyor, all controls shall be of hold to run type.

To prevent the drawing in hazards, nip guards shall be provided as shown in Figure C.26. The distance "a" between drawing-in points and the end of the conveyor shall be at least 100 mm.

If the forces occurring while telescoping exceed 150 N a pressure sensitive device shall be fitted over the whole width of the conveyor, according to 4.2.1.1.3. On each side of the pressure sensitive device a section of 50 mm may be inactive. When activating the device, the telescopic conveyor shall fulfil a reverse movement of at least 0,3 m.

The extending speed shall not exceed 0,3 m/s.

Auxiliary equipment fitted to the last section of the telescope shall be installed 500 mm behind the front of the safety device and/or the end of the conveyor. To prevent injury of fingers / hands a minimum clearance of 50 mm between the unit load and the auxiliary equipment shall be maintained.

4.20.6.1 Height adjustable telescopic conveyors

The requirements of 4.20.8.4.2 in case of "failure of a lifting element" shall be met.

To prevent foot-injuries, the shape of the height adjustable part of the frame of the conveyor shall be in accordance with Figure C.32.

If the vision on the area along the conveyor is limited, crushing and shearing points due to the lowering movements shall be safeguarded by guards according to 4.2.1.1.1 or sensitive protective devices according to 4.2.1.1.3.

4.20.6.2 Rail bound mobile telescopic conveyors

Power driven rail bound mobile telescopic conveyors moving transversal to the direction of the extension shall fulfil the requirements of 4.20.7 and the following:

- the stopping distance shall not exceed 80 mm;
- the maximum driving speed shall not exceed 0,3 m/s if the telescopic unit is fully retracted;
- the maximum driving speed shall not exceed 0,05 m/s if the telescopic unit is not fully retracted. The control of this movement shall be possible only at the last section of the telescope;
- the controls for driving shall allow good vision towards the direction of travel.

Crushing hazard for feet between wheels and rails shall be prevented by a cover plate leaving a maximum gap of 20 mm to the floor.

If clamps are fitted to generate downforce (i.e. for long telescopic conveyors with a short base frame), lateral movement shall be prevented unless the clamps are designed for sliding on the rails.

4.20.6.3 Telescopic conveyors with platforms

The platform shall be designed in accordance with EN ISO 14122 series. For ergonomic reasons, the height of the guardrail on the work front side may be reduced to 0,9 m. The handrails on the sides can be curved down to the front side guardrail. The guardrail on the work front side is not mandatory, if the possible falling height "a" under normal working conditions remains limited to 1 m (see Figure B.8).

The platform shall meet the following requirements:

- maximum deviation from the horizontal plane shall be 5°;
- the flooring of the platform shall be slip resistant and free from tripping obstacles;
- to prevent crushing of hand / fingers against the trailer wall or against the load the guardrails shall be positioned at least 50 mm inwards with respect to the platform edge.

For telescopic conveyors with platforms a pressure sensitive device as required in 4.20.6 may be omitted if the maximum speed does not exceed 0,15 m/s.

4.20.7 Rail bound conveyors

Rail bound conveyors such as rail bound mobile telescopic conveyors (see 4.20.6.2), overhead conveyors (see 4.20.8.), transfer cars (see 4.20.9) and destination coded vehicles and floor track conveyors (see 4.20.10) shall be designed to prevent derailing and/or dropping and/or accumulation of substances/obstacles on rails. The requirements may be satisfied by additional supporting devices (e.g. in case of breaking of the axles of rollers) or by design of rails preventing obstacles remaining on it.

At any end of tracks and rails end stops shall be fitted. For those line sections in which maintenance work has to be performed on carrying structure temporarily mounted end stops shall be provided.

4.20.8 Overhead conveyors

4.20.8.1 General

Persons shall be protected against the hazards caused by approaching mobile units of overhead conveyors. Interlocking or sensitive protective devices shall be in accordance with 4.2.1.1.2 or 4.2.1.1.3. This is not required for overhead conveyors according to 4.20.8.2 with a max. speed of 0,5 m/s.

A lateral safety distance of at least 1,0 m shall be maintained when they pass by doors, gates, passages or stairway exits.

The requirements of 4.20.7 shall be met.

4.20.8.2 Safety distances for overhead conveyors

A lateral minimum distance "a" of 0,5 m up to a height b of 2,5 m above the standing surface of persons shall be maintained between the conveyors, their loads and fixed objects in the surroundings (see Figure C.2). Where the lateral distance to fixed objects e.g. columns of the building is less than 0,5 m additional measures shall be fitted, e.g. sloping plates or protective devices.

The overhead conveyors shall be stopped so as to leave a distance "a" in the direction of travel between two mobile units and/or their loads of at least 0,5 m up to a height "b" of 2,5 m above the standing surface of persons (see Figure C.3). Swinging of the mobile units shall be taken into account.

The following vertical safety distances under overhead conveyors, including the suspended conveyed materials, down to the floor or up to fixed objects shall be maintained at least:

- "c" = 0,5 m between the floor and mobile units (see Figure C.3);
- "a" = 0,5 m, above parts of structures or machines and above other traffic and transport means which move under overhead conveyors where persons can be injured by crushing hazards (see Figure C.4).

4.20.8.3 Safety distances for overhead conveyors in restricted areas

In deviation to 4.20.8.2 for speeds up to 1,0 m/s the distance "c" between the floor and mobile units shall be at least 0,12 m (see Figure C.3).

4.20.8.4 Working places under, on or at overhead conveyors

4.20.8.4.1 Maximum speeds at working places under, on or at overhead conveyors

- The maximum travelling speed shall not exceed 0,2 m/s; for ergonomic reasons this is also allowed for heights from 0,12 m to 0,5 m between the floor and mobile units provided that the floor is flat and without obstacles;
- the maximum lifting speed between 0,12 m and 2,5 m shall not exceed 0,3 m/s;
- the maximum lowering speed between 2,5 m and 0,5 m to the floor shall not exceed 0,12 m/s;

- the maximum lowering speed for heights under 0,5 m to the floor shall not exceed 0,05 m/s or the lowering movement is done by a hold to run control with a maximum speed of 0,12 m/s.

4.20.8.4.2 Lifting elements in case of working places under, on or at overhead conveyors

In case of failure of a lifting element (belt, wire rope, chain, screw-drive, gear, cylinders) it shall be prevented that the load handling device or the load lowers more than 100 mm, including eventual tilting movements.

This requirement is fulfilled for:

- belts, wire ropes and chains, if at each lifting point at least two independent belts, wire ropes or chains are provided (see Figures C.27 and C.28). The breaking force shall be at least 10 times the maximum static force that can occur for belts and at least 8 times for wire ropes and chains;
- screw-drives if each spindle is fitted with a load bearing nut and an unloaded safety nut or other constantly active safety device. The safety nut shall only be loaded if the load bearing nut fails. The lead screw material shall have a higher abrasion resistance than the load bearing nut material;
- gears and winding shafts, if they are dimensioned for the double load;
- hydraulic cylinders with pilot valve including the piping system, if they are dimensioned for the double of the maximum pressure permitted by the pressure relief valve;
- pneumatic cylinders with pilot valve, if they are dimensioned for the triple of the maximum pressure permitted by the pressure relief valve.

Alternatively, an independent working safety gear and overspeed governor in accordance with EN 81-20:2020 shall be provided.

4.20.8.4.3 Inadvertent vertical motion at working places under, on or at overhead conveyors

An automatic system shall prevent inadvertent motion of the load handling device. This shall be a positive locking and/or a brake system. This system shall act directly to the winding shafts or drums. Where the redundant transmission elements have the same safety factors as the lifting elements described in 4.20.8.4.2, the safety brakes may be fitted directly at the motors. Where brakes are fitted to fulfil this requirement, compression springs shall provide the brake action. The brakes shall be capable of stopping the movements of the hoist unit with its rated load safely at its rated speed and maintaining it in its stopped position (see Figures C.27 and C.28).

If a holding brake is fitted together with other equivalent devices, the holding brake shall be able to stop any movements in an emergency case with the same conditions as above. In this case, limited lifetime of the holding brake is accepted.

For hydraulically driven lifts, pilot operated non-return valves located directly at the cylinders fulfil this requirement.

Transmission elements between driving machinery and winding shafts shall be redundant (see Figures C.27 and C.28). Positive locking transmission elements shall be provided (e.g. toothed belts, chains).

In case of failure of a lifting or transmission element and in case of slack of the lifting elements all movements shall be stopped. It shall be possible to lower the load. The lifting operation from the initial position shall be possible only without load. Lifting shall still be possible in case of slack of the lifting elements.

The load on the load handling device shall be secured by a positive locking system.

4.20.8.4.4 Working on overhead conveyors or on the load in assembly lines

Entering and leaving the overhead conveyor, respectively the load, shall happen at a height of not more than 600 mm.

The falling height shall be not more than 1 m.

4.20.8.5 Rollers of overhead conveyors

Rollers moving in tracks at a height less than 2,7 m above the ground shall be safeguarded e.g. by wheel guards providing a maximum gap "a" of 5 mm between guard and rail or guard and roller or other guards (see Figure C.12).

4.20.8.6 Dimensioning of track, steelwork and carrier

If no further data are available, the following horizontal forces shall be assumed for calculation:

- drive direction: 10 % of vertical loads;
- lateral direction: 5 % of vertical loads;
- worker forces: 500 N at the most unfavourable point and direction per worker.

4.20.8.7 Interruptions of tracks of overhead conveyors

In the case of overhead conveyors at points of interruption of tracks, e.g. switches or transfer points, there shall be devices which prevent the falling of any parts of the overhead conveyor. These devices shall be one or a combination of the following:

- appropriate electrical interlocking systems inserting automatically mechanical end stops;
- mechanical interlocking systems.

4.20.8.8 Load securing

The design shall take into account the following situations in order to keep the load fixed to the overhead conveyor:

- acceleration and deceleration;
- passing curves and switches;
- inclining and declining sections;
- emergency stop;
- crashing into mechanical bumper of conveyor ahead.

4.20.8.9 Transfer devices of overhead conveyors

For all types of overhead conveyor systems with transfer devices, transfer shall not take place until the transfer device is confirmed in position. This shall be ensured by one or a combination of the following measures:

- electric/electronic position control;
- mechanical position control.

4.20.8.10 Maintenance vehicles for overhead conveyors

Maintenance vehicles designed for use with overhead conveyors shall be fitted with the following means:

- a local control device with hold-to-run function;
- an escape device, such as a descender device according to EN 341:2011;
- means of access according 4.10.1;
- measures against falling of persons;
- protection measures against crushing either guards or a protective device according to 4.2.1 or by fitting a two-hand-control according to EN ISO 13851:2019 at a safe place for any person on the vehicle. The stopping time shall not exceed 0,5 s;
- measures against derailing according to 4.20.7;
- the maximum speed shall not exceed 0,5 m/s.

4.20.8.11 Maintenance requirements for self-propelled overhead conveyors

In addition to 4.11 the following means shall be provided:

- a dedicated station for maintenance of self-propelled overhead conveyor vehicles and carrying elements; this station shall be separated from the main track;
- a system for isolation of all energy supplies at maintenance station (see 4.7);
- a system to insert/to take out self-propelled overhead conveyors vehicles e.g. lifting track sections.

4.20.9 Transfer cars

4.20.9.1 General

Load entry/exit points to transfer cars shall be safeguarded according to 4.2.8.

The requirements of 4.20.7 shall be met.

4.20.9.2 Limitation of travel

Buffers or other equivalent devices (e.g. horizontal catching devices) shall be fitted to stop the transfer car safely at the limit of travel and to absorb the energy of the travel movement in case of a failure.

4.20.9.3 Transfer cars with guards

4.20.9.3.1 General

At least one access with interlocking device according to EN ISO 14119:2013 with provision for secure isolation (e.g. lock-out/tag-out system) or a key dependent system according to 4.2.1.1.2 shall be provided.

4.20.9.3.2 Transfer cars with additional laser scanners

If the transfer car is equipped with additional laser scanners in both driving directions the entry/exit points shall be safeguarded according either to 4.2.8 or 4.2.9 (see Figure D.20).

4.20.9.3.3 Transfer cars with short distance picking places

Where picking work places are located right at the track of the transfer car with a distance of less than 2,0 m from the transfer car or less than 1,4 m for conveying heights of at least 1,0 m one of the following mechanical protective devices shall be provided:

- 1) sluice system;
- 2) doors which shall only be open when the transfer car is in front of the door. In cases where the transfer car is equipped with telescoping forks one solution to prevent hazards caused by the movement of the forks is the following:
 - limiting the speed of the pallet load handling device to 0,3 m/s and
 - absence of any shearing point between the load/load handling device and the floor/adjacent structures and
 - a maximum clearance between the load/load handling device and the floor of 50 mm and
 - optical and/or acoustic warning signal and
 - both gate and warning signal are monitored and
 - emergency stop devices are positioned such that the distance between the emergency stop and the picking working place does not exceed 10 m;
- 3) gates according to Figure D.3 a) if the distance to the hazard point is according to EN ISO 13857:2019.

The height of the gate shall be at least 1,4 m. The gap between the conveying level and the first boom shall not exceed 0,5 m. The gaps between the booms shall not exceed 0,24 m.

NOTE The mechanical protective device protects against crushing and shearing as well as falling off the connecting conveyor.

Where the work places are separated from the track of the transfer car by a racking system with apertures of a maximum height of 0,5 m and a safety distance to the next crushing and shearing hazard of at least 1,0 m, the above-mentioned measures are not necessary.

4.20.9.4 Transfer cars without separation

Where the transfer car is not separated from the other areas by fixed and interlocked guards, the following requirements shall apply:

- the transfer car shall be provided with a sensitive protective device and
- for an emergency stop the maximum overall stopping distance shall not exceed 2,5 m and
- the detection zone of the scanner shall reach under the connecting conveyors in a width "a" of min 0,1 m on each side (see Figure C.16). Alternative to 0,1 m at each side under the connecting conveyors a second laser scanner shall be fitted on the transfer car (only up to a conveyor height of 1,0 m) which covers the area above the conveyors in a width "a" of at least 0,1 m at a height of max. 0,2 m above the conveyors, (see Figure C.16) and
- the lateral parts of the transfer car shall have a distance of max. 30 mm to the floor or the shape shall be as shown in Figure C.32 and

- while the transfer car is moving a minimum distance “a” of 500 mm between the transfer car or the load on the transfer car and the load on the connecting conveyors shall be maintained (see Figure C.17) and
- continuous fixed guards (1) in front of the connecting conveyors, parallel to the track of the transfer car shall be provided with a maximum gap of 30 mm between the transfer car and the guards. The height of the continuous fixed guards shall be nearly the same as the upper edge of the conveyor. Instead of this frontal guard devices to prevent standing (3) may be fitted at the lateral ends of the last connecting conveyors only. The device to prevent standing shall be yellow coloured (see Figure C.17);
- the front and rear end of the transfer car shall be designed continuously closed and without peaks or sharp edges.

4.20.9.5 Transfer cars without separation in restricted areas

For transfer cars located in the restricted area the requirements of 4.20.9.4 or the following requirements shall apply:

- the maximum speed of the transfer car shall not exceed 0,6 m/s and
- between the transfer car and fixed parts of the connecting conveyors a gap of at least 120 mm shall be provided and
- while the transfer car is moving a minimum gap of 500 mm between load on the transfer car and the loads on the connecting conveyors shall be maintained and
- a continuous frontal guard parallel to the track of the car shall be provided and
- a circulating marking around the danger area shall be provided and
- a control panel in the vicinity of the transfer car shall be provided.

4.20.9.6 Transfer cars with onboard operator

Transfer cars with onboard operators shall be fitted with the following means:

- a local control panel on the transfer car with hold-to-run function;
- access according 4.10.1;
- measures against falling of persons;
- protection measures against crushing either guards or a protective device according to 4.2.1 or by fitting a two-hand-control according to ISO 13851:2019;
- measures against derailing according to 4.20.7;
- a device to prevent unauthorized use;
- provisions to ensure a clear view in the driving direction.

4.20.10 Destination Coded Vehicle – systems and rail-guided floor track conveyors

The requirements of 4.20.7 shall be met.

Access to the danger area for maintenance or trouble-shooting shall be protected either by guards or protective devices according to 4.2.8.

If the system is split into multiple safety areas, (e.g. to prevent a shutdown of the complete system) each area shall be safeguarded to the adjacent areas according to 4.2.8. It shall be possible to isolate each area separately.

The border of each area shall be clearly identifiable.

A separate place for maintenance shall be provided so that the system can be operated during maintenance of single DCVs or floor track conveyors.

4.20.11 Vertical transfer devices

4.20.11.1 Access to vertical transfer device

An interlocked access with provision for secure isolation (e.g. lock-out/tag-out system) or a key dependent system according to 4.2.1.1.2 shall be provided at each level with connecting conveyors. After opening the door, the operator shall be prevented from falling by guard rails complying with EN ISO 14122-3:2016. Due to operational reasons, the height of the guard rails may be reduced to 0,9 m. The flooring of every fixed landing shall be as close as possible to the vertical transfer device. The distance "a" between the guards and the VTD or the guard rail shall be at least 500 mm (see Figures D.12, D.13).

For unit loads up to 50 kg instead of an interlocked access door an interlocked opening which allows the trouble shooting from outside may be provided; the risk of falling shall be prevented.

If guard rails cannot be applied for technical reasons to prevent the danger of falling the floor shall be designed in a way that the approach to falling edge is noticed in time (e.g. by fitting mesh flooring with openings between 50 mm × 50 mm and 100 mm × 100 mm). The distance "a" from the beginning of the specially designed floor surface to the falling edge shall be at least 2 m (e.g. for overhead conveyors, see Figure D.20).

Anchor devices for fixing PPE against falling according to EN 795:2012 shall be provided. Alternatively, structural parts can be used as anchor points if they are marked as such and withstand at least a static force of 12 KN without permanent deformation.

Interlocked accesses at intermediate levels are not necessary, if all the following requirements are fulfilled:

- the shaft of the vertical transfer device is completely enclosed except entry/exit points and access doors;
- the gap between the vertical transfer device and the housing is less than 180 mm;
- there are anchor devices for PPE against fall within the range of all connecting conveyors;
- the connecting conveyor shall be designed to allow the operator to walk on for a distance of at least 1,2 m from the opening (e.g. by grating panels between chains of chain conveyors or by filling plates between rollers of roller conveyors);
- the opening is safeguarded by completely closed mechanical guards e.g. roller shutter gates or sliding doors; the closed position shall be monitored;
- the mechanical guards open only if the lifting carriage is at the corresponding level;

- an interlocked access is provided at the top and bottom level of the vertical transfer device;
- the lifting carriage of the vertical transfer device is designed for service personnel to stand or to ride on (see 4.20.11.10 and 4.20.11.11).

4.20.11.2 Preventing access from the working place and traffic area to the danger area of vertical transfer devices

Access from the working place and traffic area to the danger area shall be safeguarded according to 4.2.8 (see Figure D.12).

4.20.11.3 Preventing access from the restricted area to the danger area of a vertical transfer device

Access from restricted area to danger area shall be safeguarded according either to 4.2.8 or 4.2.9 (see Figure D.13).

4.20.11.4 Safety clearances in vertical transfer devices

For maintenance purposes above and below the lifting carriage of a vertical transfer device, a clear volume of $0,5\text{ m} \times 0,6\text{ m} \times 1,0\text{ m}$ high shall be provided by construction or ensured by a built-in blocking device. Alternatively, all maintainable components shall be reachable from the outside.

4.20.11.5 Falling of lifting carriage or counterweight of vertical transfer devices above working places, traffic area and restricted area

Measures shall be provided to protect persons against falling of lifting carriage, take up devices or counterweights. Possible measures are e.g.:

- guards preventing access to the area beneath the load holding device, take up device or counterweight or;
- safety gear or mechanical stops which guarantee a vertical clearance of at least 2,5 m.

4.20.11.6 Falling of lifting carriage or counterweight of vertical transfer devices on storey floors

Where a vertical transfer device is to be installed on a storey floor and there is a risk to persons at a lower floor level if the storey floor breaks due to the falling of the lifting carriage or counter weight then a catching-device or buffers shall be provided.

4.20.11.7 Switching off for vertical transfer devices

Where vertical transfer devices are equipped with safety gear or with more than one lifting element for the lifting carriage without safety gear, these shall be installed so that all hazardous movements are stopped on actuation of the safety gear or on breakage of any single lifting element.

4.20.11.8 Lowering speed for hydraulic and pneumatic powered vertical transfer devices

Hydraulic and pneumatic drive mechanisms of vertical transfer devices which are not intended to carry persons shall be provided with protection to ensure that in the event of leaks in the line system, the transfer device is controlled to a rate of not more than 1,5 times the operational lowering speed of the load.

The limiting of lowering speed may be achieved by:

- check valves arranged directly at the working cylinder;
- flow limiting valves, chokes, diaphragms at the working cylinder.

4.20.11.9 Overload protection system of vertical transfer devices

A vertical transfer device shall be equipped with an overload protection system if the rated load is more than 1 000 kg.

The overload protection system is not required if the load is reliably known or weighed prior to reach the vertical transfer device and the load does not exceed the rated load.

The following requirements apply:

- the overload protection shall stop all movements of the equipment as soon as the load exceeds the rated capacity to prevent the equipment from operating outside the load limit; movements shall only be possible in manual mode at a max. speed of 0,05 m/s;
- the overload protection shall override the control of the system concerned until the overload has been removed;
- the overload protection shall give a visual or audible signal when it stops the movements.

4.20.11.10 Vertical transfer device where riding on the lifting carriage is intended

- Where the vertical transfer device is designed for service personnel to ride or stand on the lifting carriage for installations, maintenance and repair, the following design requirements shall be met:
- all hoist units shall be equipped with brakes capable of stopping the movements of the hoist unit with its rated load safely at its rated speed and maintaining it in its stopped position. If a holding brake is fitted together with other equivalent devices, the holding brake shall be able to stop any movements in an emergency case with the same conditions as above. In this case limited lifetime of the holding brake is accepted;
- static load factor of 8 for ropes and chains and 10 for belts (see 4.2.4.2) shall be applied for lifting elements; the load consisting of the rated load, personnel, tools and self-weight of lifting carriage;
- at least two independent systems including the lifting elements with its own anchorage or pivot point (e.g. for endless chains) and breaks shall be provided (see Figures C.27 and C.28); in the event of a lifting element, gear or brake failing the vertical movement of the fully loaded lifting carriage shall be limited to 0,2 m; as an alternative to the redundant system an independent working safety gear and overspeed governor in accordance with 5.6.2 of EN 81-20:2020 may be provided. In this case the static load factor of 8 respectively 10 for the single lifting element shall be maintained. The maximum deceleration shall be 3g;
- an active overload protection system shall be provided; the system shall monitor that the static load factor is not exceeded;
- rope drums shall be provided with a single continuous spiral groove for each rope. The rope shall only be wound on in one layer. At least two turns of each rope shall still be on the drum when the lifting carriage is in its lowest position;
- the ratio of the diameter of pulleys and drums measured at the centreline of the rope and the nominal diameter of the rope shall be in accordance with recognized codes of practice for load spectrum and operating time class, but in no case less than 22:1;
- rope pulleys, chain wheels or sprocket wheels shall be provided with guards to prevent the ropes or chains from leaving the grooves or teeth;

- rope or chain terminations shall have a minimum breaking load of at least 80 % of the minimum breaking load of the rope or chain. U-bolt grips shall not be fitted for rope terminations for load carrying ropes;
- control equipment shall be located on the lifting carriage and shall have priority over all other control equipment except the emergency stop. The control equipment shall:
 - a) consist of a hold-to-run three-position-controller, and
 - b) prevent horizontal driving of the conveying system on the lifting carriage;
- travel speed under maintenance conditions shall not exceed 0,05 m/s. If the lifting carriage is equipped with guards (minimum height: 1 000 mm, minimum distance of the handrail to fixed points of the vertical transfer device: 50 mm) a maximum speed of 0,15 m/s is allowed;
- where no guards are provided, means shall be provided to anchor or retain the person against a fall. This shall be ensured by anchoring or retaining points (according to EN 795:2012) on the lifting carriage;
- the maximum acceleration shall not exceed $2,5 \text{ m/s}^2$;
- where an end buffer is installed the maximum deceleration shall not exceed $4,0 \text{ m/s}^2$ if the buffer is actuated during regular operation. Else the deceleration due to the buffer shall not exceed $3g$;
- flooring shall be provided on whole surface of the lifting carriage (e.g. by panelling of the area to be stood on or by filling plates between rollers of roller conveyors or grating panels between the chains of chain conveyors). The minimum dimensions of the flooring shall be at least 600 mm \times 600 mm. The strength and the anti-slippery surface of this flooring shall be in accordance with EN ISO 14122-2:2016;
- where a seat is provided, the free height shall be at least 1 500 mm, and where no seat is provided 2 000 mm;
- chains used as lifting elements shall be leaf or roller type only.

NOTE All safety factors refer to the rated loads.

4.20.11.11 Vertical transfer devices where standing on and/or under the lifting carriage is intended

Where standing on and/or under the lifting carriage is only intended when stationary, positive locking safety devices, e.g. safety bolts or holding ropes or chains, shall be provided which can be fixed from outside; dead bolts shall have a safety factor of at least 2 (shear strength versus the static load), ropes and chains a safety factor of at least 4. The locking safety device shall be installed at the lifting carriage. Alternatively, it can be installed directly at the winding shaft or drum. In this case, the safety factor of the lifting elements shall be at least 8 for ropes and chains and 10 for belts; redundancy is not required.

4.20.11.12 Slackness of rope, belt or chain

In case of slackness of rope, belt or chain the lowering movement shall be stopped. Movements shall only be possible in manual mode at a max. speed of 0,05 m/s.

4.20.11.13 Circulating conveyor – protective measures

Movable guards with interlocking in the run-in and out area shall be fitted. The opening shall enable the removal of the unit load (see Figure C.43).

4.20.12 Horizontal transfer devices

4.20.12.1 Turntable (turning the conveyor)

4.20.12.1.1 General

Turntables shall be either protected by design (e.g. closed static base) or by protecting the drawing-in points according to 4.2.1.1.6, 2nd clause, 1st dash (see Figure C.1) or by guards with an interlocked access according to 4.2.1. The access across load entry/exit points shall be prevented by means according to 4.2.8.

In case of fixed guards interlocked access doors shall be provided for trouble-shooting and maintenance. The space between fixed guards and turntable shall be at least 500 mm.

Lateral guides of the loads on the turntable and on the connecting conveyor shall have a distance of at least 180 mm.

The maximum distance of the gap between the rotating lateral guard of the turntable and the floor shall be not greater than 50 mm. The distance may be increased up to a maximum of 240 mm, if the distance between the bottom edge of the guard and the first accessible hazard exceeds 550 mm.

4.20.12.1.2 Turntable in restricted area

For turntables located in the restricted area the access across load entry/exit points shall be prevented by means according to either the requirements of 4.2.8 or 4.2.9.

Turntables exceeding a length of 4,0 m shall comply with the above mentioned or with the following requirements:

- the maximum speed of the turntable shall not exceed 0,6 m/s at the most unfavourable point and
- between the turntable and fixed parts of the connecting conveyors a gap of at least 120 mm shall be provided and
- while the turntable is moving a minimum gap of 500 mm between load on the turn table and the loads on the connecting conveyors shall be maintained and
- operation area of the turntable shall be marked on the floor and
- at each turntable a control panel shall be provided.

4.20.12.2 Pushers

Access to the pusher shall be prevented according to 4.2.1 and 4.2.8 and the distance between pusher element and front / exit of the tunnel edge shall be at least 850 mm. This is not necessary if the force of the pusher element is limited to a maximum static force of 150 N.

Either an interlocked access hatch of a size that allows the removal of the largest unit load or an interlocked access door according to 4.2.1.1.2 shall be provided where appropriate.

The max. height of the unit load shall be at least 50 mm less than the height of the tunnel opening.

The requirements described above are not necessary in restricted areas if:

- for telescopic pushers (Figures C.35 and C.36):

- the maximum speed of the pusher element does not exceed 1 m/s and
- the distance “b” between belt / frame and pusher element does not exceed 5 mm or is more than 50 mm and
- the distance “a” between moving and fixed parts is at least 50 mm and
- a telescopic shaped guard is provided where the drive mechanism has additional shearing and crushing points;
- for chain pushers (Figures C.40 and C.41):
 - the maximum speed of the cam does not exceed 1,5 m/s and
 - the cams have a gap “a” between 25 mm and 50 mm (Figure C.40) to fixed parts when immersing and
 - there is a maintenance switch in the vicinity.

4.20.13 Sorters

Access to danger zones of sorters shall be prevented by guards according to 4.2.1 and the requirements of 4.2.8.

Guards to prevent crushing and drawing-in hazards by the moving sorter deck are not necessary if:

- there is no tilting movement of the sorter trays in accessible areas and;
- there is a minimum gap “a” of 50 mm combined with a smooth and continuous surface of the static part (see Figure C.31);

Where operators require access to the safe guarded danger area of a sorter the following requirements apply:

- an interlocking device according to EN ISO 14119:2013 with provision for secure isolation (e.g. lock-out/tag-out system) or a key dependent system according to 4.2.1.1.2 shall be provided and
- a local control panel with a hold-to-run control device with a stop function according to 4.11 shall be provided and
- the max. speed shall not exceed 0,5 m/s and
- warning signal shall act at least 4 s before starting.

Safeguarding of the carrying elements on the charge and discharge section of a line-sorter (see Figure A.21) is mandatory unless:

- the carrying elements of the line sorter exists out of a smooth and continuous surface and fulfils the requirements of 4.2.1.1.5 or
- the carrying elements are out of reach based on Table 1 of EN ISO 13857:2019.

Safeguarding of the carrying elements on the straight section of a line sorter - shoe-system (Figure A.13) is mandatory unless:

- the carrying elements are out of reach based on Table 1 of EN ISO 13857:2019 or

- the conveying level is at least 1,0 m above the floor and
 - the static structure of the sorter consists of a smooth and continuous surface with a maximum gap of 8 mm between moving and static parts and
 - gaps between carrying elements are smooth and have a shape that prevent entrapment when moving and
 - the height of the shoes does not exceed 60 mm or a side panel is fitted higher than the shoe or a safety distance of at least 800 mm is provided e.g. by output, chutes or containers.

For conveying levels below 1,0 m, an additional sideguarding (e.g. railing or panel) shall be provided. The sideguard shall have a height "b" of at least 1,0 m (see Figure C.38).

4.20.13.1 Safety measures at induct points

In addition to the requirements of 4.20.13 a safeguard to prevent drawing in of the whole body caused by the drawing in point between sorter and induction unit shall be provided e.g. by a horizontal or vertical plate guard. The additional safeguard shall prevent persons from coming closer than "a" = 500 mm or to reach the drawing-in point with the whole body (see Figure C.29).

4.20.13.2 Safety measures for manual infeed positions

Manual infeed positions shall only be installed where there is no exposure to relative movement between the carrying elements of the loop-sorter.

The operators shall be safeguarded from the carrying elements of the sorter by means of a table and a vertical guard that is either continuous and/or has a length "a" of at least 1,5 m to prevent the operator from accidentally reaching the hazardous area created by leading edge of the table / vertical guard and the passing the carrying elements of the sorter (see Figure C.30).

The gap "a" between table / vertical guard and the moving parts of the sorter shall be at least 50 mm. The table / vertical guard (static parts) shall have a smooth and continuous surface on the moving sorter parts side (see Figure C.31).

4.20.13.3 Safety measures for the use of service vehicles for loop-sorters

For riding in service vehicles on loop-sorters the following requirements shall be met:

- if the free space between the seating/laying place on the vehicle and parts of the surrounding structure above the service vehicle is less than 1,2 m a roof shall be provided;
- the distance between the roof and the surrounding structures shall be at least 120 mm if applicable;
- a fall restraint system (see EN 363) or any device against falling shall be provided;
- an escape device, such as a descender device according to EN 341:2011 shall be provided;
- all movements of the service vehicle shall be by hold-to-run control together with enabling devices;
- the max. speed shall not exceed 0,5 m/s; the stopping distance shall not exceed 0,5 m;
- the service vehicle shall be fitted to the loop-sorter line with a positive locking system;
- when riding the service vehicle, it shall not be possible to start the automatic mode (e.g. by a lockable mode selection).

4.20.13.4 Chutes at sorters

Unauthorised access to hazardous areas of the sorter via the chute shall be safeguarded according to 4.2.8. The sign "Access for unauthorized persons prohibited" (see Figure 4) shall be fitted at any discharge point. Alternatively, the access is intended to be prevented, if the following requirements are met:

- The straight chute is at least 2 m long, has an angle of at least 20 degrees and the discharge edge is at least 0,7 m above floor level.
- At the centreline the spiral chute is at least 2 m long and has an angle of at least 20 degrees. The discharge edge is at least 0,7 m above floor level.

If it is necessary to enter the chute for maintenance works (e.g. trouble shooting, cleaning) a protective structure against falling with a height of at least 900 mm shall be provided where a falling height is greater than 1 m.

The hazard of sliding down a chute shall be reduced for maintenance-personnel e.g. by provision of appropriate rubber mats or insert plates with anti-slip profile.

4.20.14 Conveyors in public areas of airports

By exception of 4.2.1 the maximum gap of drawing-in points shall be 3 mm instead of 5 mm. This solution applies only for flat belts.

Alternatively, the conveyors shall be safeguarded by:

- pressure sensitive devices at the drawing-in point (see EN ISO 13856-2:2013) or
- movable front guard; in case of drawing-in the guard will be opened and a safety switch stops the conveyor (Figure C.37).

If the conveyor has over-lapping flexible elements they shall be imbricated in such a way that the moving elements will not open-up in case of contact with static parts or persons (see Figure A.18).

4.20.14.1 Manned check-in conveyors

The check-in desk shall be equipped with a control panel with a key switch. It shall be possible to remove the key only in the off-position.

The access to the non-public area (airside) shall be prevented by provision of an interlocked guard.

Where the collector belt (see Figure A.17) is located in the public area, the access to the collector belt across a switched-off check-in conveyor shall initiate a stop of the collector belt by a sensitive protective device (e.g. AOPD) or the access shall be prevented by an interlocked guard. The access to the collector belt from other sides shall be prevented by closed barriers with a height of at least 1,1 m. When the last check-in desk is switched off, a gate at the entrance of the collector belt to the non-public area shall close automatically.

If AOPDs with 2 beams are provided, they shall be installed above the conveyor level at 200 mm and 700 mm.

4.20.14.2 Self-check-in conveyors

Self-check-in conveyors shall be equipped with means operating as a sluice, e.g. two alternating guards.

4.20.14.3 Reclaim conveyors

Each reclaim conveyor in a public area shall be equipped with the following safety means:

- acoustic and visual alarm as a start-up warning shall act at least 4 s before starting;

- in deviation to 4.18 one or more emergency switches, which shall be installed in such a way that at least one may be reached within 5 m from any point of the equipment;
- to prevent unintended activation the emergency stop can be installed in a recess, the diameter of the recess shall be 50 mm or more.

To prevent access to the non-public area a moveable guard according to 4.2.1.1.2 shall close automatically the opening above the conveyor or the opening to the feeding conveyor directly after the conveyor has stopped. The control system shall monitor the closed position of the guard, if not closed the system shall generate an alarm.

Baggage carousels shall be designed in a way that baggage cannot fall into the inner circle e.g. by means of inner side guarding (see Figure A.18).

4.21 Safety related parts of control systems/performance level

Safety related parts of control systems shall be in accordance with EN ISO 13849-1:2015. The minimum performance levels shall be in accordance with Table 3.

Table 3 — List of safety functions with required performance levels

	Safety function	Clause EN 619	Performance Level (PL_r)	Comments
1	Safety related stop by interlocking of doors or guards to the danger area	4.2.1.1.2	PL _r = c	
2	Protective systems (only if sensitive protective systems as described in 4.2.1.1.3 are provided)	4.2.1.1.3	PL _r = c	
3	Preventing relative movements of loads	4.2.1.1.5	PL _r = c for working places where persons may stand between the loads Otherwise, reduction to PL _r = b may apply	
4	Speed limitation in the different areas	4.2.1.2	PL _r = c	
5	Speed limitation on assembly lines where persons travel on the conveyor	4.2.2	PL _r = c	
6	Sensitive protective systems for crossover passageways	4.10.2	PL _r = b	
7	Work at machines with open guards	4.11.1 a), c), d), f), g)	PL _r = c	

	Safety function	Clause EN 619	Performance Level (PL_r)	Comments
8	Monitoring + maintenance category 2-stop functions	4.17	PL _r = c	
9	Emergency stop function	4.18	PL _r = c	Emergency stop buttons such as pushbutton, pull-wire, etc.
10	Safety related stop of vertical switch conveyor by interlocking	4.20.1	PL _r = c	
11	Speed limitation for underfloor chain conveyors	4.20.5	PL _r = c	
12	Protective devices for underfloor chain conveyors	4.20.5	PL _r = c	
13	Pressure sensitive protective system for reverse movement	4.20.6	PL _r = c	
14	Hold-to-run control of telescopic conveyors	4.20.6	PL _r = c	
15	Speed limitation of rail bound telescopic conveyors	4.20.6.2	PL _r = c	
16	Function to prevent a deviation of more than 5° from the horizontal plane	4.20.6.3	PL _r = c	
17	Function to monitor access to overhead conveyor	4.20.8.1	PL _r = c	
18	Safety related stop of OHCs by interlocking	4.20.8.1	PL _r = c	
19	Speed limitation for OHC	4.20.8.1 4.20.8.4.1	PL _r = c	
20	Hold-to-run control of OHC	4.20.8.4.1	PL _r = c	
21	Stopping the movement in case of failure or slack of a lifting or transmission element of OHC	4.20.8.4.3	PL _r = c	
22	Actuation of the mechanical end stops	4.20.8.7	PL _r = c	
23	Electric/electronic position control of transfer devices of overhead conveyors	4.20.8.9	PL _r = c	
24	Speed limitation for maintenance vehicles of overhead conveyors	4.20.8.10	PL _r = c	

	Safety function	Clause EN 619	Performance Level (PL_r)	Comments
25	Hold-to-run control incl. two-hand-control	4.20.8.10	PL _r = c	
26	Safety related stop of transfer cars (requirements of 4.2.8) by interlocking	4.20.9.1	PL _r = c	
27	Safety related stop of the transfer car at the limit of travel	4.20.9.2	no PL _r	Buffer for 100 % No control measures required = no PL _r
			PL _r = d	"Without buffer or <100 %": System of speed monitoring, brake activation and position measurement
28	Laser scanner as additional protecting system for transfer cars	4.20.9.3	PL _r = c	
29	Sensitive protecting system for TC without separation	4.20.9.4	PL _r = d	
30	Speed limitation for TC in restricted area	4.20.9.5	PL _r = c	
31	Hold-to-run control of TC	4.20.9.6	PL _r = c	
32	Safety related stop of destinated coded vehicles and rail-guided floor track conveyors by interlocking	4.20.10	PL _r = c	
33	Safety related stop of VTDs by interlocking	4.20.11.1	PL _r = c	
34	Safety related stop of VTDs by interlocking (requirements of 4.2.8)	4.20.11.2	PL _r = c	
		4.20.11.3	PL _r = c	
35	Stopping the movement in case of failure of a lifting element or actuation of the safety gear of VTD	4.20.11.6	PL _r = c	
36	Overload protection system (no persons riding on VTD)	4.20.11.9	PL _r = b	
37	Overload protection system (persons riding on VTD), systems for limitation of speed and acceleration	4.20.11.10	PL _r = c	
38	Hold-to-run control of VTD	4.20.11.10	PL _r = c	

	Safety function	Clause EN 619	Performance Level (PL_r)	Comments
39	Safety related stop of turn tables (requirements of 4.2.8) by interlocking	4.20.12.1.1 4.20.12.1.2	PL _r = c	
40	Speed limitation of turntables	4.20.12.1.2	PL _r = c	
41	Safety related stop of pushers by interlocking	4.20.12.2	PL _r = c	
42	Speed limitation of pushers	4.20.12.2	PL _r = c	
43	Speed limitation when operators access the safeguarded area	4.20.13	PL _r = c	
44	Hold-to-run control of sorters	4.20.13	PL _r = c	
45	Safety related stop of sorters by interlocking	4.20.13.1	PL _r = c	
46	Speed limitation of loop sorters when using the service vehicle	4.20.13.3	PL _r = c	
47	Hold-to-run control for service vehicles of loop-sorters	4.20.13.3	PL _r = c	
48	Stopping the movement of conveyors in public areas of airports in case of drawing in	4.20.14	PL _r = c	
Abbreviations list: See the Introduction.				

NOTE Where the speed is limited by design below the required values the speed monitoring devices are not required.

5 Verification of safety requirements and/or protective/risk reduction measures

5.1 General

The requirements given in chapter 4 and information given in Clause 6 of this standard shall be verified according to the instructions below and in accordance with Table 4.

For all equipment the manufacturer shall verify the suitability of all the health and safety measures during the design stage before starting the manufacturing process. The inspection points given in Table 4 shall be carried out. The results of the verification shall be documented.

Material handling equipment/systems are in most cases assembled at its place of use. Each verification shall be executed in the corresponding phase:

- design phase (Design Verification = DV);
- parts and sub-assembly manufacturing (Factory Acceptance Test = FAT);
- assembling, installation and functional testing on site (Site Acceptance Test = SAT).

Where material handling equipment is completely assembled in a factory (whereby installation at site is limited to fixation to a floor and providing energy) the SAT can be merged into the FAT.

Verification is categorized in the following types:

- 1) Visual inspection (V), the result of which only is to establish that something is present (e.g. a guard, marking or a document);
- 2) Measurement (M), the result of which is that the stated measurable parameters have been met (e.g. geometric dimensions, noise, impedance, force);
- 3) Functional tests (F), the result of which shows that the adequate signals intended to be forwarded to the main control system of the complete machine are available and comply with the requirements and technical documentation;
- 4) Calculation (C), the result of which complies with the characteristics of the relevant requirement;
- 5) Special verification (S), the procedure being given under “remarks” or in the referred clause.

5.2 Visual inspections

- **Mechanical parts:** Verify that mechanical components are securely fixed and all unnecessary sharp edges have been removed.
- **Pneumatic systems:** Verify that pneumatic components and piping conform to the safety requirements of EN ISO 4414:2010 and are correctly installed.
- **Hydraulic systems:** Verify that hydraulic components and piping conform to the safety requirements of EN ISO 4413:2010 and are correctly installed.
- **Electrical systems:** Verify that the electrical equipment and installation including the documentation is in compliance with the technical documentation described in Clause 17 of EN 60204-1:2018.

- **Guards:** Verify that all guards are in place and securely fixed and that the guards and their dimensions are appropriate for the hazards expected and their dimensions are according to the design. Verify that all interlocking devices are fitted. Verify that adjustable guards can be properly adjusted to the foreseen products and pack sizes.
- **Marking and warning signs:** Verify that the required markings and warning signs are fitted permanently and at the required positions.

5.3 Measurements

- **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 hazardous zones comply with the requirements detailed in 4.2.1.1.1.
- **Electrical testing:** The tests a), b), c) and h) as described in 18.1 of EN 60204-1:2018 shall be performed on every machine.
- **Noise:** Verify the efficiency of technical measures taken at the design stage to reduce noise by measuring the A-weighted emission sound pressure level (see Annex E).
- **Extreme temperature:** For every type of machine, with the machine operation temperature, check that the external guard temperatures are not higher than the burn threshold limits for the foreseen contact times and materials as stated in 4.8.

5.4 Functional test

All safety related parts of the control system shall be functionally tested; this implies that every safety sensor (e.g. end switch, AOPD, interlock) and actuator shall be tested.

5.5 Calculation

For every type of safety device like electro-sensitive protective devices and interlocking devices, check that there is a calculation of the safety distances according to EN ISO 13855:2010.

5.6 EMC-Tests in relation to the Machinery Directive

Compliance with the EMC-requirements of 4.4 shall be checked by carrying out preliminary testing and function testing. If testing of the completed continuous handling equipment is not reasonably practicable due to the size of the machinery, the manufacturer shall verify that all appropriate equipment sub-assemblies comply with 4.4. The manufacturer shall also verify that these sub-assemblies are suitably installed and wired to minimize the effects of disturbances on the equipment and in accordance with any recommendation of the supplier(s) of the sub-assemblies and parts.

Table 4 — Verification of the essential health and safety requirements and/or measures

Sub clause	Stage	Type of verification(s)	Note/remarks
4.1.2 Restricted area	DV, SAT	V	The area concept shall be verified during the design stage; complex systems require a dedicated layout unless the entire system is allocated in only one type of area
	SAT	F	All access doors shall be functionally tested. In case of interlocked doors the interlock functionality shall be tested on all applied safety functions. The emergency release handle on each access door shall be tested as well as the self-closing functionality
	DV, SAT	V, M	Guard heights
	DV, SAT	M	The free zone at the entrance of the restricted area
	DV	V	The connecting walkways/accessibility
	SAT	M	The connecting walkways/lighting intensity
	SAT	F	The control panel shall be functionally tested
4.2.1 General requirements for protection against moving parts	DV, SAT	M	Minimum distances to prevent hazard zones to be reached
	DV, SAT	M	The minimum gaps to prevent crushing
	DV, SAT	V	Guards or protective devices for moving parts
4.2.1 General requirements for protection against moving parts	SAT	F	ESPE
4.2.1.1 Guards	DV, SAT	V, M	Open topped guards
4.2.1.2 Interlocking devices associated with movable guards			Interlocked devices associated with movable guards
	SAT	F	Mode switch operation
	SAT	F	Opening of doors from inside without key
	SAT	F	Restart after closing of the guard
4.2.1.3 Sensitive protective devices			Sensitive protective devices
	DV	V	Specification
	SAT	F	AOPD function test
4.2.1.4	DV, SAT	V, M	Shearing/crushing between load and fixed adjacent objects

Sub clause	Stage	Type of verification(s)	Note/remarks
Shearing/crushing between load and a fixed adjacent object			
4.2.1.1.6 Drawing-in points	DV, SAT	V, M	Drawing-in points
4.2.1.2 Maximum speed for risk due to movement of unit loads	DV SAT	C M	Allowed speeds
4.2.2 Conveyors in assembly-lines on which persons may travel in horizontal direction	DV SAT DV, SAT	C M V	Speed limitation Guard rails
4.2.3 Measures for protection against unintended movement	DV SAT	C F	Unintended reverse movement
4.2.4.1 strength of non-fixed load lifting attachments	DV	C	Removable load handling device
4.2.4.2 Strength of ropes, chains and belts for lifting purposes	DV FAT	C S	Strength of ropes, chains and belts S; tensile test on sample or certified material
4.2.5 Stability against overturning for mobile conveyors	DV FAT	C S	Stability against overturning S; tilting test
4.2.6 Protection against falling or ejected objects	DV SAT	V	Protection against falling or ejected objects
4.2.7 Prevention of sharp edges, sharp angles and rough surfaces	FAT SAT	V	Prevention of sharp edges

Sub clause	Stage	Type of verification(s)	Note/remarks
4.2.8 Preventing access to danger areas across the load entry/exit points or stopping the dangerous movement	DV, SAT	V	Visual verification of applied solution(s)
	DV, SAT	M	Measurement of all minimum/maximum dimensions
	SAT	F	Functional test of ESPE, interlocked doors
4.2.9 Preventing access across the load entry/exit points to restricted areas	DV, SAT	V	Visual verification of applied solution(s)
	DV, SAT	M	Measurement of all minimum/maximum dimensions
	SAT	F	Functional test of ESPE, interlocked doors
4.3.1 Electrical equipment	SAT	M, V	
4.3.2 Means of disconnection	DV	V, F	
4.3.3 IP-Degree of protection	DV	V	Specification
4.4 Safety requirements related to EMC	FAT	S	Tests in accordance with EN IEC 61000-6-2:2019
	SAT	V	
4.5 Electrostatic charges	FAT, SAT	M, V	
4.6.1 Hydraulics	DV	V	
4.6.2 Pneumatics	DV	V	
4.7 Measures for isolation and energy dissipation	SAT	F	Isolation and energy dissipation
4.8 Protection against thermal hazards	SAT	M	Specification or see EN ISO 13732-1:2008
4.9 Noise reduction at design stage	DV, FAT, SAT	M	Noise test code (Annex E)
4.10.1 General	DV, SAT	V, M	

Sub clause	Stage	Type of verification(s)	Note/remarks
4.10.2 Cross over passageways	DV	V, C	C & F only if protective devices are fitted on crossover passageways
	SAT	M, F	
4.11.1 Work at machines with open guards	DV	V, C	
	SAT	F	
4.11.2 Lighting	DV, FAT	V	In case of integral lighting
	SAT	M	
4.12 Transport of machines	DV	C, V	
4.13 Lifting of machines or parts of the plant	DV	C, V	
4.14 Ergonomic requirements in machine design	DV	V	Ergonomic requirements
	SAT	M	
4.15 Control devices	DV	V	Control devices
	SAT	F	
4.16 Start and restart function	DV	V	Start and restart
	SAT	F	
4.17 Stop functions and stop control devices	DV	V	Stop functions
	SAT	F	
4.18 Emergency stopping	DV	V	Emergency stop
	SAT	F	
4.19 Failure of the power supply	DV	V	Failure of the power supply
	SAT	F	
4.20.1 Vertical switch conveyors	DV	V	Vertical switch conveyors, FAT instead of SAT allowed for completed assembly
	SAT	F	
4.20.2.1 Crushing and shearing points between roller conveyors and conveyed unit loads	DV	V, M	Crushing/shearing between roller conveyor/unit load

Sub clause	Stage	Type of verification(s)	Note/remarks
4.20.2.2 Crushing and shearing points between carrying-chain or multi belt conveyors and conveyed unit loads	DV	V, M	Crushing/shearing between chain or multi belt conveyor/unit load
4.20.3 Nip points on belt driven roller conveyors	DV	V, M	Belt driven roller conveyors
4.20.4 Plate conveyors	DV	V	Plate conveyors
4.20.5 Underfloor chain conveyors	DV	V	Underfloor chain conveyors
	SAT	M	
4.20.6 Telescopic conveyors (boom conveyors)	DV	V, C	Telescopic conveyor, FAT instead of SAT allowed for completed assembly
	SAT	F	
4.20.6.1 Height adjustable telescopic conveyors	DV	V	
	SAT	M	
4.20.6.2 Rail bound mobile telescopic conveyors	DV	V, C	Rail bound mobile telescopic conveyors
	SAT	F	FAT instead of SAT allowed for completed assembly
	SAT	M	
4.20.6.3 Telescopic conveyors with platforms	DV	V	Telescopic conveyors with platforms
	SAT	M, F	With levelling feature functional test required FAT instead of SAT allowed for completed assembly
4.20.7 Rail bound conveyors	DV	V	Rail bound conveyors
4.20.8.1 General	DV	V	Overhead conveyors
	SAT	M	
4.20.8.2 Safety distances for overhead conveyors	DV	V	Safety distances for overhead conveyors
	SAT	M	
4.20.8.3 Safety distances for overhead conveyors in restricted areas	DV	V	Safety distances for overhead conveyors in restricted areas
	SAT	M	

Sub clause	Stage	Type of verification(s)	Note/remarks
4.20.8.4.1 Maximum speeds at working places under, on or at overhead conveyors	DV	C	Maximum speeds of overhead conveyors at working places
	SAT	M	
4.20.8.4.2 Lifting elements in case of working places under, on or at overhead conveyors	DV	V, C	Lifting elements of overhead conveyors at working places
4.20.8.4.3 Inadvertent vertical motion at working places under, on or at overhead conveyors	DV	V, C	Inadvertent motion of overhead conveyors at working places
4.20.8.4.4 Working on overhead conveyors or on the load in assembly lines	DV	M	Working on overhead conveyors or on the load
4.20.8.5 Rollers of overhead conveyors	DV, SAT	V	Rollers of overhead conveyors
4.20.8.6 Dimensioning of Track, Steelwork and Carrier	DV	C	Dimensioning of Track
4.20.8.7 Interruptions of tracks of overhead conveyors	DV	V, F	Interruptions of tracks of overhead conveyors
4.20.8.8 Load Securing	DV, FAT, SAT	V, F	Load Securing
4.20.8.9 Transfer devices of overhead conveyors	DV	V, F	Transfer devices of overhead conveyors
4.20.8.10 Maintenance vehicles for overhead conveyors	DV	V	Maintenance vehicles for overhead conveyors
4.20.8.11 Maintenance requirements for self-propelled overhead conveyors	DV	V	Maintenance requirements for self-propelled overhead conveyors

Sub clause	Stage	Type of verification(s)	Note/remarks
4.20.9.1 General	SAT	V	Safeguarding of transfer cars
4.20.9.2 Limitation of travel	SAT	V	Limitation of travel of transfer cars
4.20.9.3.1 General	SAT	V	Access with interlocking device
4.20.9.3.2 Transfer cars with additional laser scanners	DV, SAT	V, F	Transfer cars with additional laser scanners
4.20.9.3.3 Transfer cars with short distance picking places	DV, SAT	V, M	Transfer cars with short distance picking places
4.20.9.4 Transfer cars without separation	DV	V	Transfer cars without separation
	SAT	M	FAT instead of SAT allowed for completed assembly
4.20.9.5 Transfer cars without separation in restricted areas	DV	V	Transfer cars without separation in restricted areas
	SAT	M	FAT instead of SAT allowed for completed assembly
4.20.9.6 Transfer cars with onboard operator	SAT	F	Operator controlled transfer cars
4.20.10 DCV – systems and rail-guided floor track conveyors			DCV systems and rail-guided floor track conveyors
	DV	V	Visual verification of applied solution(s)
	SAT	M	Measurement of all minimum/maximum dimensions
	SAT	F	Functional test of ESPE, interlocked doors
4.20.11.1 Access to vertical transfer device			Access to vertical transfer device
	DV, SAT	V	
	DV, SAT	M	
	SAT	F	

Sub clause	Stage	Type of verification(s)	Note/remarks
4.20.11.2 Preventing access from the working place and traffic area to the danger area of vertical transfer devices			Access working place/traffic area to danger area
	DV, SAT	V	Visual verification of applied solution(s)
	DV, SAT	M	Measurement of all minimum/Maximum dimensions
	SAT	F	Functional test of ESPE, interlocked doors
4.20.11.3 Preventing access from the restricted area to the danger area of a vertical transfer device			Access restricted area to danger area
	DV, SAT	V	Visual verification of applied solution(s)
	DV, SAT	M	Measurement of all minimum/maximum dimensions
	SAT	F	Functional test of ESPE, interlocked doors
4.20.11.4 Safety clearances in vertical transfer devices	DV	V, M	Safety clearances in vertical transfer devices
4.20.11.5 Falling of lifting carriage or counterweight of vertical transfer devices above working places, traffic area and restricted area	DV	V, C	Falling of lifting carriage or counterweights of vertical transfer devices
4.20.11.6 Falling of lifting carriage or counterweight of vertical transfer devices on storey floors	DV	V, C	Falling of lifting carriage or counterweight of vertical transfer devices
4.20.11.7 Switching off for vertical transfer devices	SAT	F	Switching off for vertical transfer devices
4.20.11.8 Lowering speed for hydraulic and pneumatic powered vertical transfer devices	DV	C, M	Lowering speed for hydraulic and pneumatic powered vertical transfer devices
	SAT	S	S: according to EN ISO 4413:2010 / EN ISO 4414:2010
4.20.11.9 Overload protection system of vertical transfer devices	DV	V, C	Overload protection system of vertical transfer devices
	SAT	F, M	

Sub clause	Stage	Type of verification(s)	Note/remarks
4.20.11.10 Vertical transfer devices where riding on the lifting carriage is intended	DV	M, C	Riding on the carriage of vertical transfer devices
	SAT	M, F	
4.20.11.11 Vertical transfer devices where standing on and/or under the lifting carriage is intended	DV, FAT	C, V	Standing on the lifting carriage of vertical transfer devices
4.20.11.12 Slackness of rope, belt or chain	DV	C	Slackness of rope, belt or chain
	SAT	F, M	
4.20.11.13 Circulating conveyor – protective measures	DV	V	Circulating conveyor – protective measures
4.20.12.1.1 General			Turntable
	DV, SAT	V	Visual verification of applied solution(s)
	DV, SAT	M	Measurement of all minimum/maximum dimensions
	SAT	F	Functional test of ESPE, interlocked doors
4.20.12.1.2 Turntable in restricted area			Turntable in restricted area
	DV	V	Visual verification of applied solution(s)
	SAT	M	Measurement of all minimum/maximum dimensions
	SAT	F	Functional test of ESPE, interlocked doors
4.20.12.2 Pushers			Pushers
	DV	V	Visual verification of applied solution(s)
	SAT	M	Measurement of all minimum/maximum dimensions
	SAT	F	Functional test of ESPE, interlocked doors
4.20.13 Sorters			Sorters
	DV	V	Visual verification of applied solution(s)
	SAT	M	Measurement of all min./max. dimensions
	SAT	F	Functional test of ESPE, interlocked doors
4.20.13.1 Safety measures at induct points	DV	V	Induct points
	SAT	M	

Sub clause	Stage	Type of verification(s)	Note/remarks
4.20.13.2 Safety measures for manual infeed positions	DV	V	Infeed position
	SAT	M	
4.20.13.3 Safety measures for the use of service vehicles for loop-sorters	DV	V	Use of service vehicles
	SAT	V, M, F	
4.20.13.4 Chutes at sorters	F		Chutes
	DV	V	Visual verification of applied solution(s)
	SAT	M	Measurement of all minimum/maximum dimensions
	SAT	F	Functional test of ESPE, interlocked doors
4.20.14 Conveyors in public areas of airports	DV	V	Conveyors in public areas of airports
	SAT	M, F	Functional test of ESPE, interlocked doors
4.20.14.1 Manned check-in conveyors	DV	V	Manned check-in conveyors
	SAT	M, F	Functional test of ESPE, interlocked doors
4.20.14.2 Self-check-in conveyors	DV	V	Self-check-in conveyors
	SAT	M, F	Functional test of ESPE, interlocked doors
4.20.14.3 Reclaim conveyors	DV	V	Reclaim conveyors
	SAT		
4.21 Safety related parts of control systems/performance level	DV	C	Performance level
6 Information for use	DV	V	

Key

DV - design verification

FAT - factory acceptance test

SAT - site acceptance test

C - calculation

F - functional test

M - measurement

S - special verification

V - visual inspection

6 Information for use

6.1 Instruction handbook

6.1.1 General

The instruction handbook shall be in accordance with 6.4.5 of EN ISO 12100:2010. This information shall include the conditions under which the equipment is intended to be used, in particular with regard to:

- the materials to be handled: indication of the maximum permissible characteristics, e.g. dimension;
- operating conditions: indication of the operating mode(s), e.g. automatic/manual operation;
- range of intended environmental conditions according to the restrictions in the scope, e.g. wind, temperature, relative humidity.

Details of safety functions and list and location of safety devices shall also be provided.

The instruction handbook shall also contain information on foreseeable misuse e.g.:

- handling of unit loads different from those specified and hazardous unit loads;
- man-riding;
- use of way of least resistance.

6.1.2 Instructions for the installation of the equipment

When the equipment is supplied unassembled, the manufacturer shall provide with the equipment assembly specifications preferably with drawings showing:

- the maximum weights, dimensions and lifting points of the separate components supplied;
- the assembly phases and technical requirements;
- the handling method required;
- the floor loadings for individual pieces of equipment; In particular, the floor beneath vertical transfer devices shall be designed with the load bearing capacity to support falling lifting carriages and rated loads;
- requirements for anchoring and fixing points.

6.1.3 Instructions for the use of the equipment

The instruction handbook shall include, in addition to 6.4.5.1 of EN ISO 12100:2010 the following information:

- instructions that only qualified personnel shall start, operate or interfere with the normal working of the system;
- stopping modes and means; in particular, normal and emergency stopping devices shall be made known to all appropriate personnel. Information concerning that the areas giving access to them shall be kept clear of obstacles. Their proper working shall be periodically checked;
- description of safety devices;

- description of the safety concept, if applicable;
- instructions on how to safely move the machine, especially mobile conveyors, as well as moveable parts and special equipment delivered with the machine;
- information about conditions e.g. sufficient space for non-permanent means of access, where applicable;
- information about the maximum number of persons and the maximal additional live load for platforms of man-rider telescopic conveyors.

The emergency stop device shall not be used for normal stopping.

All restarting operations on equipment which has been inoperative because of an emergency or accidental stoppage shall be preceded by an inspection aimed at:

- determining the cause of the emergency or accidental stoppage;
- repairing the fault.

Information that stopped equipment is not a safe equipment where stored energy may be released unintentionally or by incorrect isolation and dissipation procedures. Information about correct isolation and dissipation procedures, e.g. freeing a blockage, where the equipment is operating.

The instruction handbook shall draw the attention of the user that:

- the user shall be careful to ensure a regular feed, avoiding over-loading;
- modification of the design or configuration of the equipment may lead to new hazards or higher risks that are not reduced adequately by the risk reduction measures of the manufacturer;
- all loading and working places and passageways shall be kept clear;
- the user shall be appropriately dressed to prevent clothing or hair from becoming entangled.

6.1.4 Instructions for maintenance

The instruction handbook shall specify in particular (see 6.4.5.1 of EN ISO 12100:2010):

- a) the technical knowledge and skills of the maintenance staff specially for particular operations which need specific competence, and that all adjustments, whether mechanical or electrical, shall be carried out by qualified persons only;
- b) the conditions under which maintenance works and rectification of faults on continuous handling equipment or systems can be performed e.g. by requiring that the equipment is isolated, protected against unexpected start-up and measures are taken against unexpected movements e.g. by mounting of temporary end stops;
- c) a list of wearing parts, as well as the approximate frequency and conditions for their replacement;
- d) a list of parts (e.g. safety devices) to be checked periodically as well as the recommended frequency;
- e) the conditions for examination and discard of wire ropes according to ISO 4309:2017 and chains;
- f) that access to maintenance and inspection points shall be kept clear of obstacles.

Attention shall be specifically drawn to the obligation of stopping all or part of the equipment to replace certain components such as conveyor rollers.

The instruction handbook for maintenance will require (at least) that:

- 1) continuous handling equipment shall be kept in proper working condition and maintained in accordance with the manufacturer's instructions;
- 2) inspection, adjustment, maintenance and cleaning of moving parts shall be carried out regularly in a safe manner according to the manufacturer's instructions;
- 3) if possible, inspection and adjustment of continuous mechanical handling equipment, in motion or in use, shall only be carried out with guards in position;
- 4) displacing or removal of a guard and/or neutralization of a safety device shall be carried out in accordance with 6.3.3 of EN ISO 12100:2010;
- 5) repairs and removal of protective enclosures or panels shall only be carried out after stopping the equipment and starting devices have been rendered inoperative by qualified persons;
- 6) entering the space below the lifting carriage of vertical transfer devices is only permissible if the safety devices are in place.

6.1.5 Training

In the instruction handbook, the manufacturer shall indicate whether operator training is required and give details of this training.

6.1.6 Remaining underneath loads

Attention shall be drawn by a notice that no one may remain underneath loads, unless it is foreseen by the manufacturer.

6.1.7 Instruction handbook for vertical transfer devices

Special reference shall be made in the instruction handbook for vertical transfer devices that during maintenance work:

- entering the space beneath the lifting carriage is permissible only if the safety devices are present and effective;
- working on lifting devices or on the lifting drive may be started only if the lifting carriage is prevented from unintentional movement or falling;
- riding on lifting carriages only under the foreseen conditions;
- test runs of vertical transfer devices with access to dangerous moving parts or with opened panelling are permissible only if they are performed by a qualified person making use of hold to run control devices; no other control devices may have any effect.

6.1.8 Hazards generated by conveyed loads

Reference shall be made in the instruction handbook that additional measures have to be taken if special hazards can occur generated by the conveyed loads e.g. radiation, explosion or poisoning.

6.1.9 Noise emission declaration

The instruction handbook and technical sales literature shall provide a noise emission declaration according to E.7.

6.2 Marking

6.2.1 Rating plate

The equipment shall be marked according to 6.4.4 a) of EN ISO 12100:2010.

6.2.2 Load bearing capacity

The load bearing capacity shall be indicated in kilogram (kg) or ton (t) legibly and indelibly at loading points, in so far as the loading of the conveyor is not automatically limited by the type of load handling device or loading method. In addition, for telescopic conveyors with platforms the maximum number of persons shall be indicated.

6.2.3 Sign at vertical transfer devices

If hinged supports or bolts are fitted in vertical transfer devices, a clearly recognizable sign shall be installed at both ends of the route with, for example, the following text:

"Shut down the unit, lock the main switch.

Bring hinged supports or safety bolts into the protective position".

6.2.4 Marking of hydraulic fluid reservoirs

Fluid reservoirs shall be marked legibly and indelibly with a means of identifying which units are served by each individual fluid reservoir and at least the serial number, the year of construction, designation of series or type of system, working pressure and details of the correct type of hydraulic fluid.

6.2.5 Marking of couplings in hydraulic or pneumatic systems

Where incorrect connection or reconnection of couplings in hydraulic or pneumatic systems is not prevented by incompatible couplings, labelling or colour coding shall be provided.

6.2.6 Prohibition sign for unauthorised persons

Prohibition sign for unauthorised persons shall be fitted at:

- access doors to restricted and danger areas;
- at chutes for sorters where access for maintenance is intended.



Figure 4 — “Access for unauthorized persons prohibited”

Example for additional text for restricted areas

RESTRICTED AREA – AUTHORIZED PERSONNEL ONLY
WARNING; EQUIPMENT WILL REMAIN OPERATIONAL
See machine documentation for detailed instructions

6.2.7 Sign “No thoroughfare”

The sign “No thoroughfare” shall be fitted at:

- load entry/exit points (see Figure D.6);
- at chutes for sorters where access is not intended.



Figure 5 — “No thorough fare”

6.2.8 Signs at conveying systems

At any control position the sign M002 — “Refer to instruction manual” according to EN ISO 7010:2020⁴ shall be fitted.

Annex A (informative)

Examples of continuous handling equipment

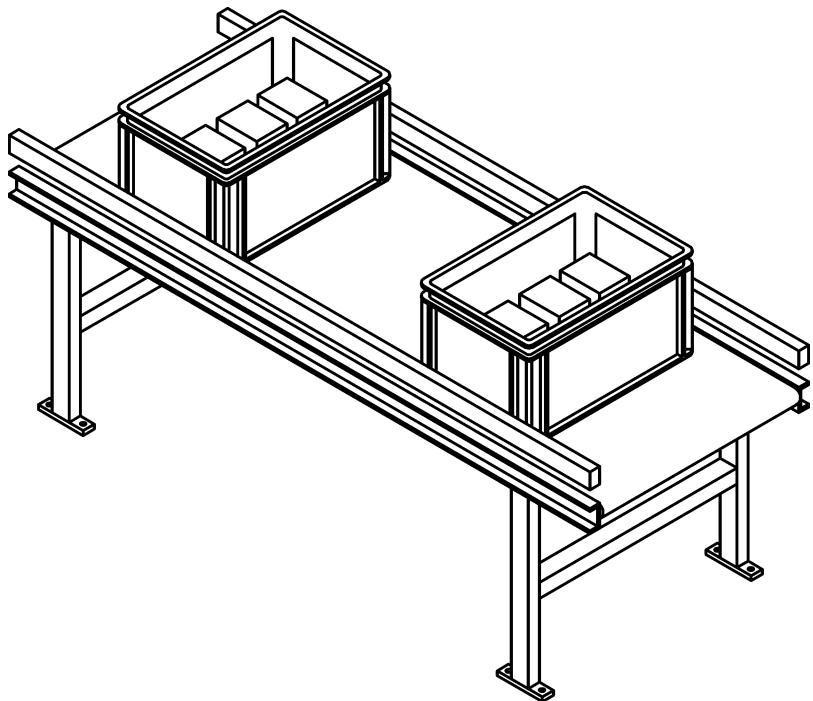


Figure A.1 — Belt conveyor

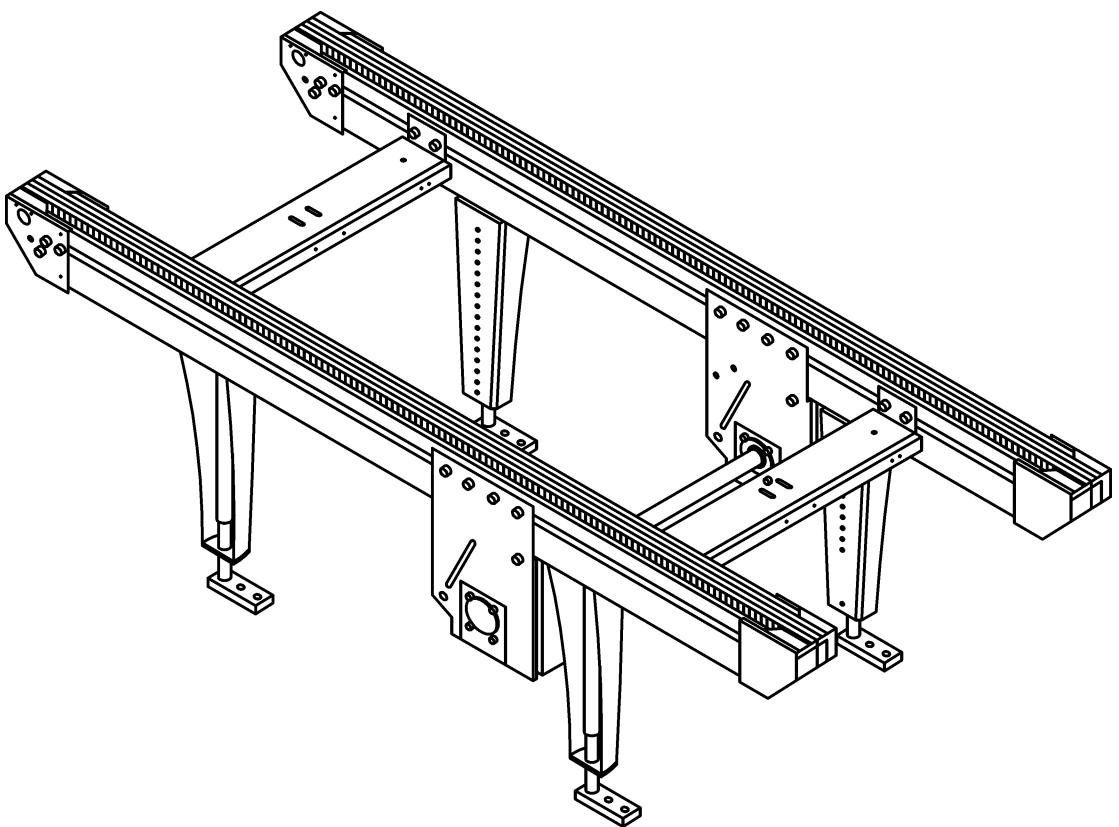


Figure A.2 — Carrying-chain conveyor

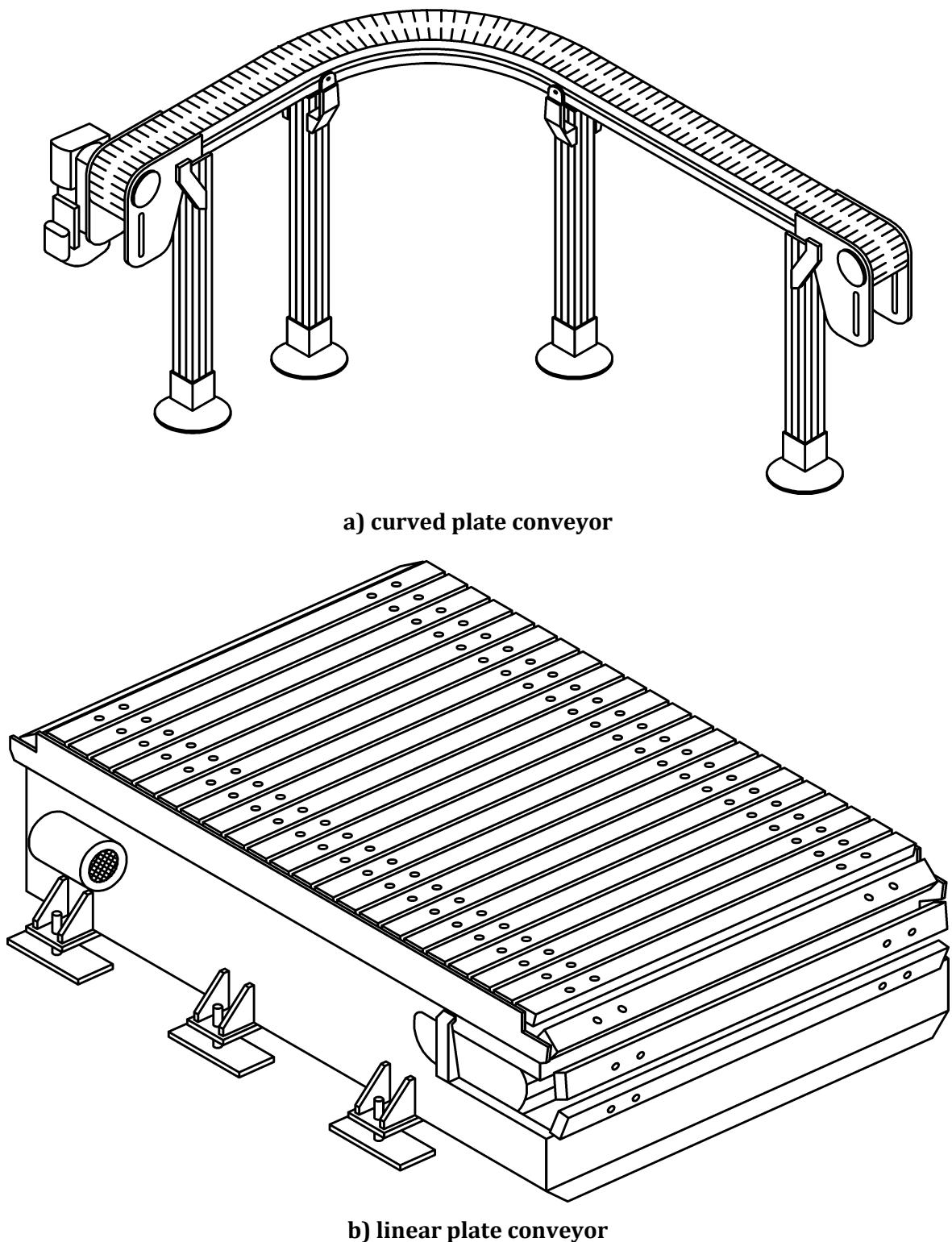


Figure A.3 — Plate conveyors (curved plate conveyor / linear plate conveyor)

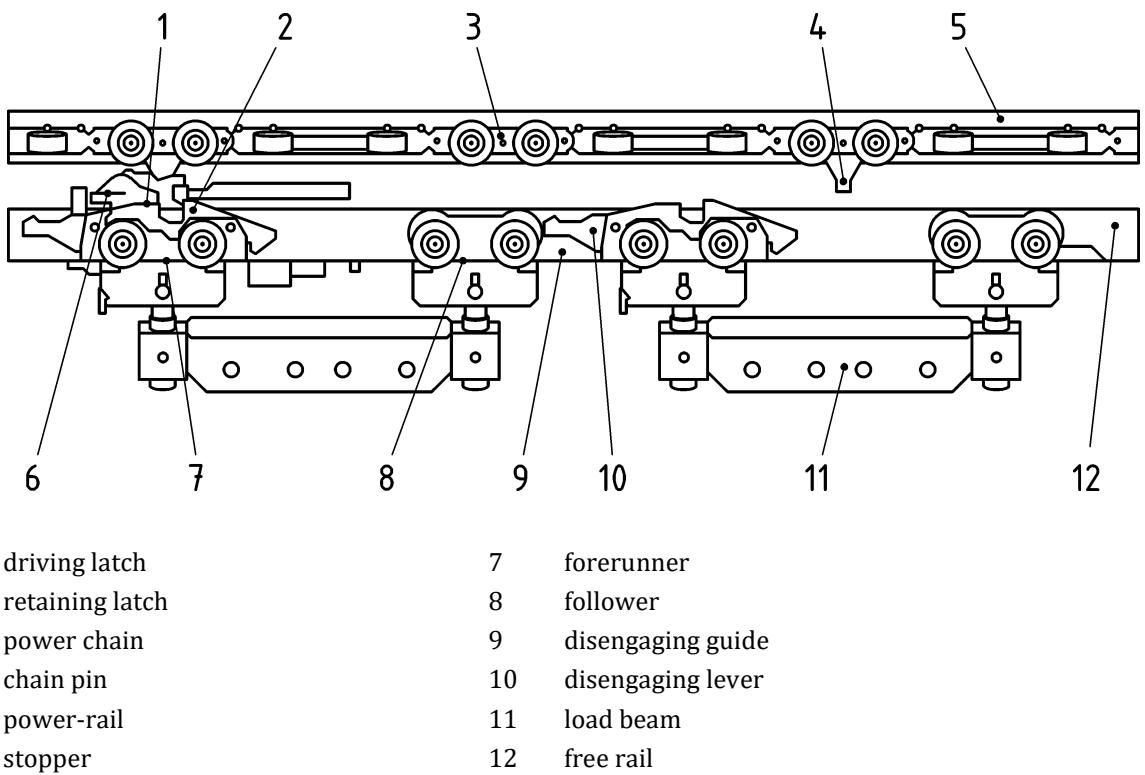


Figure A.4 — Circular overhead conveyor, power and free-conveyor (side view)

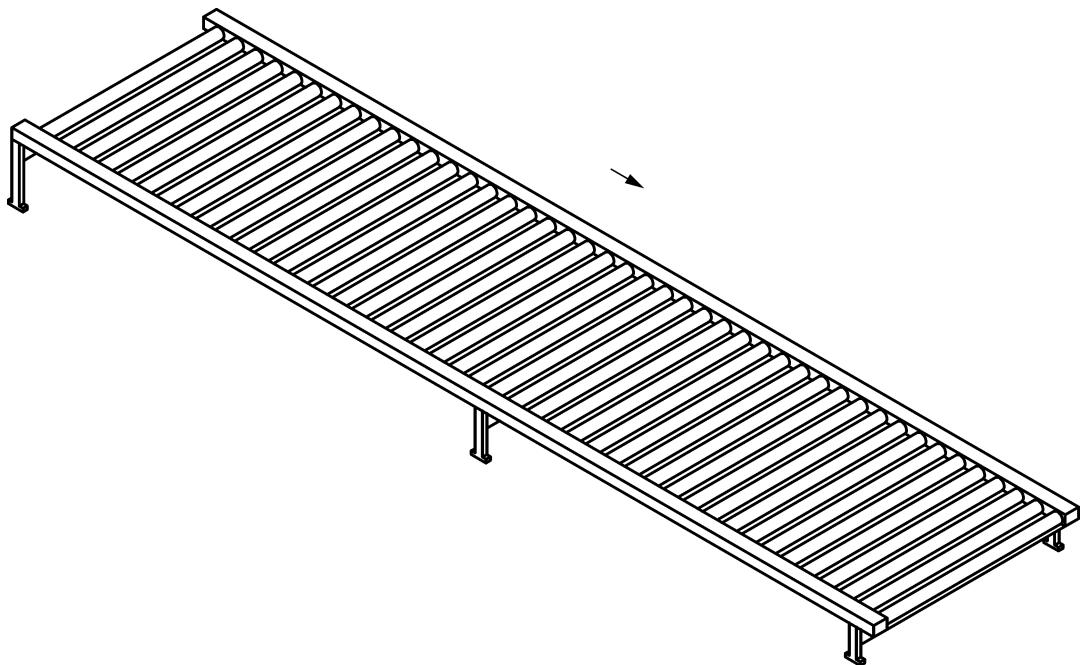


Figure A.5 — Gravity roller conveyor

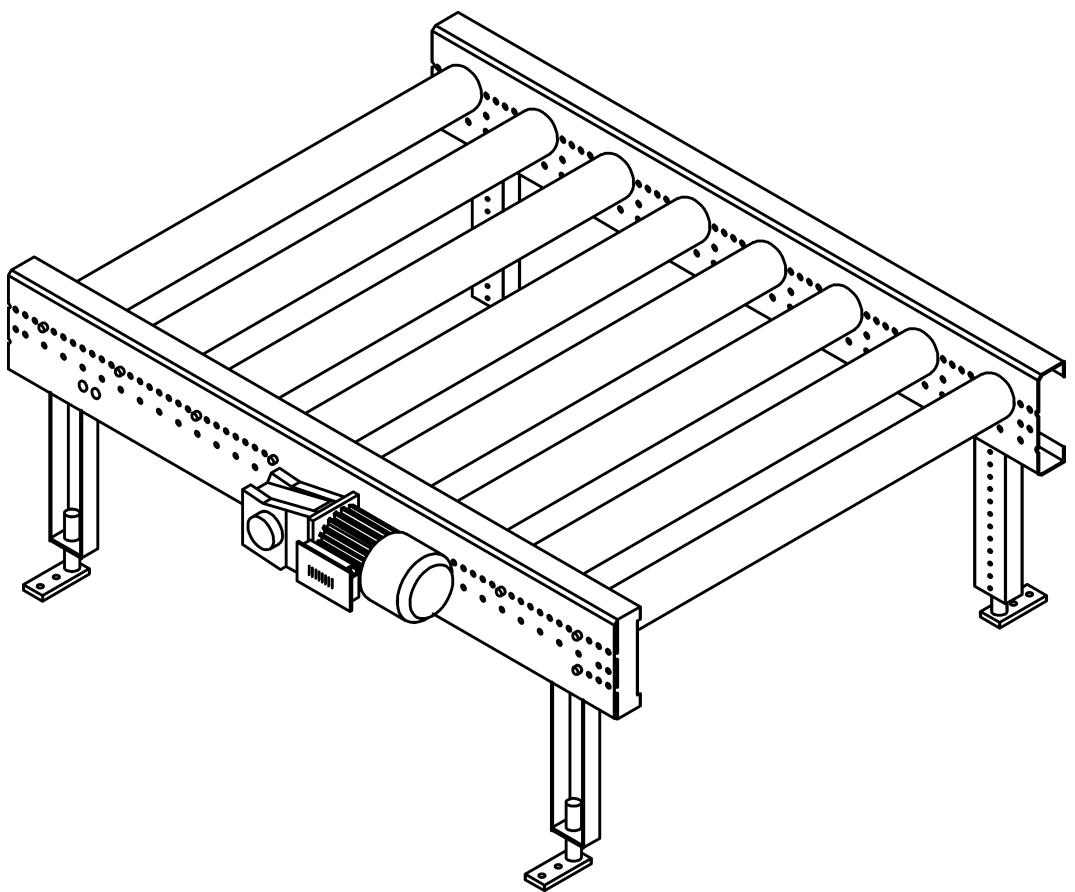
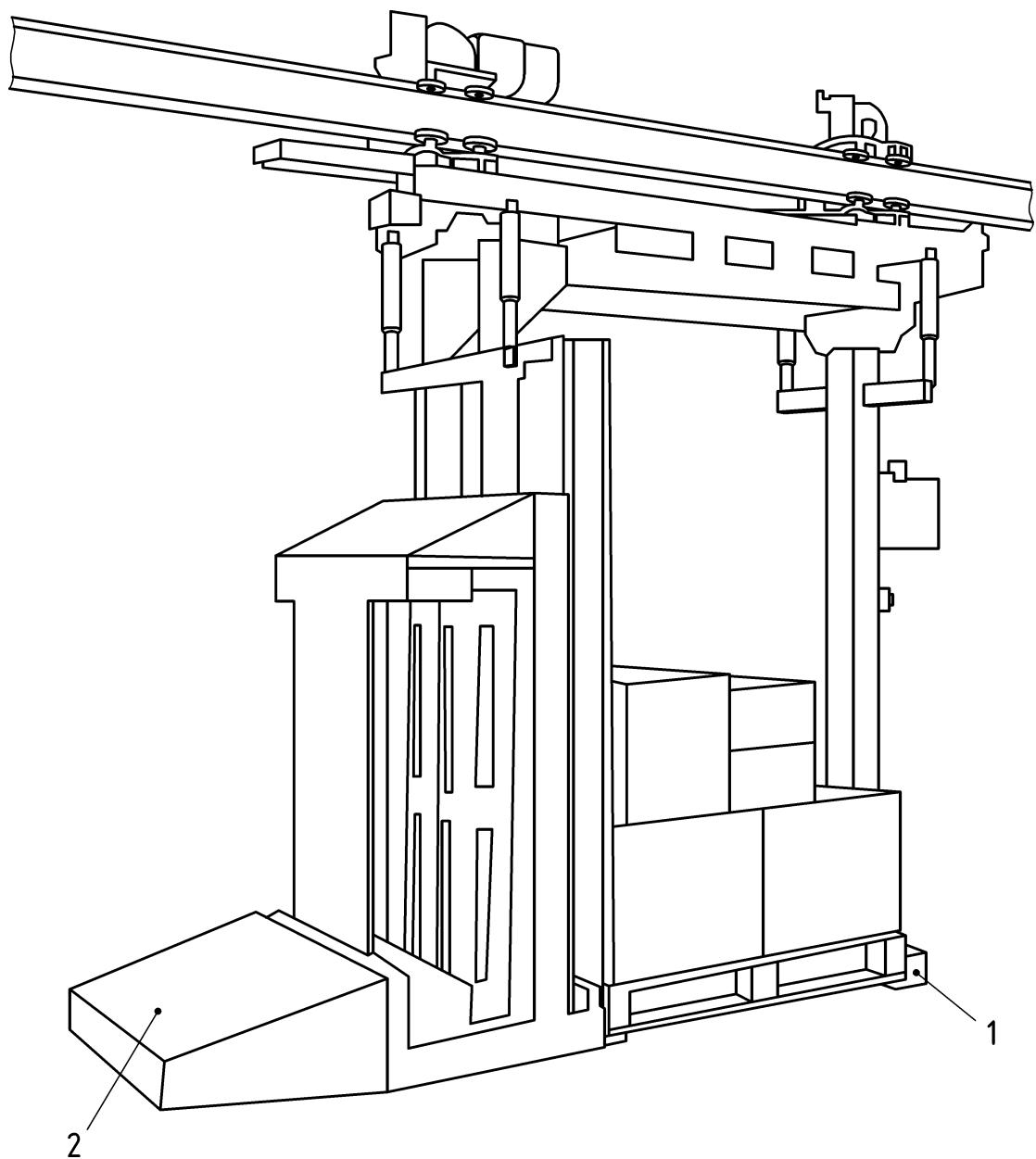
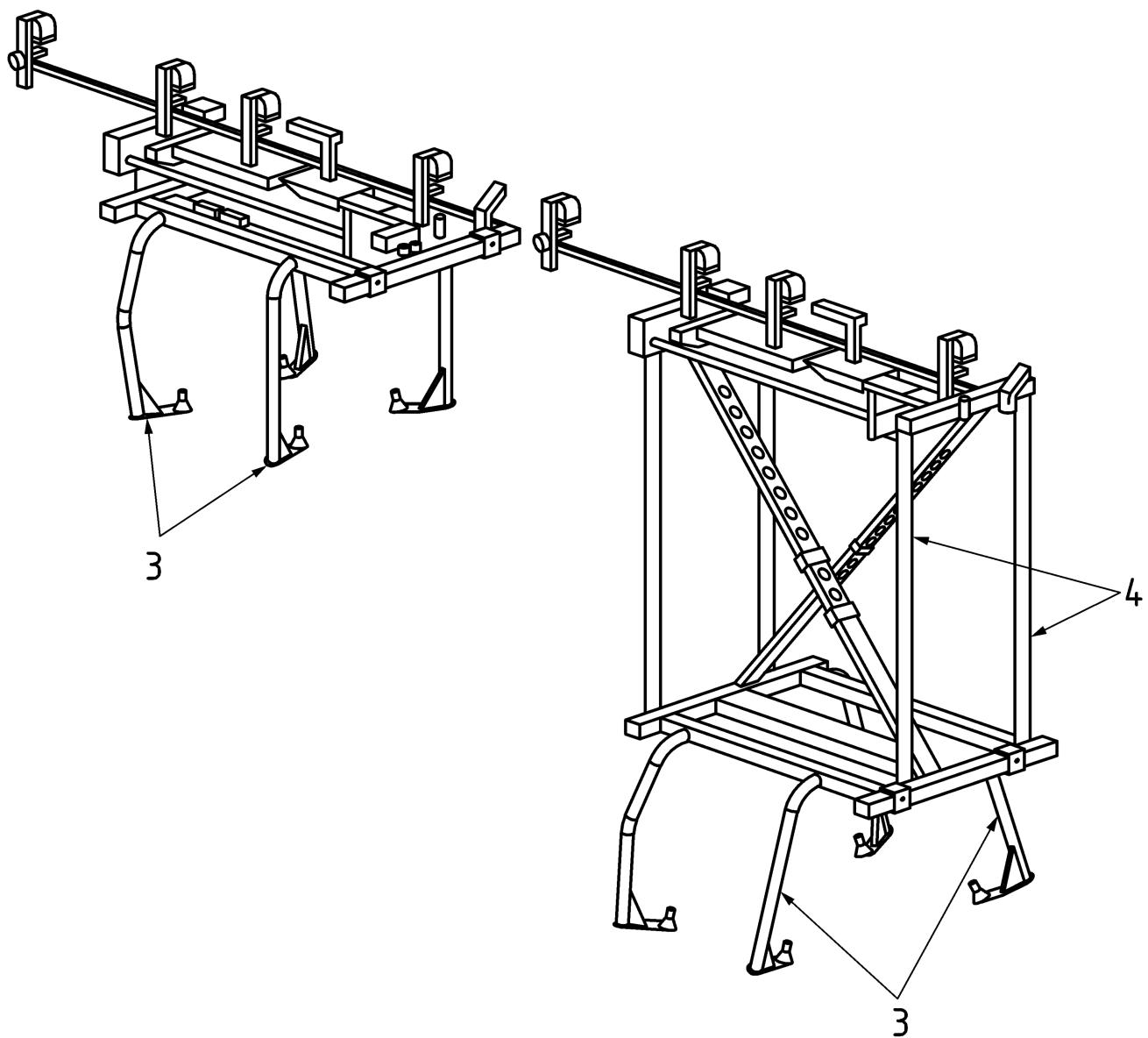


Figure A.6 — Driven roller conveyor



a) Self-propelled overhead conveyor with bumper



b) Self-propelled overhead conveyor with lifting equipment

Key

- 1 carrying element
- 2 bumper
- 3 load handling device
- 4 lifting element

Figure A.7 — Self-propelled overhead monorail conveyors

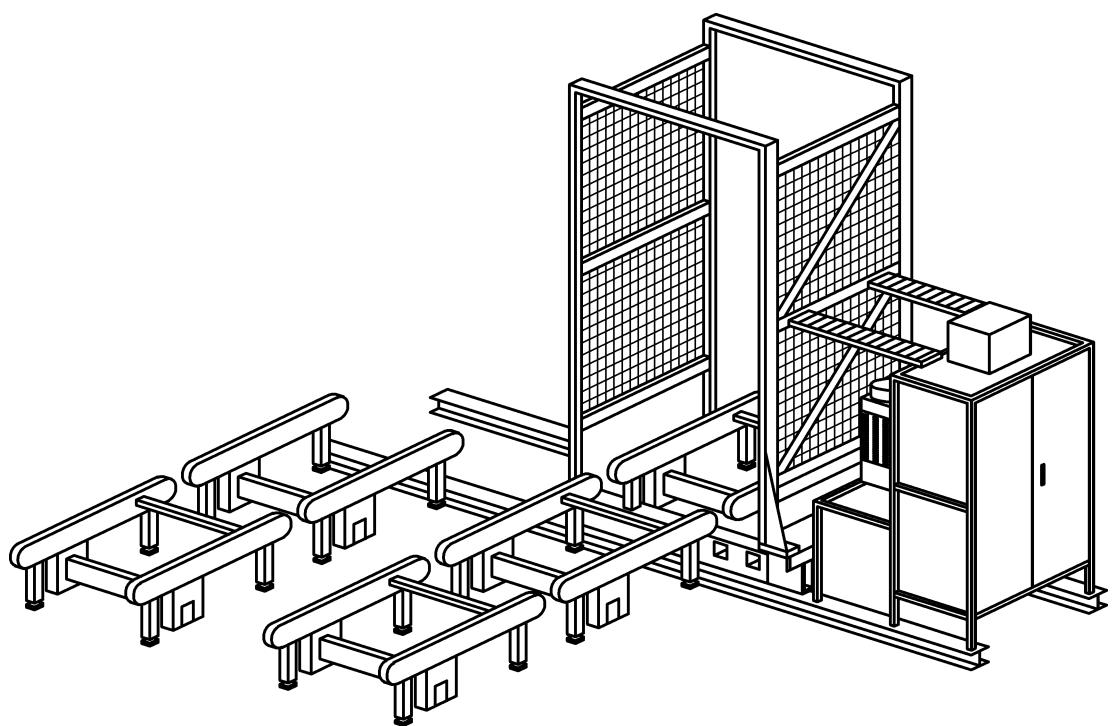
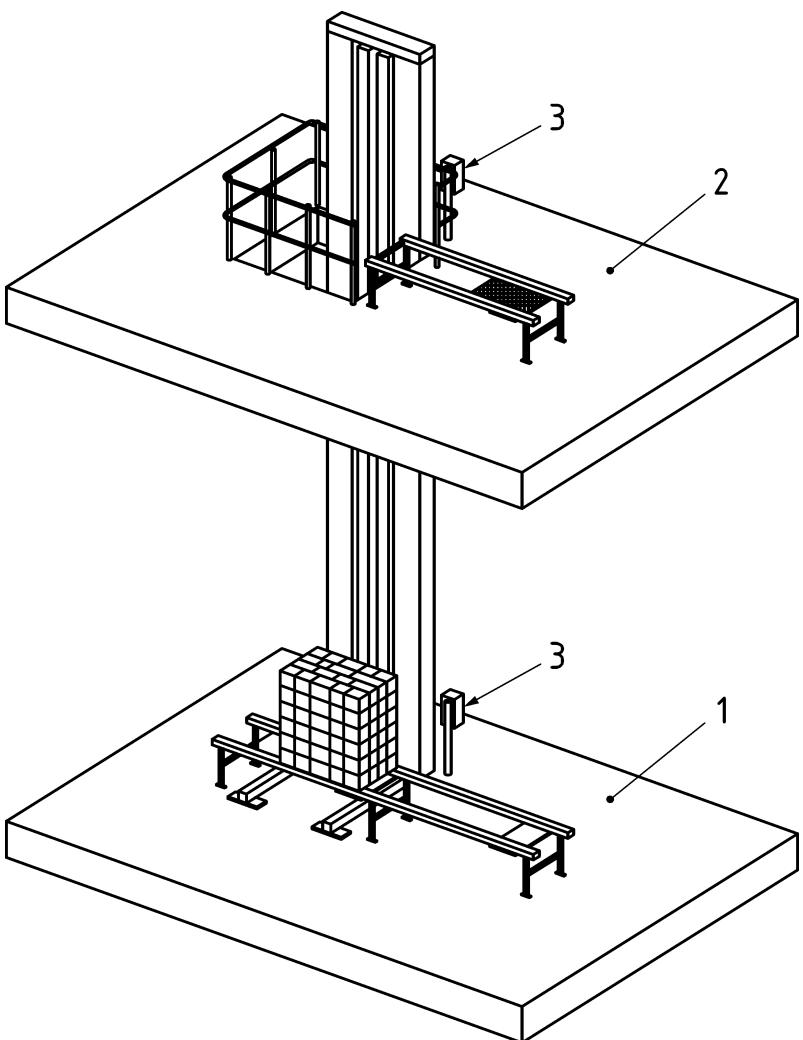


Figure A.8 — Transfer car



Key

- 1 floor level
- 2 upper level
- 3 control panel

Figure A.9 — Vertical transfer device

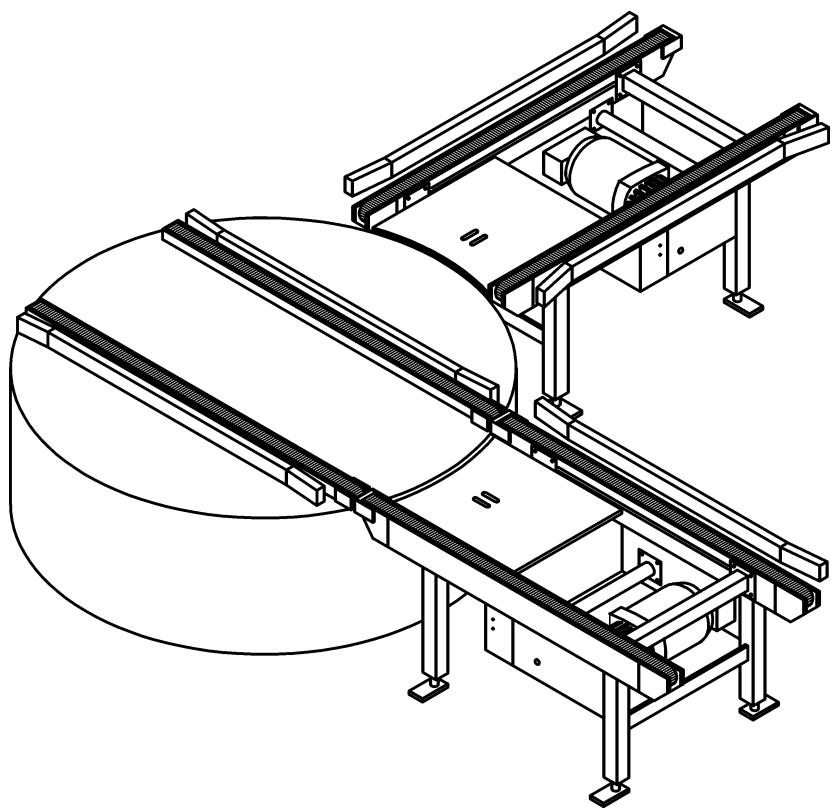


Figure A.10 — Horizontal transfer device (turntable)

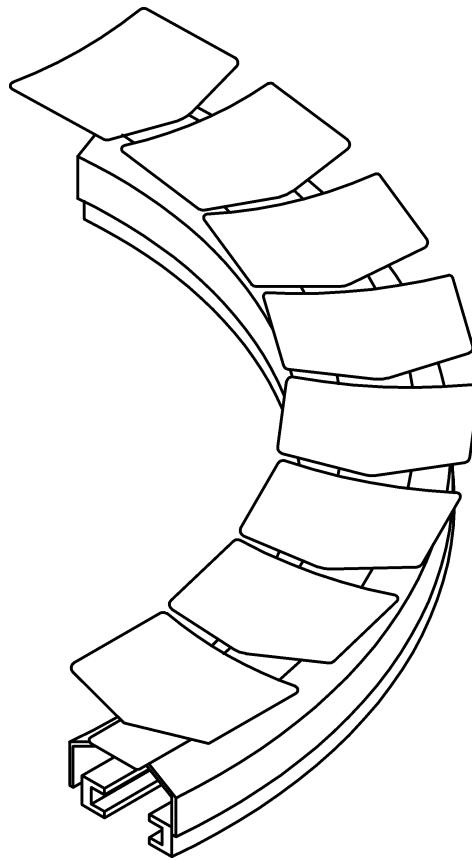


Figure A.11 — Loop sorter - Tilt tray system

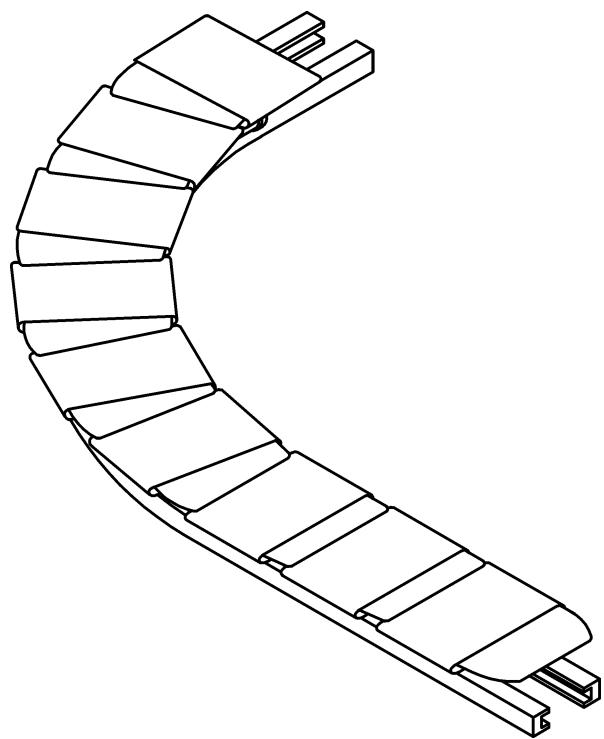


Figure A.12 — Loop sorter - Cross belt system

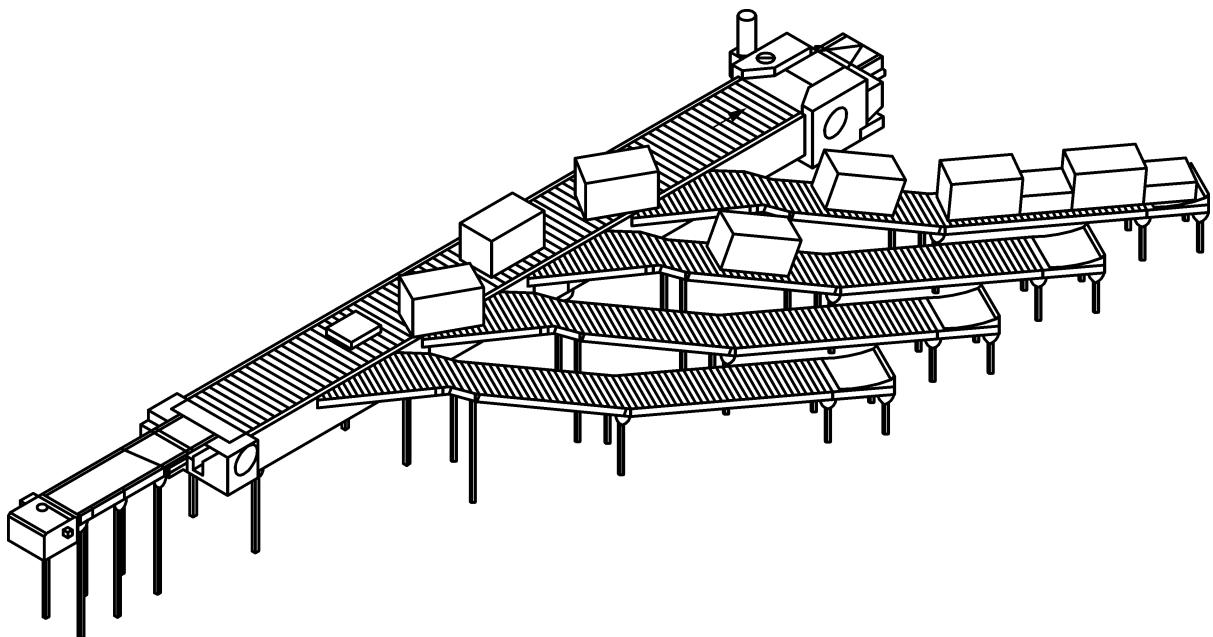


Figure A.13 — Line sorter - Shoe system

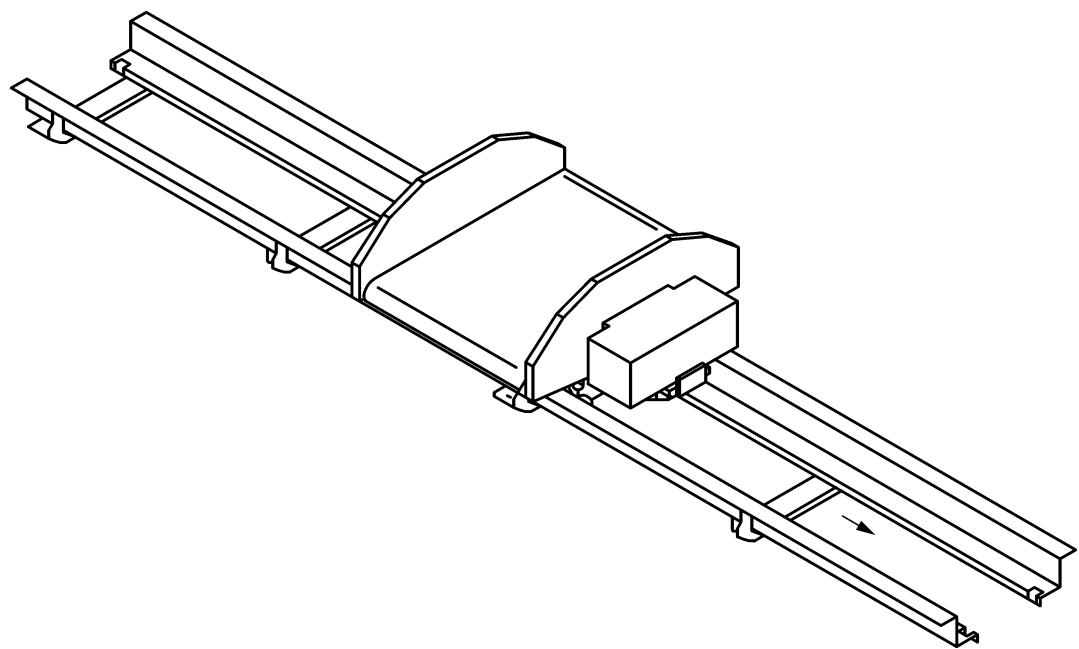


Figure A.14 — Destination coded vehicle (DCV)

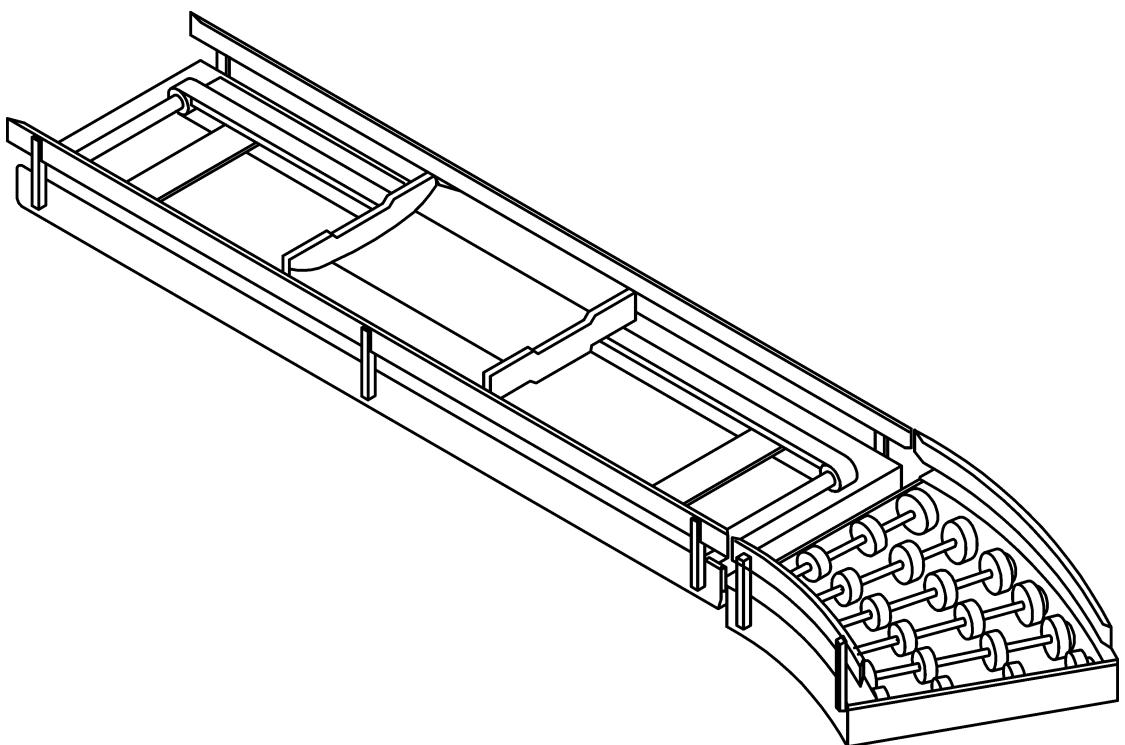


Figure A.15 — Tote conveyor

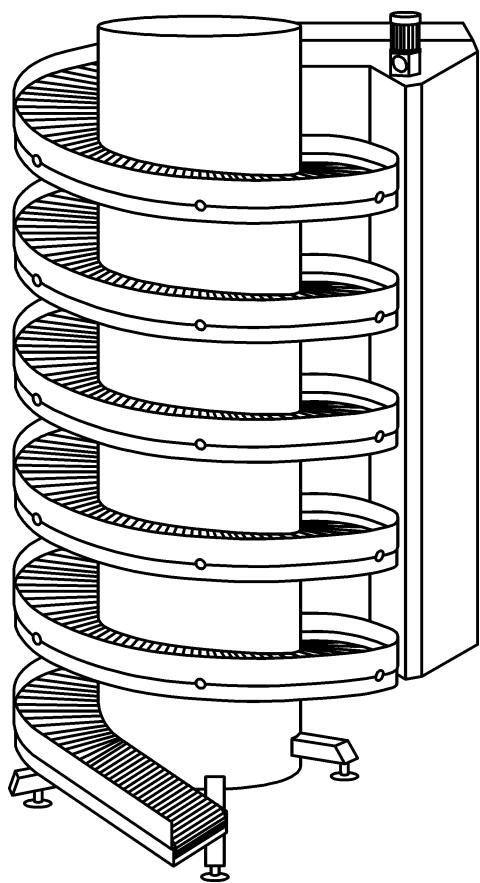
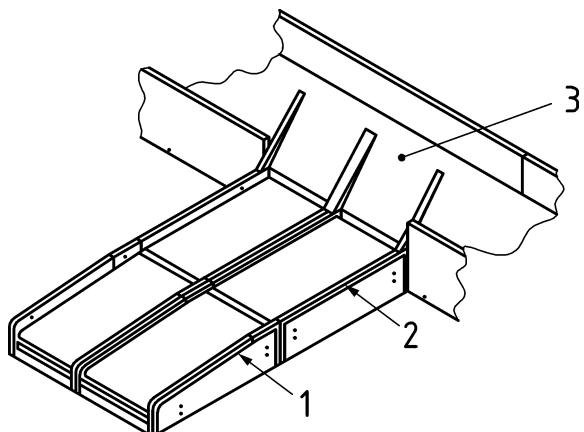


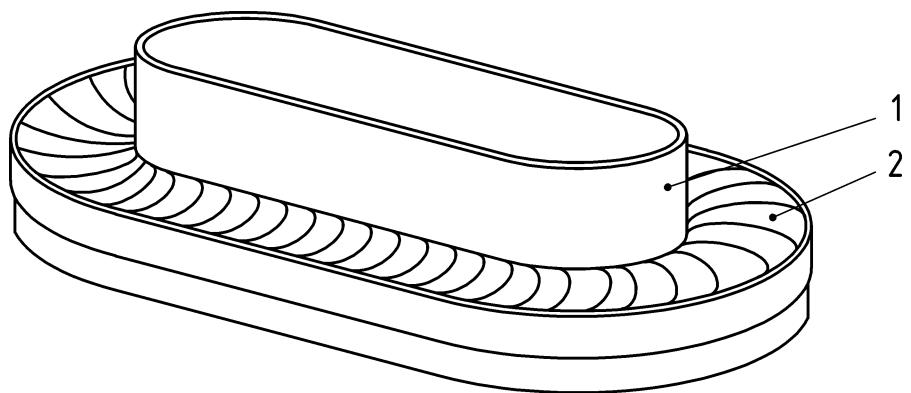
Figure A.16 — Driven spiral conveyor



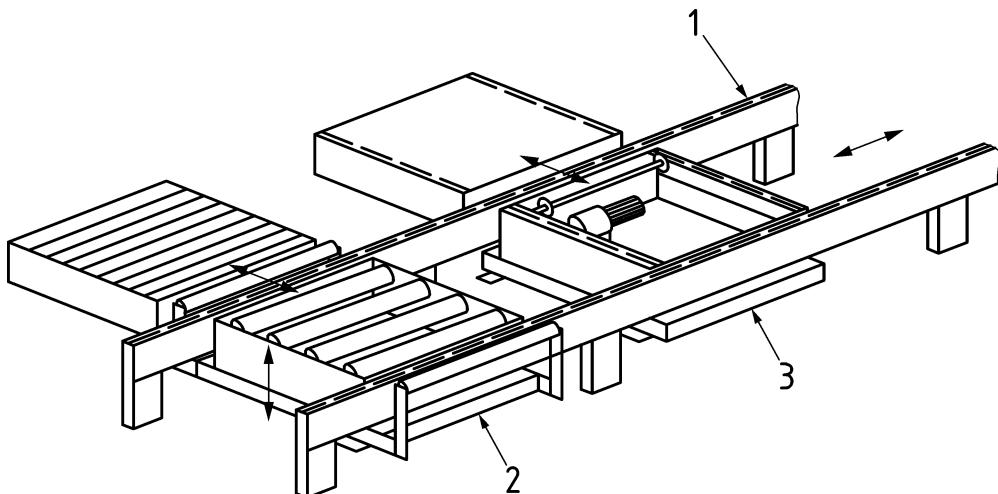
Key

- 1 weighing and labelling belt conveyor
- 2 feeding belt conveyor
- 3 collector belt conveyor

Figure A.17 — Check-in-conveyor

**Key**

- 1 inner side guarding
- 2 overlapping flexible elements

Figure A.18 — Baggage carousel**Key**

- 1 chain conveyor
- 2 divert roller pallet
- 3 divert chain pallet

Figure A.19 — Diverting conveyors

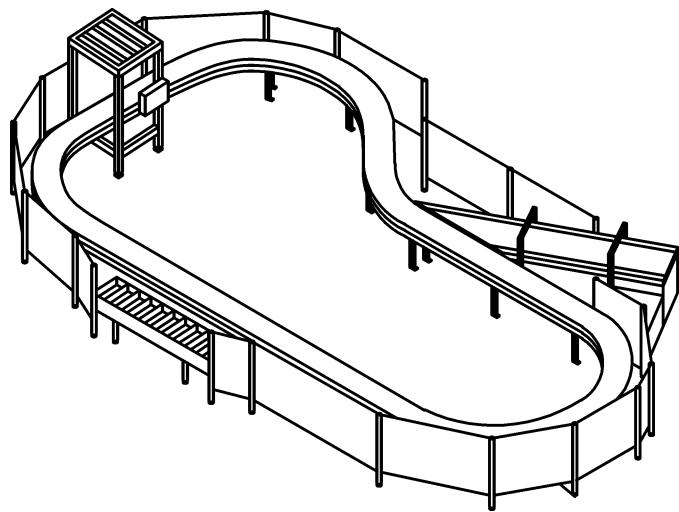


Figure A.20 — Loop sorter

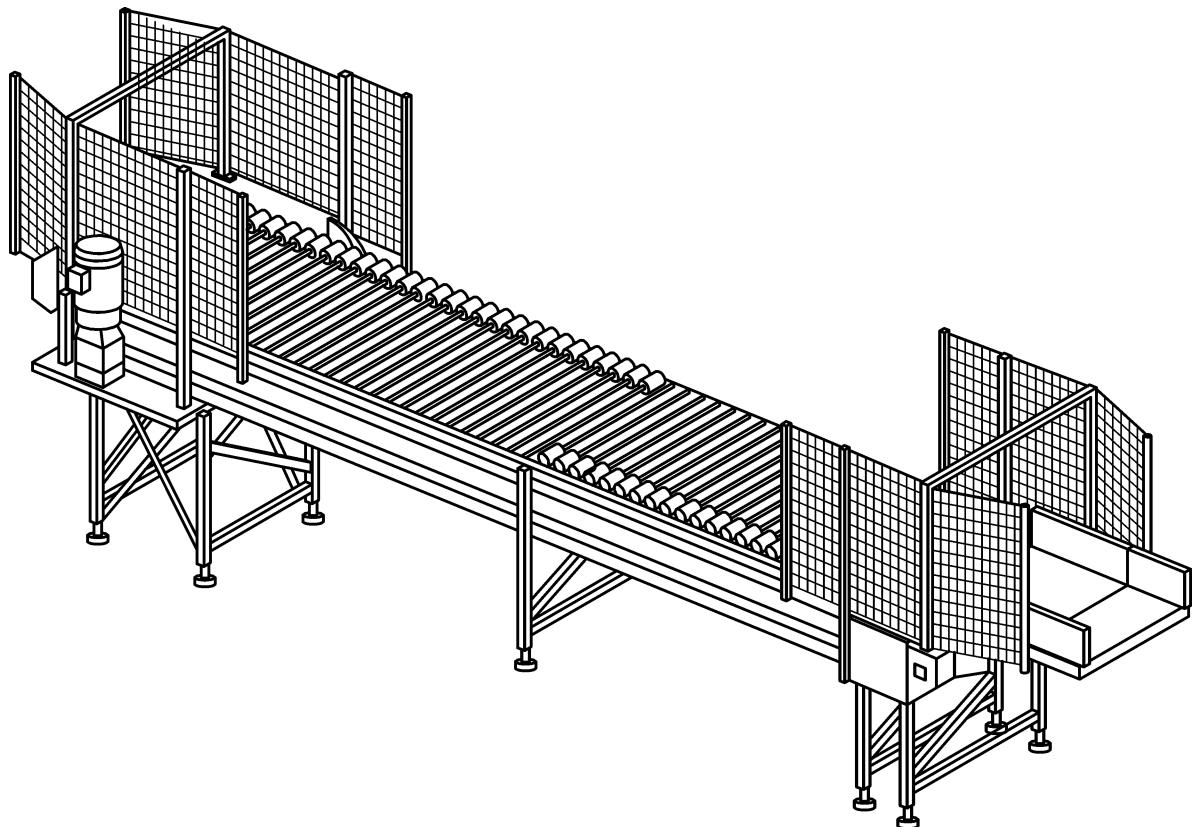
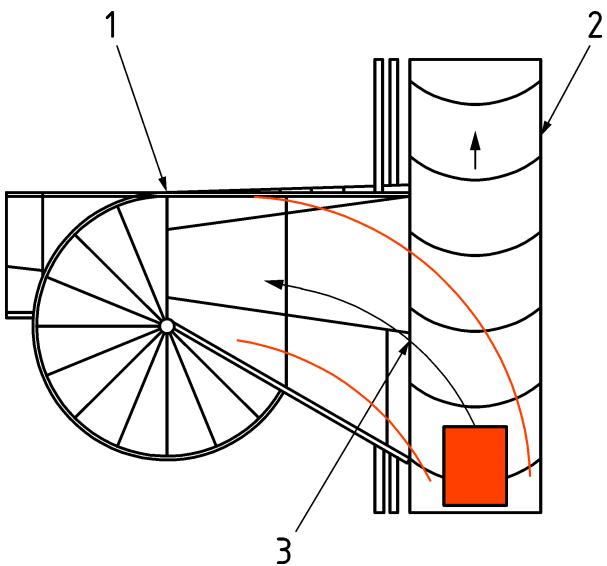


Figure A.21 — Line sorter with fixed guards

**Key**

- 1 destination
- 2 sorter
- 3 discharge point of sorter

Figure A.22 — Discharge point of sorter (top view)

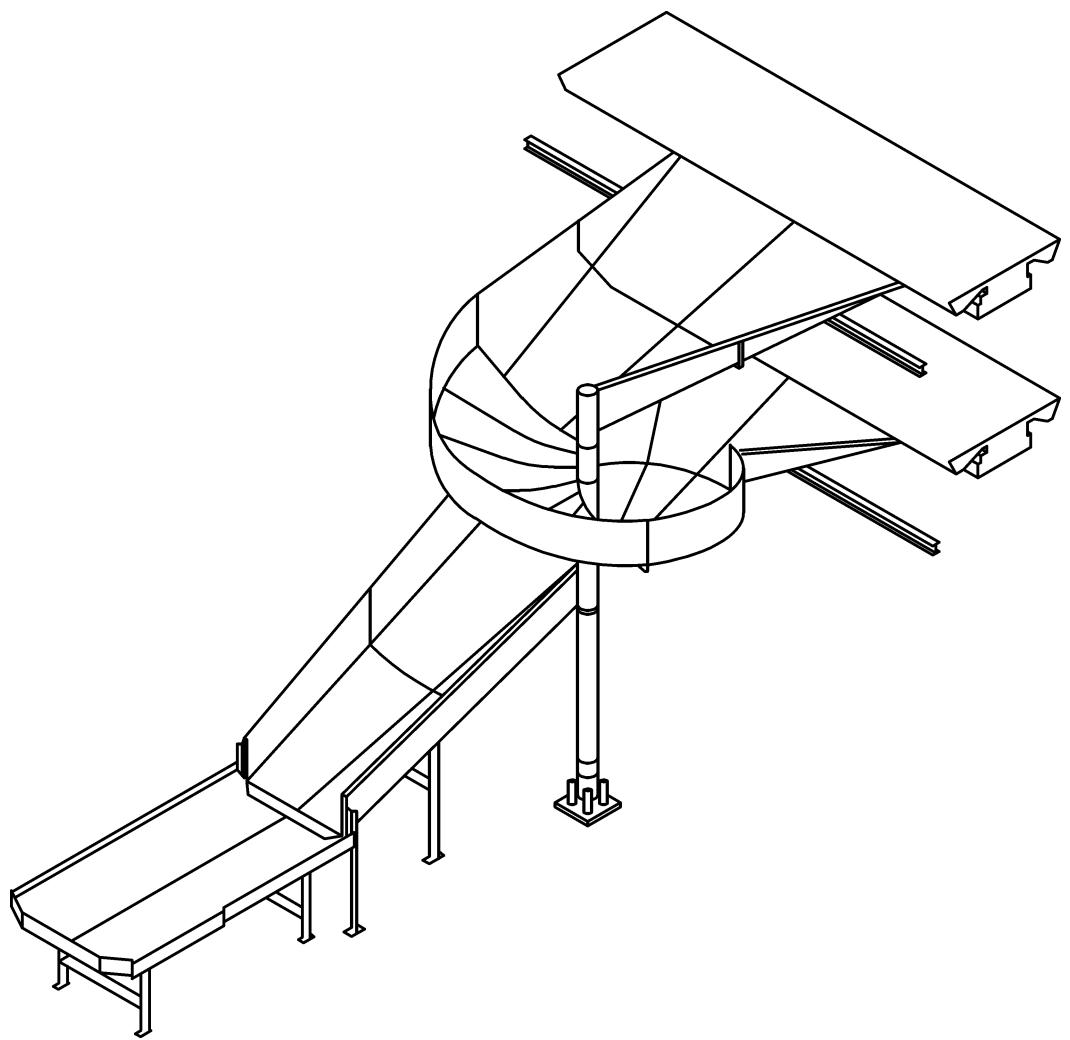


Figure A.23 — Spiral chute

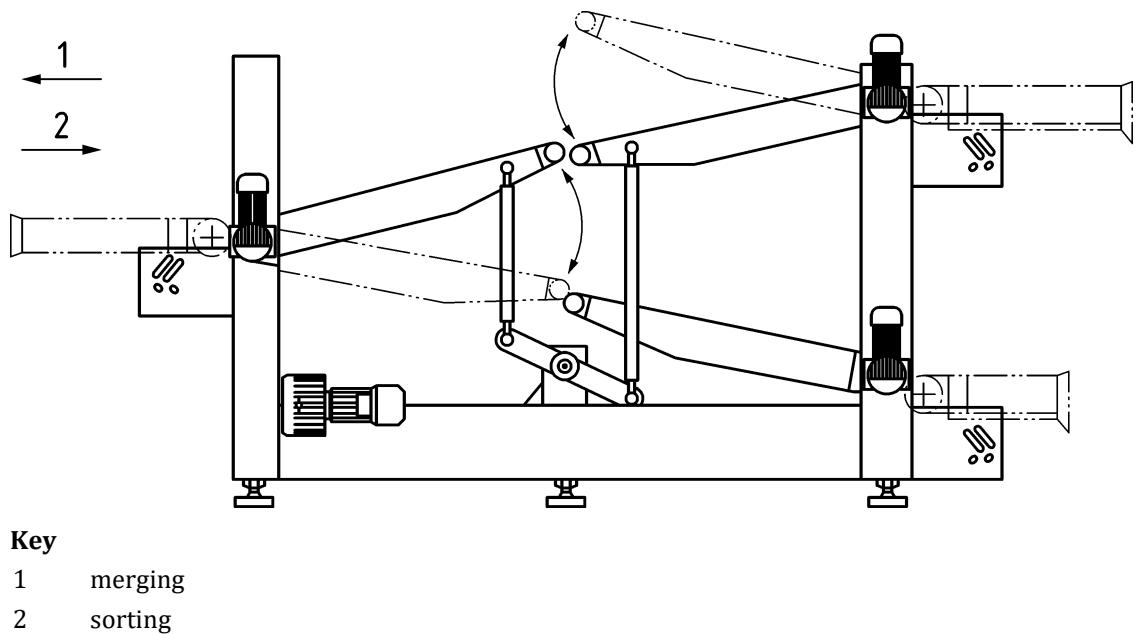


Figure A.24 — Vertical switch conveyor (side view)

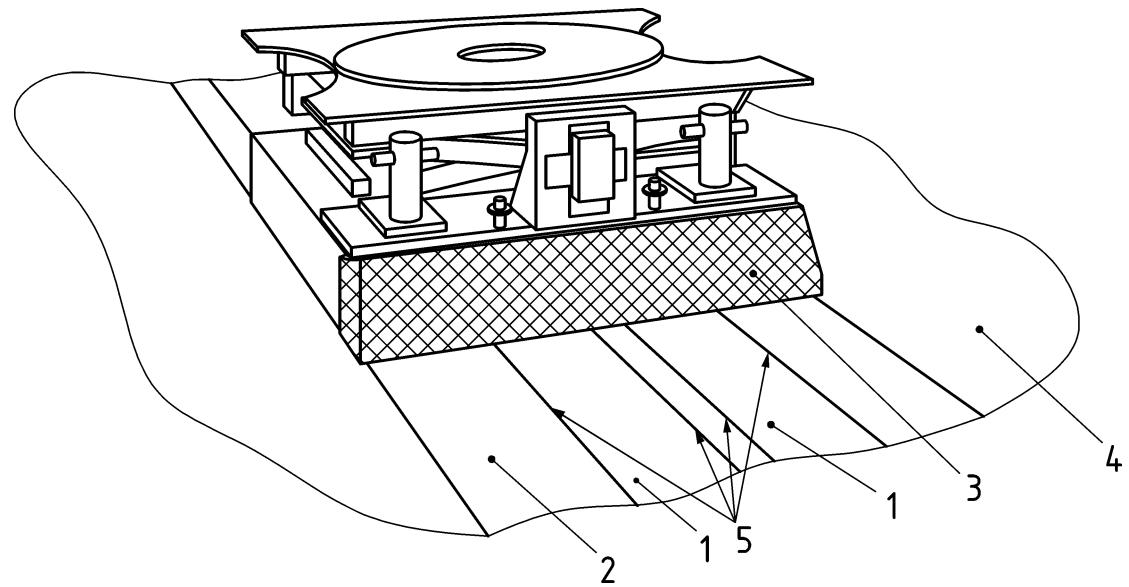
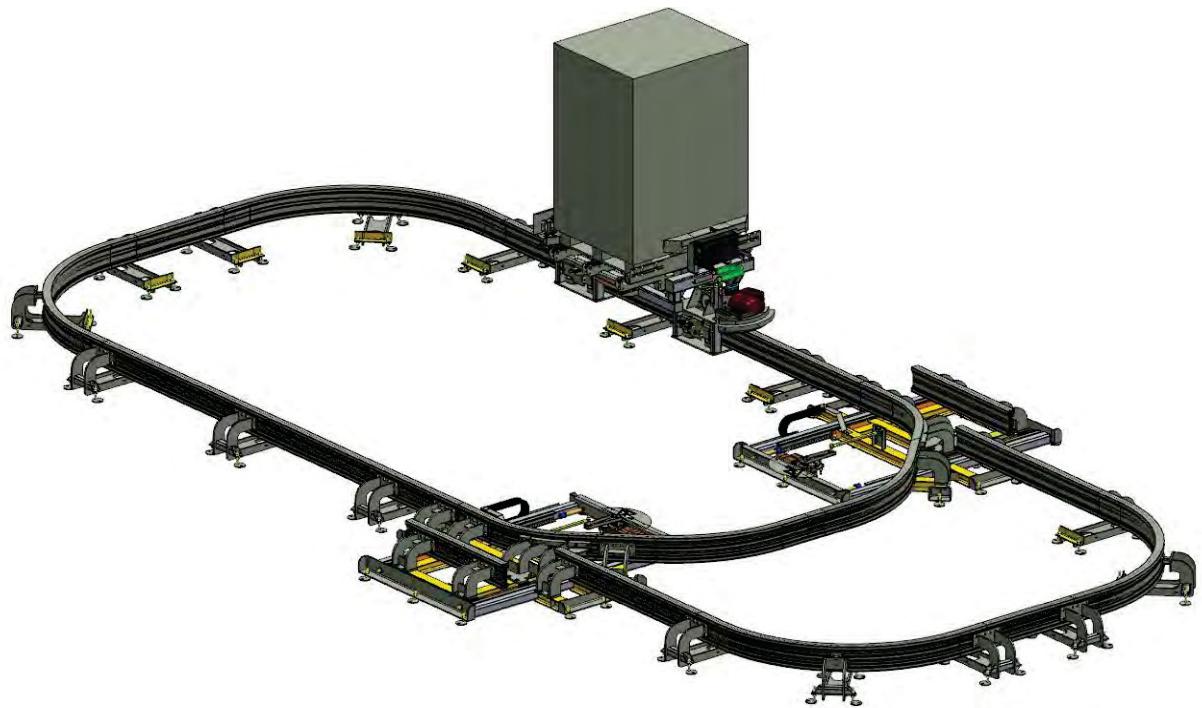
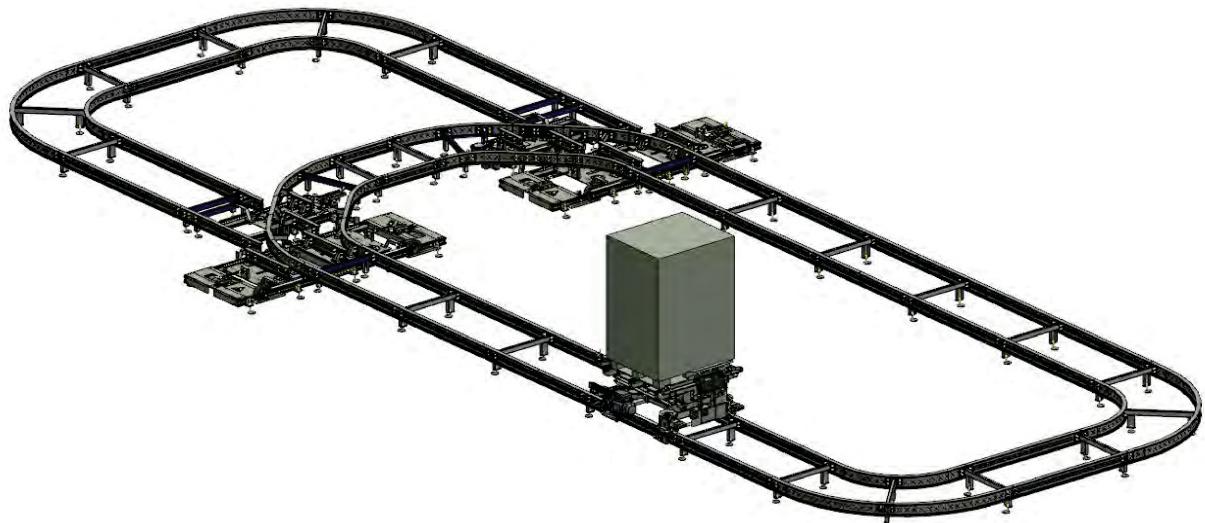


Figure A.25 — Underfloor chain conveyor

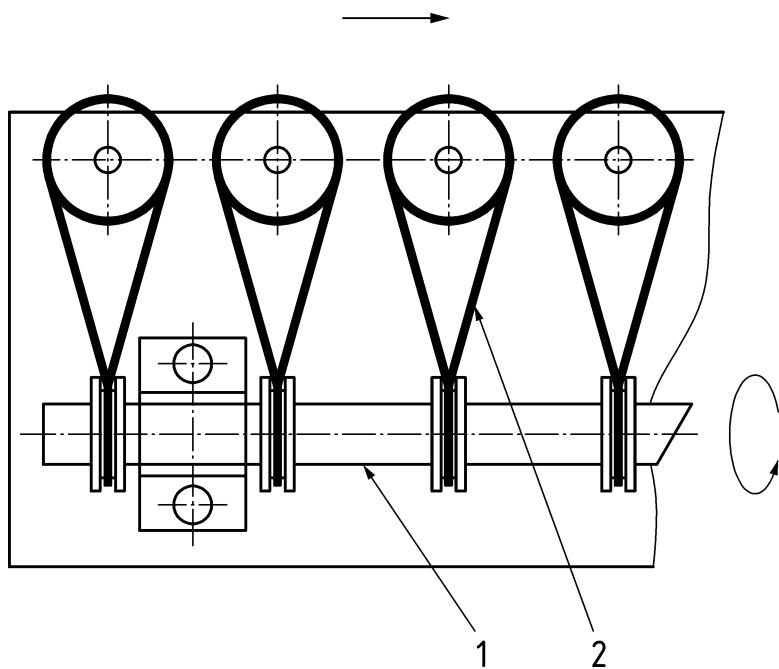


a) monorail floor track conveyor



b) double rail floor track conveyor

Figure A.26 — Rail guided floor track conveyor

**Key**

- 1 main shaft
- 2 drive belt

Figure A.27 — Roller conveyor propelled by a main shaft

Annex B (informative)

Examples of mechanical hazards

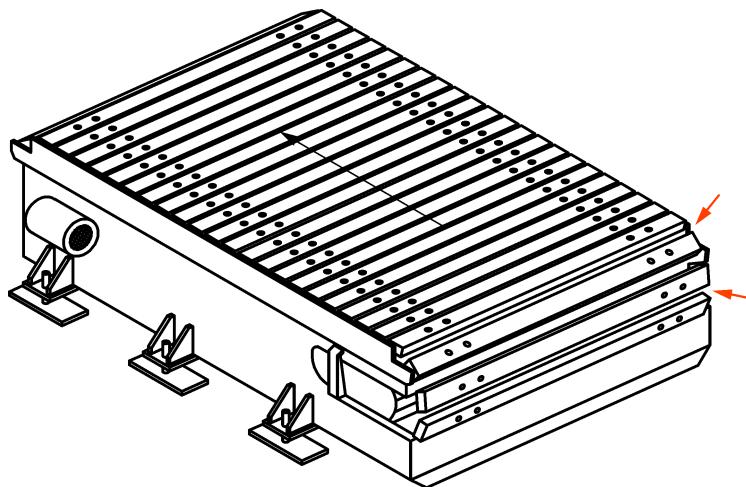


Figure B.1 — Crushing hazard

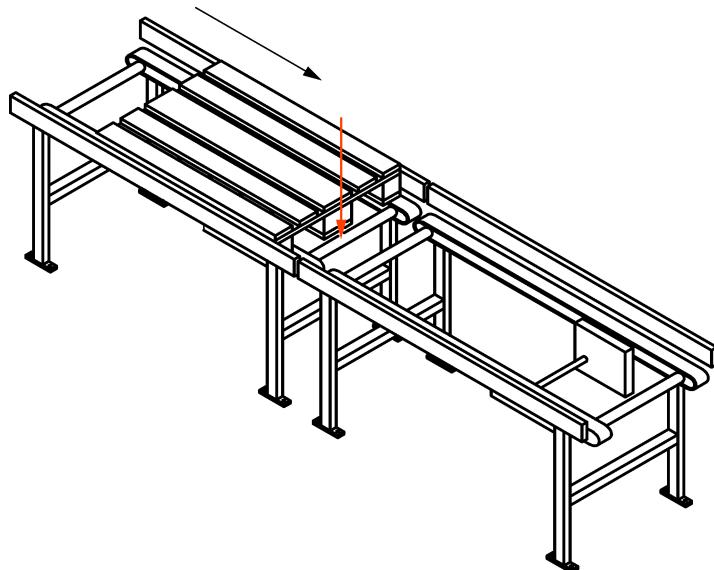


Figure B.2 — Shearing hazard

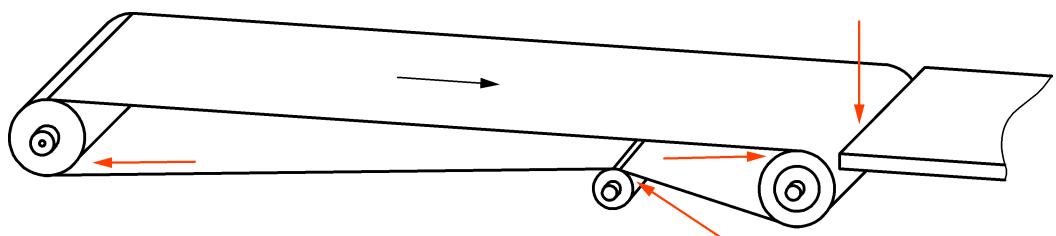


Figure B.3 — Drawing-in hazards

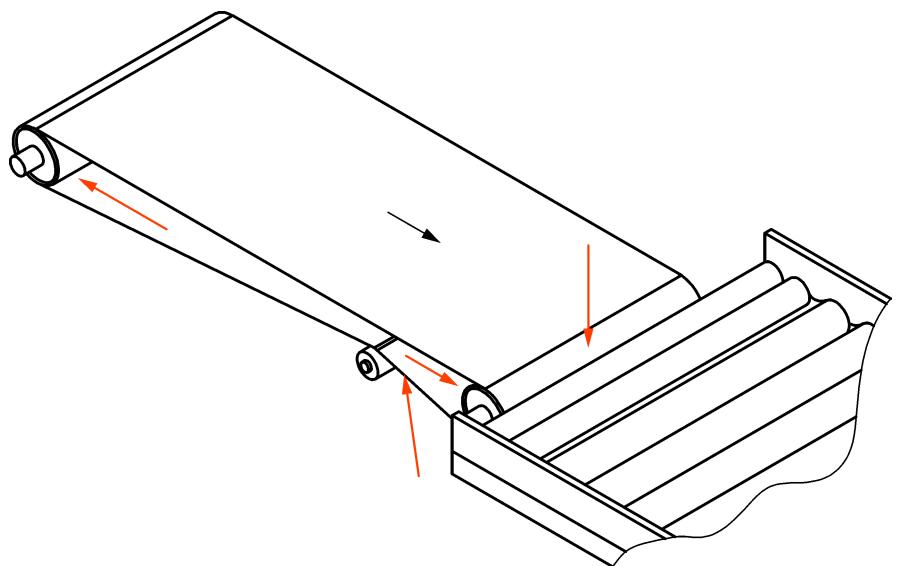


Figure B.4 — Drawing-in hazards

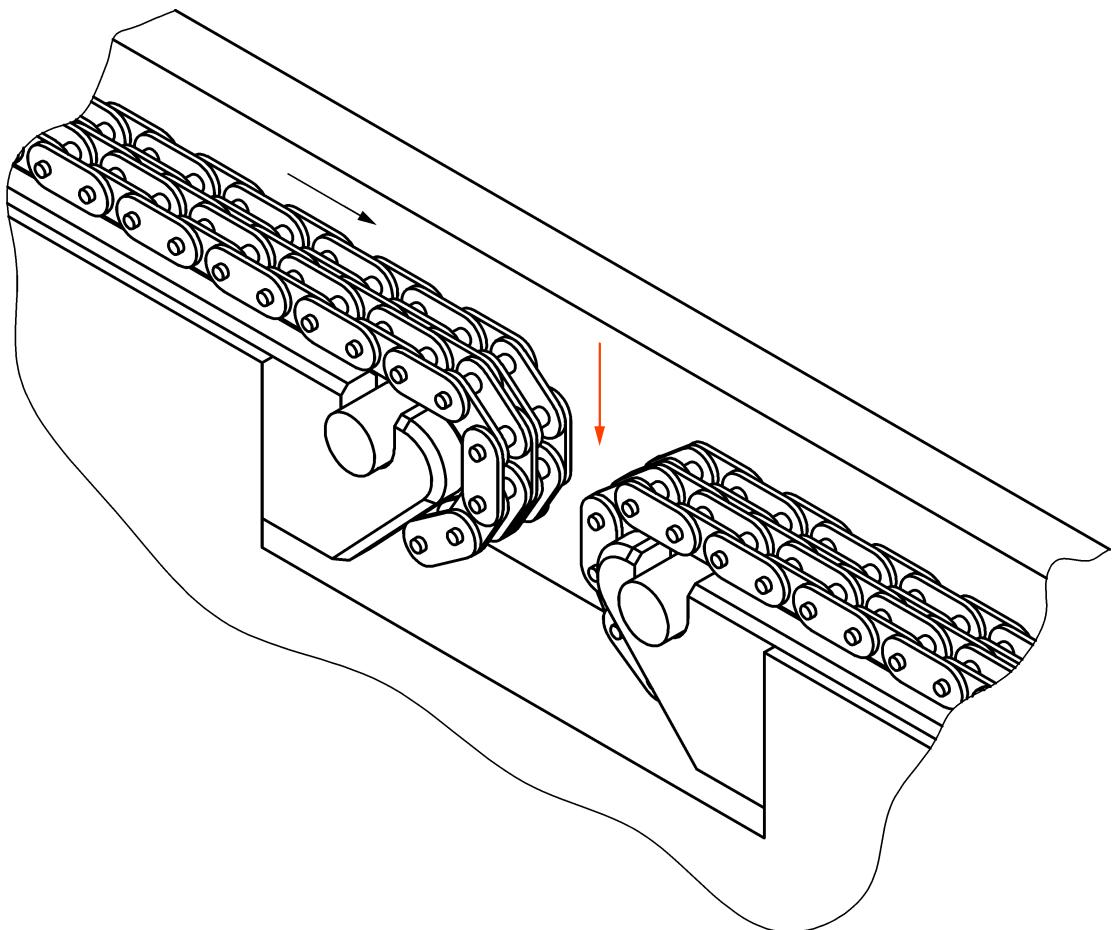


Figure B.5 — Drawing-in hazards

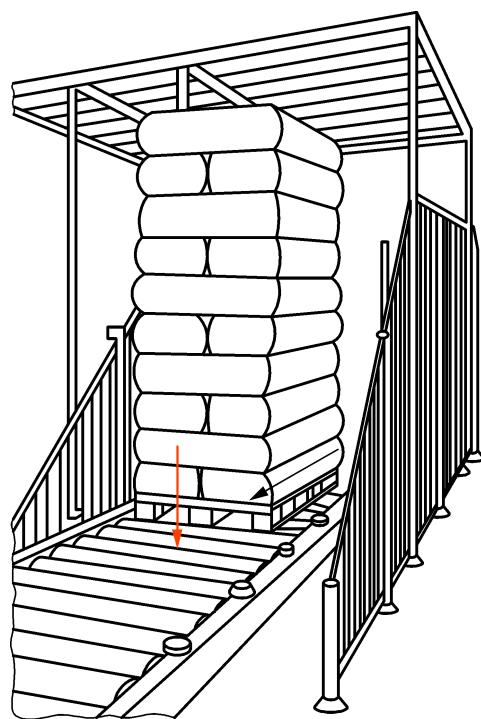
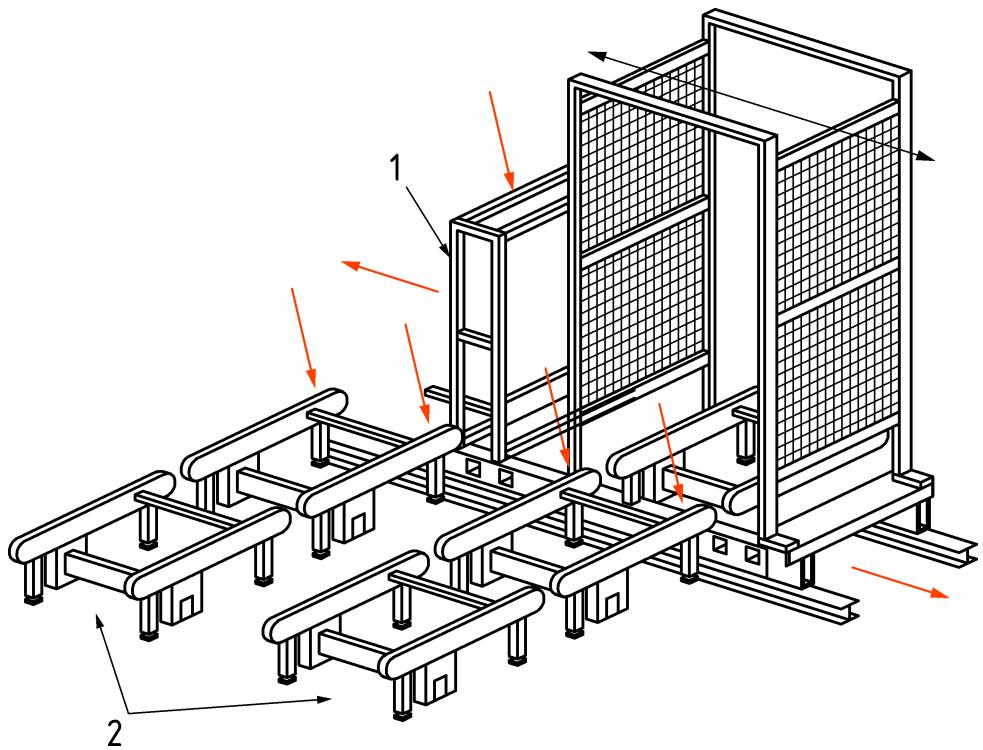


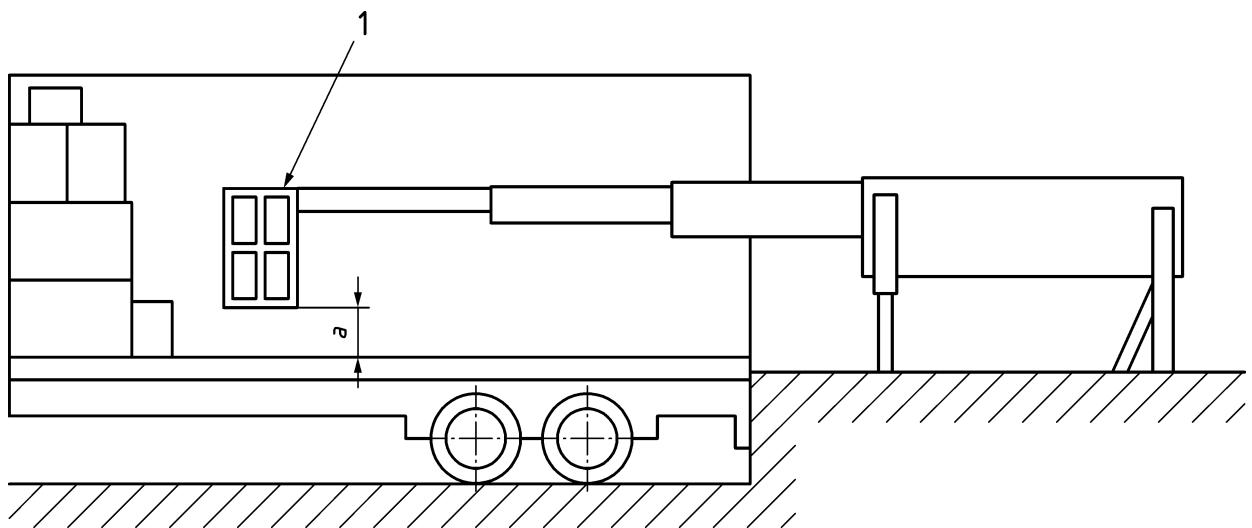
Figure B.6 — Shearing hazard



Key

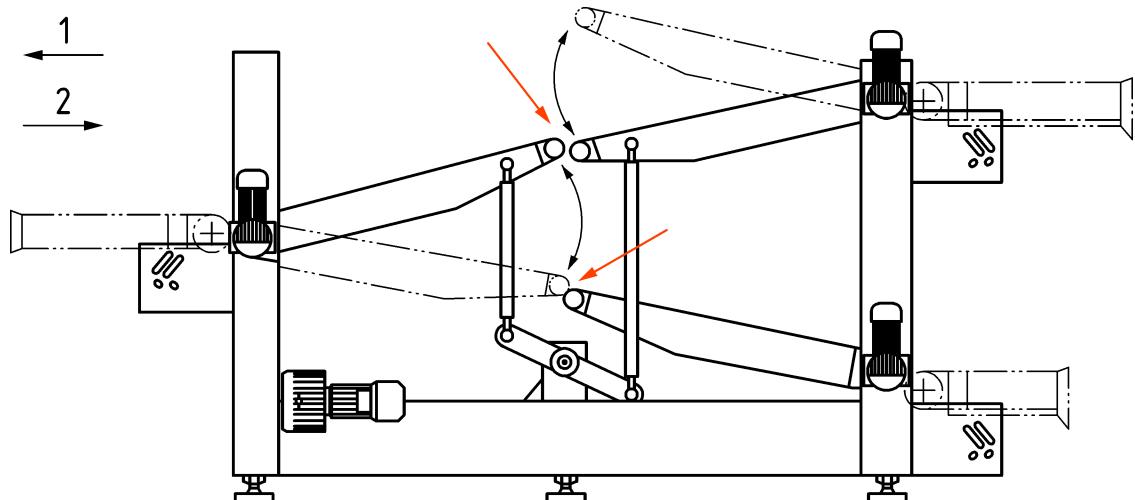
- 1 transfer car
- 2 connecting conveyors

Figure B.7 — Shearing and impact hazard

**Key**

a falling height

1 platform

Figure B.8 — Falling hazard on telescopic conveyor with platform**Key**

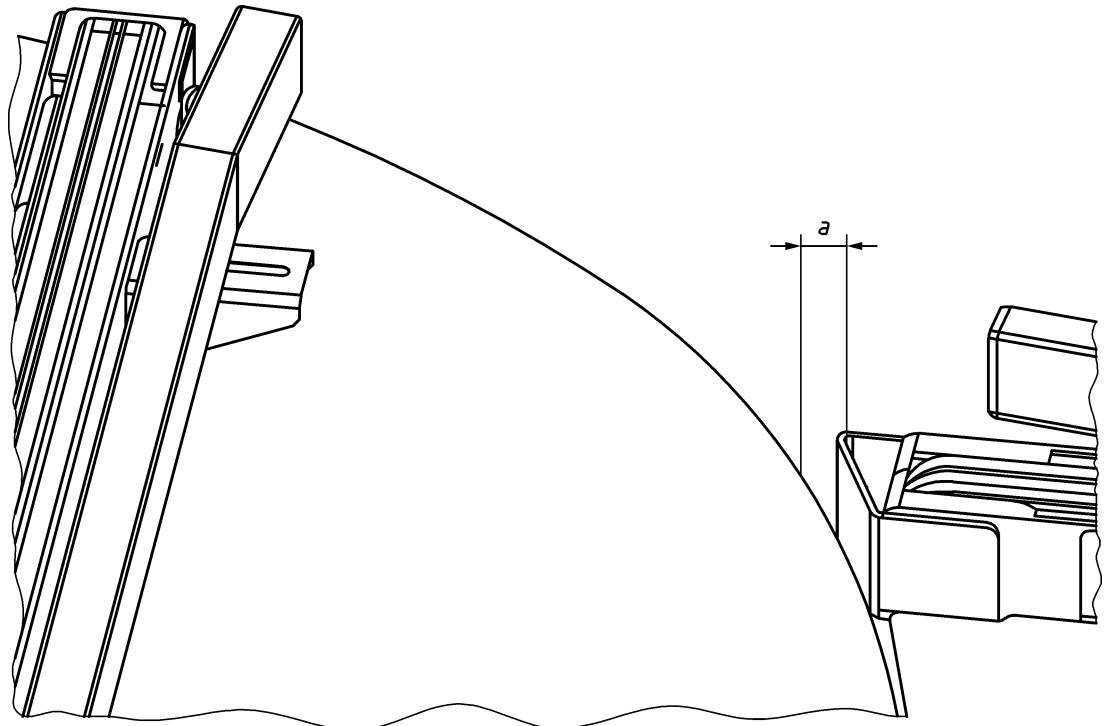
1 merging

2 sorting

Figure B.9 — Crushing and shearing hazards at vertical switch conveyor

Annex C (normative)

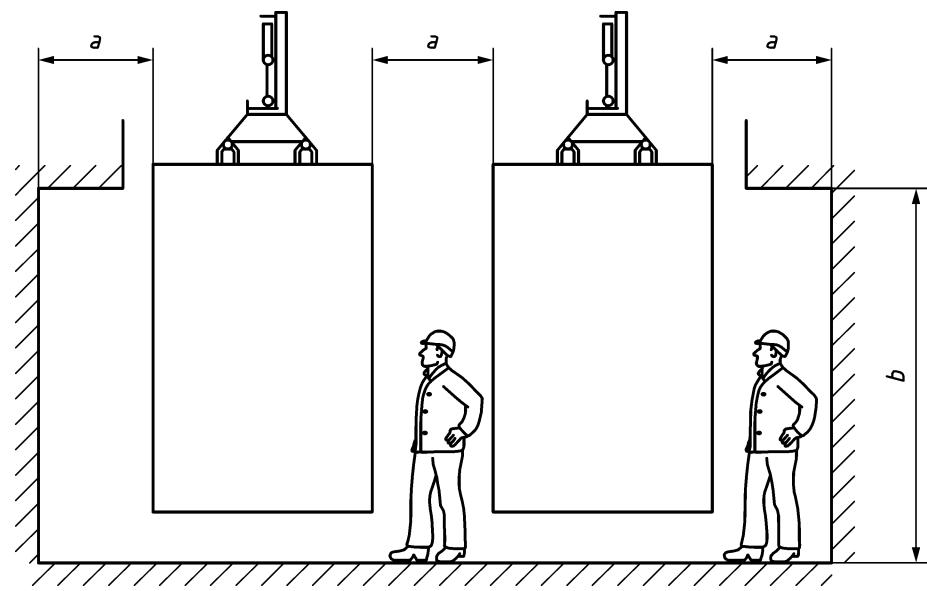
Typical safety requirements and/or measures



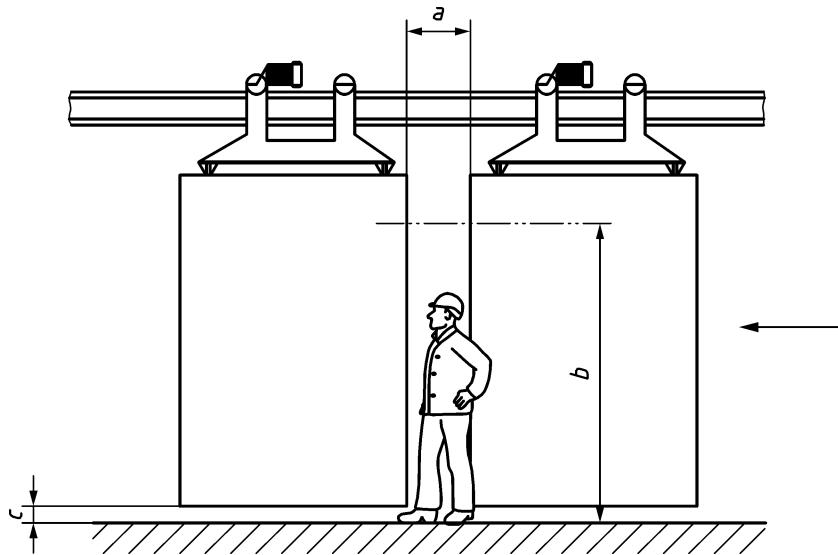
Key

a gap between turntable and connecting conveyor

Figure C.1 — Turntable — Continuous gap

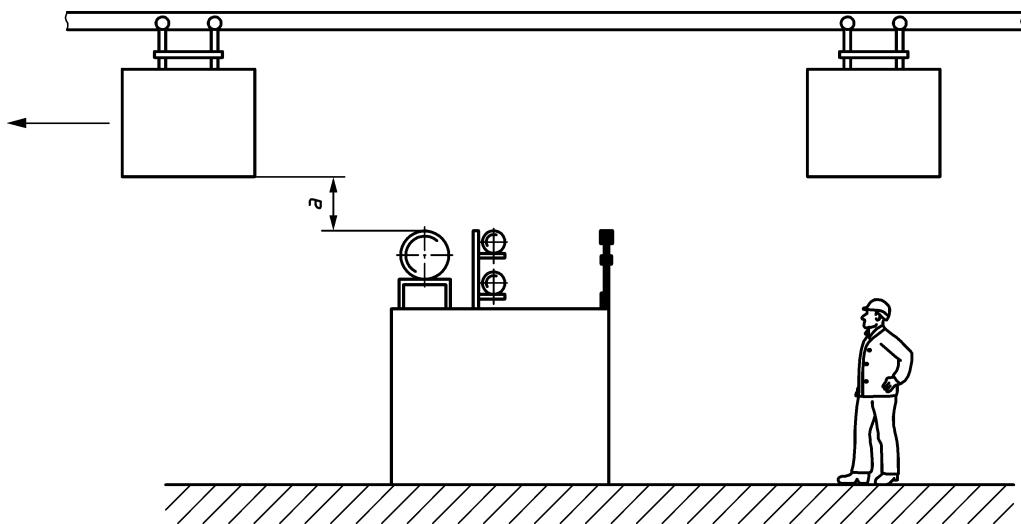
**Key**

- a* lateral distance
- b* height above standing surface

Figure C.2 — Minimum lateral safety distances at vehicles of overhead conveyors**Key**

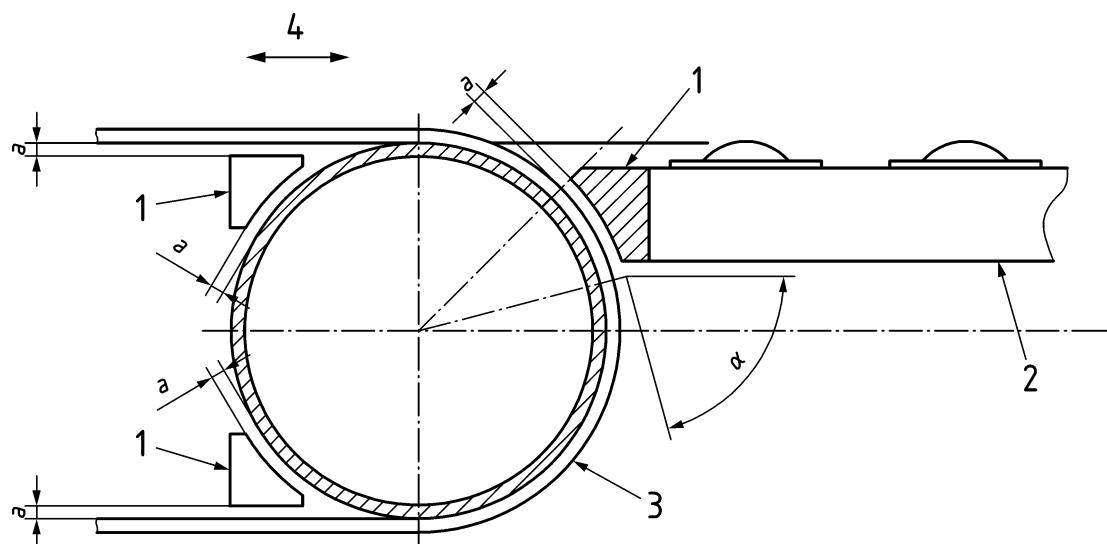
- a* distance between two mobile units
- b* height above standing surface
- c* distance between floor and mobile units

Figure C.3 — Minimum safety distances under and between vehicles arranged one behind the other

**Key**

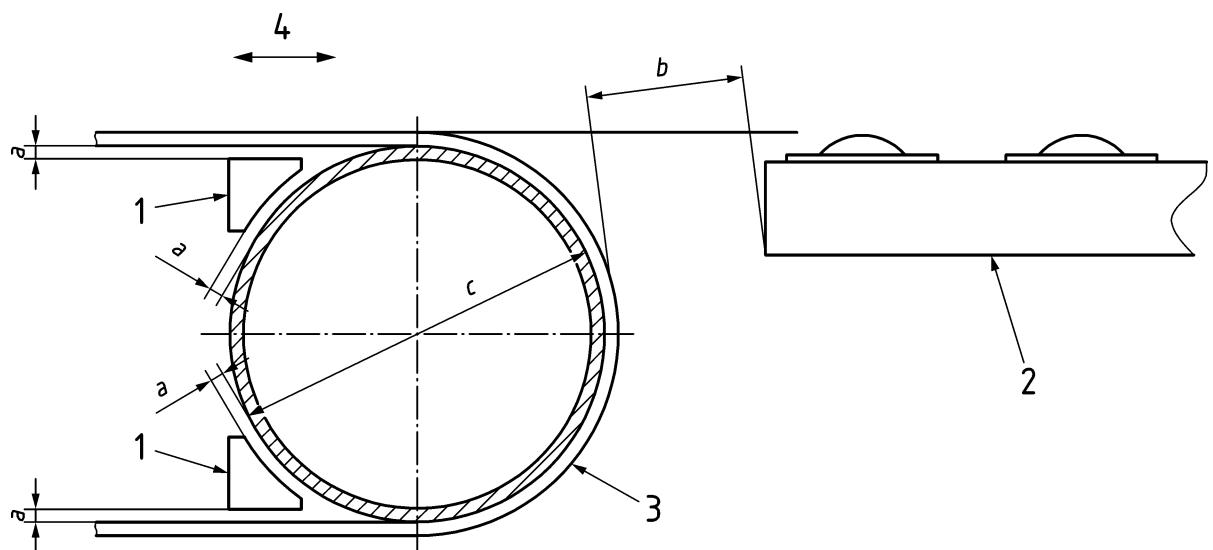
a distance between fixed objects and mobile units of overhead conveyors

Figure C.4 — Minimum safety distance above parts of structures or machines

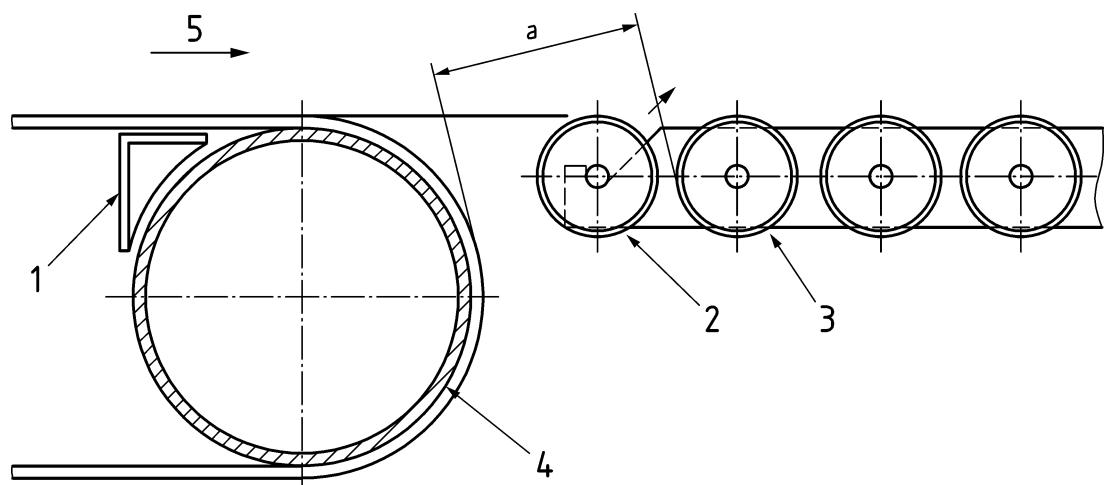
**Key**

1	protective device	4	moving direction
2	table	<i>a</i>	gap between rotating and fixed components
3	belt conveyor	α	angle between fixed part and rotating part

Figure C.5 — Protection by nip-guards

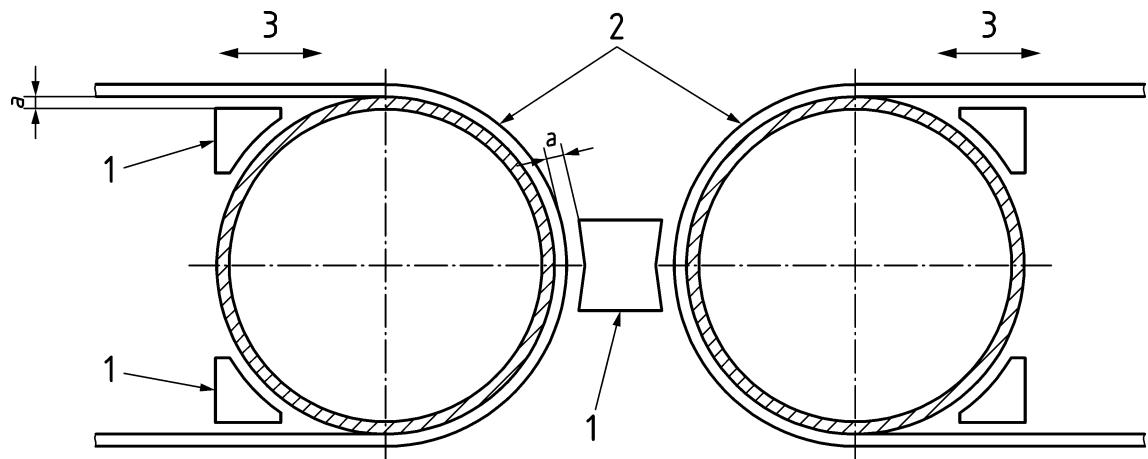
**Key**

- 1 protective device
- 2 table
- 3 belt conveyor
- 4 moving direction
- a* gap between rotating and fixed components
- b* distance between rotating and fixed/rotating components
- c* diameter of rotating parts

Figure C.6 — Protection by nip-guards and distance**Key**

- 1 protective device
- 2 pop-up roller
- 3 fix roller
- 4 belt conveyor
- 5 moving direction
- a* gap between rotating and fixed/rotating components

Figure C.7 — Protection by nip-guard and pop-up roller



Key

- 1 protective device
- 2 belt conveyors
- 3 moving directions
- a gap between rotating and fixed/rotating components

Figure C.8 — Protection by nip-guard between two belt conveyors

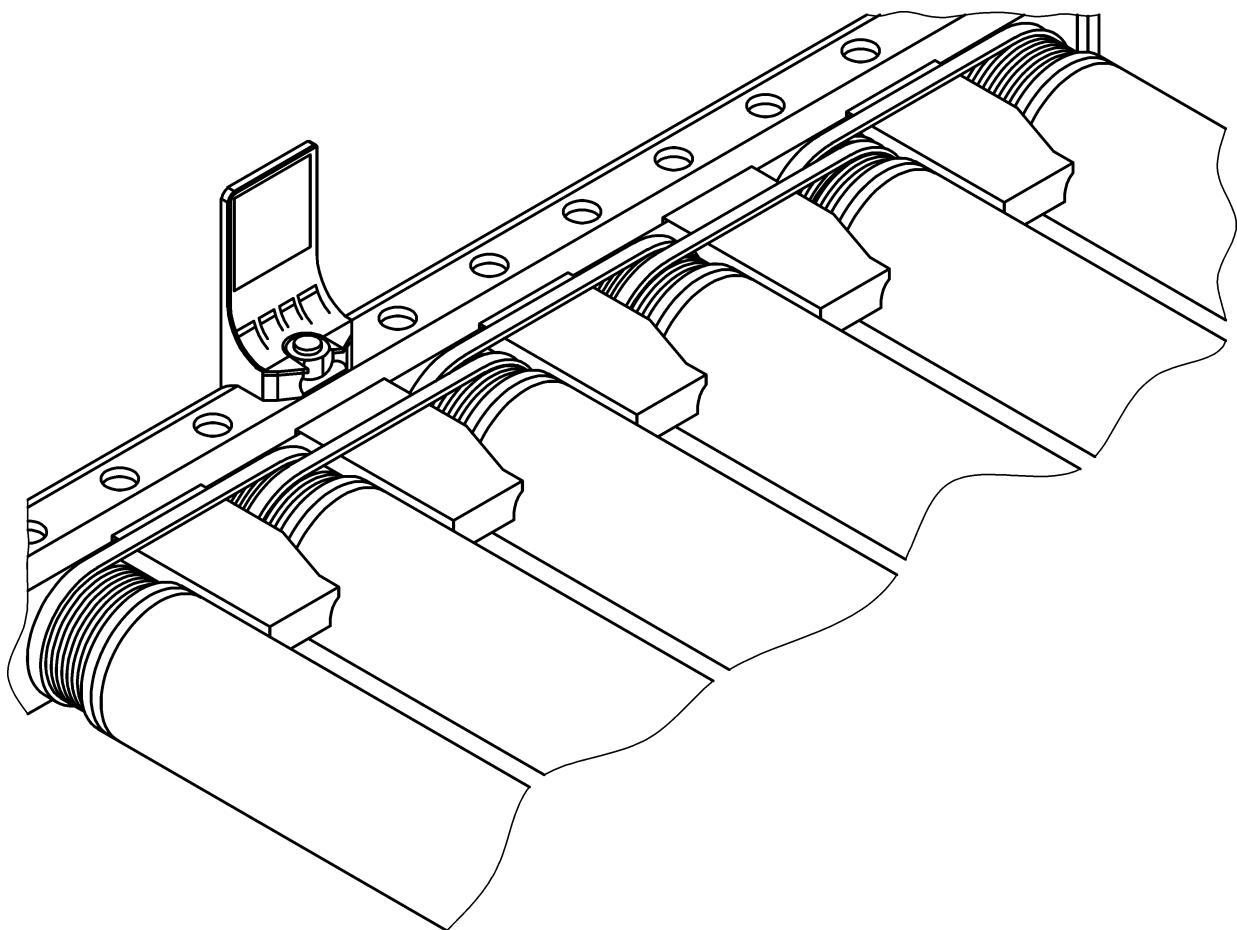
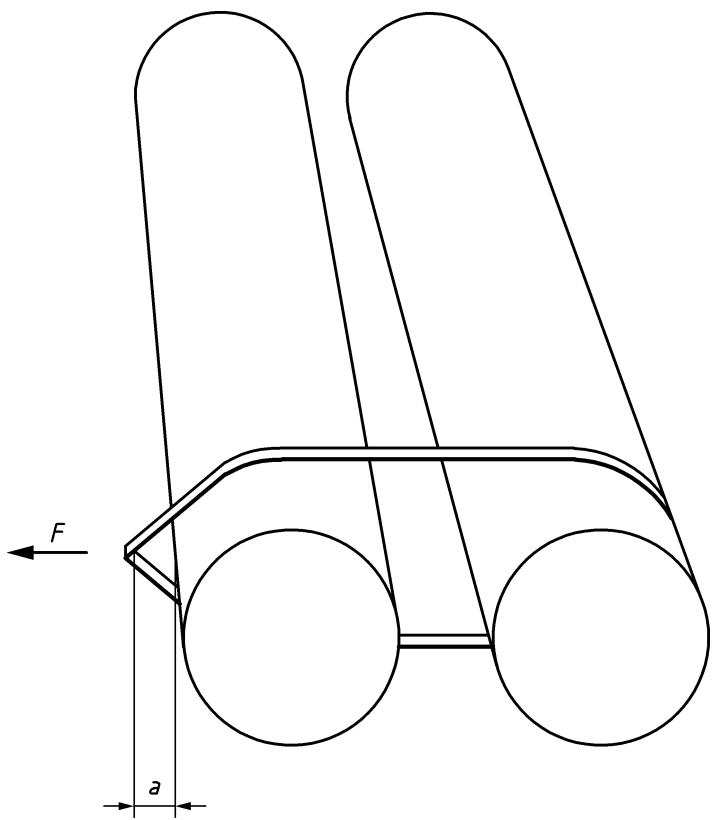
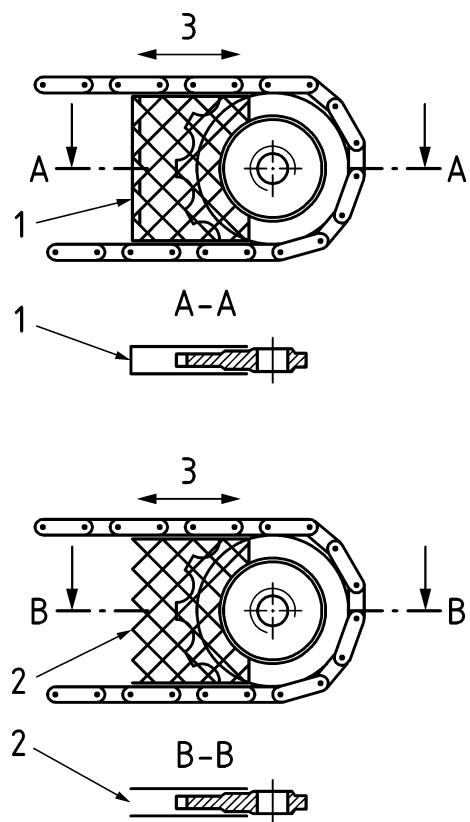
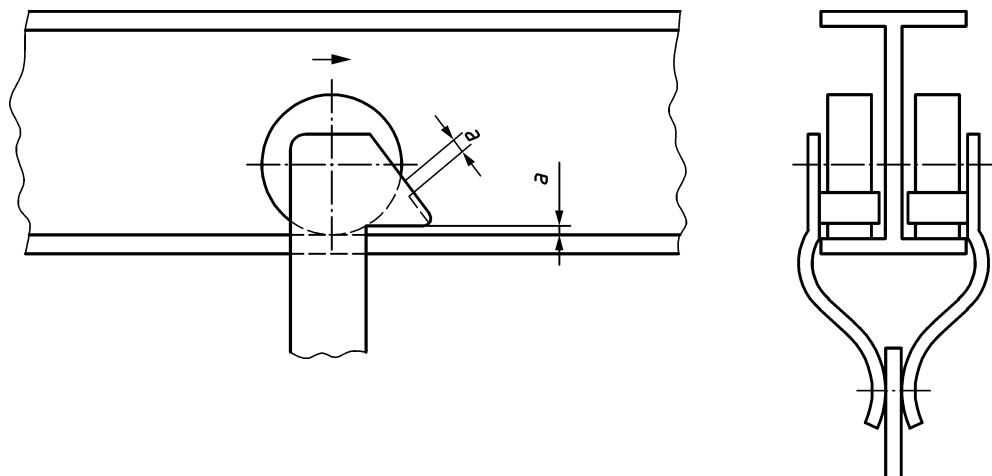


Figure C.9 — Nip guards at drive belts

**Key** F force a clearance between belt and roller**Figure C.10 — Roller conveyor with flexible, weak drive belt**

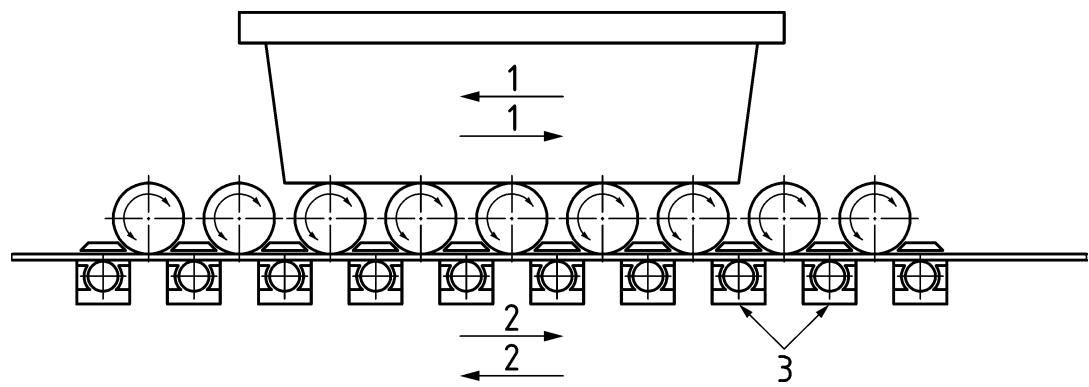
**Key**

- 1 closed guard
- 2 open guard
- 3 moving direction

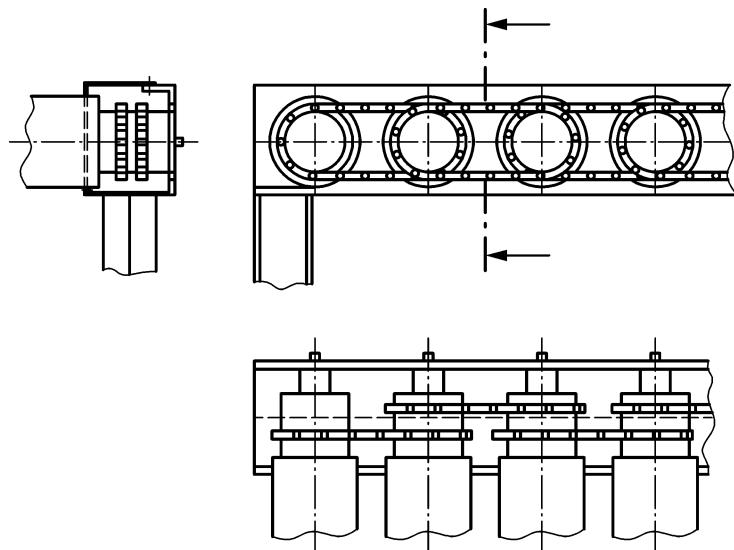
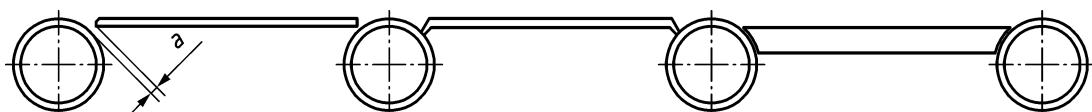
Figure C.11 — Guards on sprockets**Key**

- a gap between guard and rail or roller

Figure C.12 — Nip guards at rollers of overhead conveyors

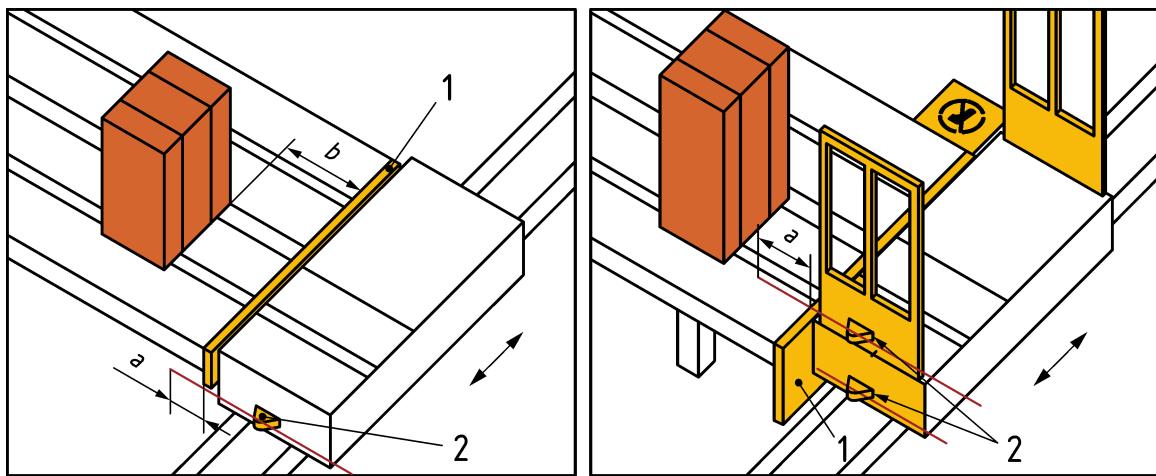
**Key**

- 1 direction of load
- 2 direction of belt
- 3 protective device

Figure C.13 — Nip guards at nip points on belt driven roller conveyors**Figure C.14 — Protection on chain driven roller conveyors****Key**

- a gap between plate cover and roller

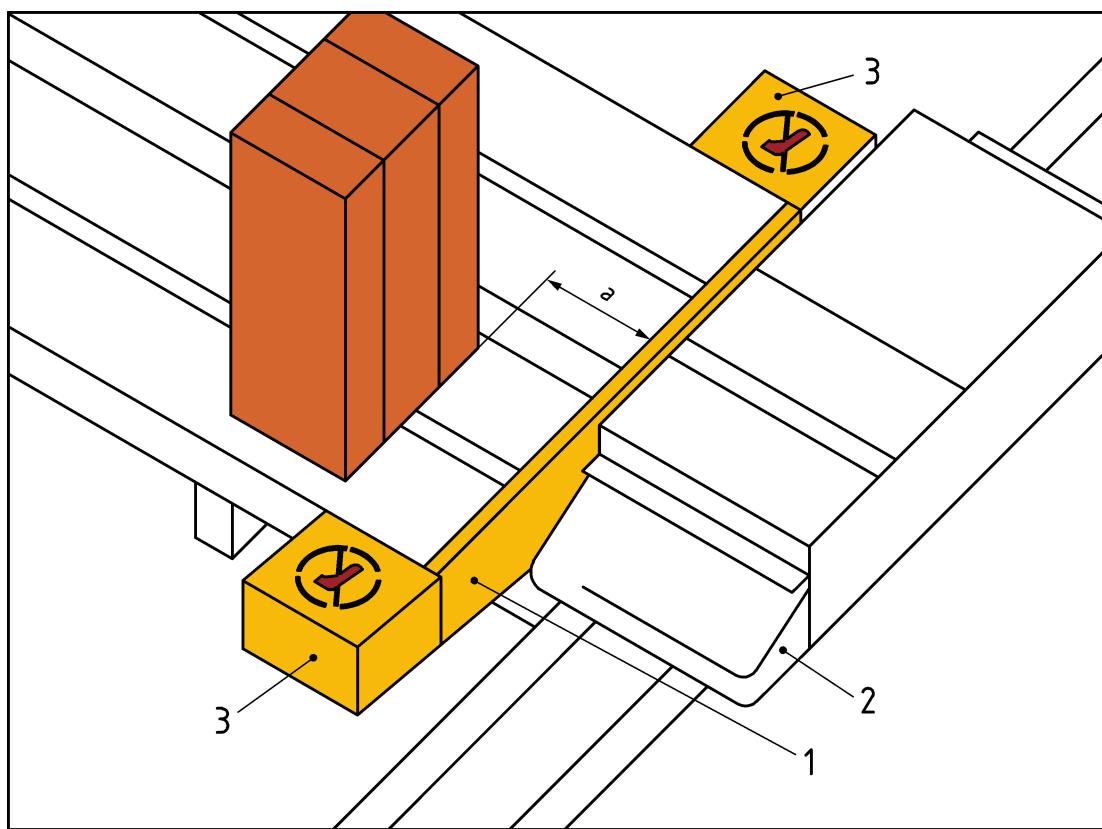
Figure C.15 — Protection between roller conveyors and conveyed unit loads



Key

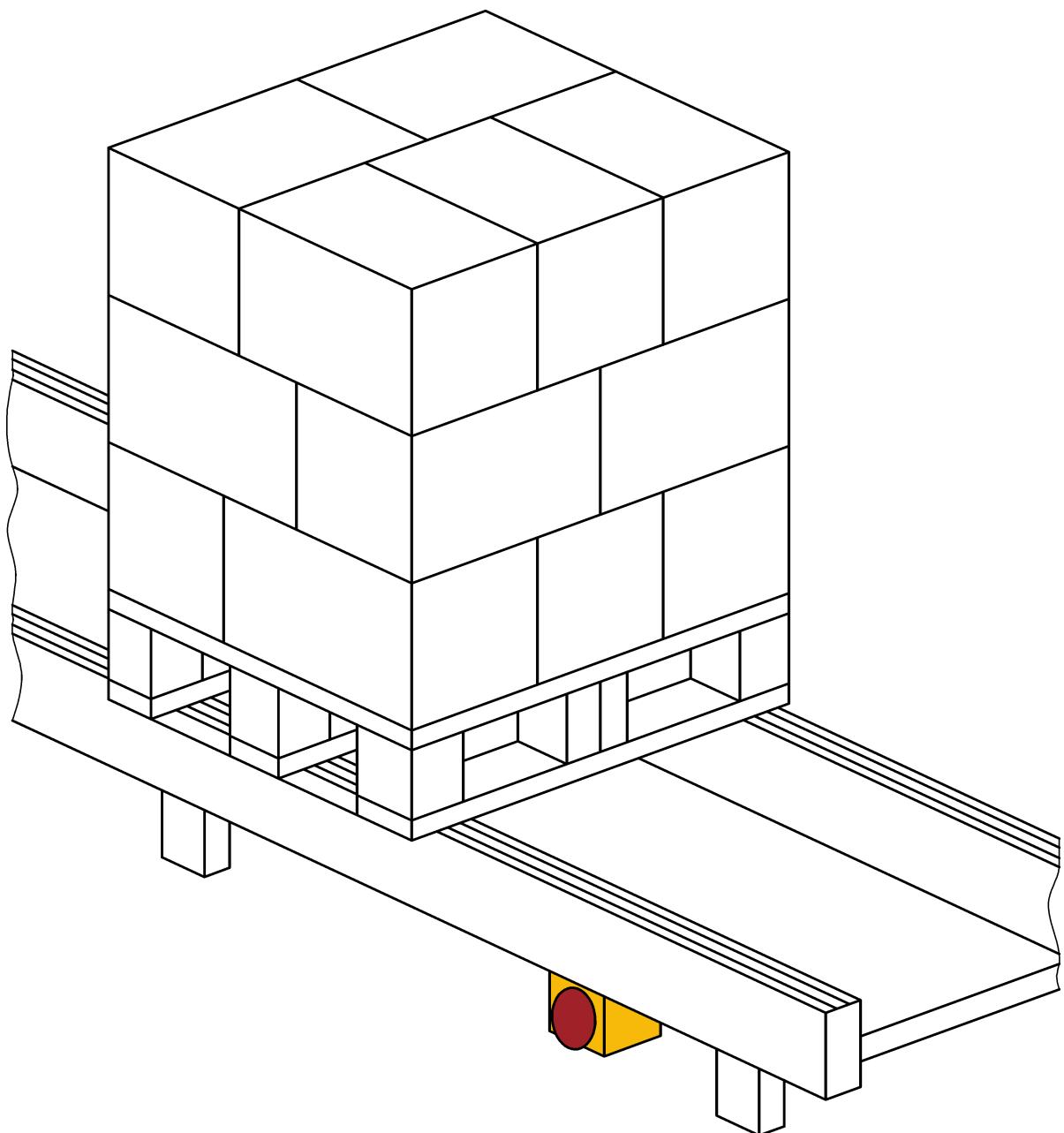
- 1 frontal fixed guard
- 2 laser scanner
- a detection zone under or above the connecting conveyors
- b minimum gap between transfer car and the load

Figure C.16 — Protection by laser scanner (see 4.20.9.4.)

**Key**

- 1 frontal fixed guard
- 2 bumper
- 3 device to prevent standing in this area (e.g. foam blocks)
- a distance between transfer car and the load

Figure C.17 — Protection by bumper (see 4.20.9.4)



a) carrying chain conveyor

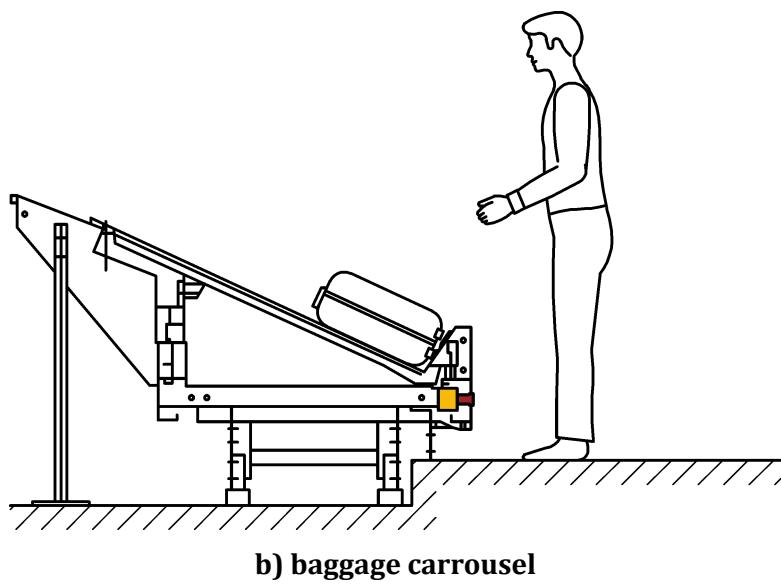
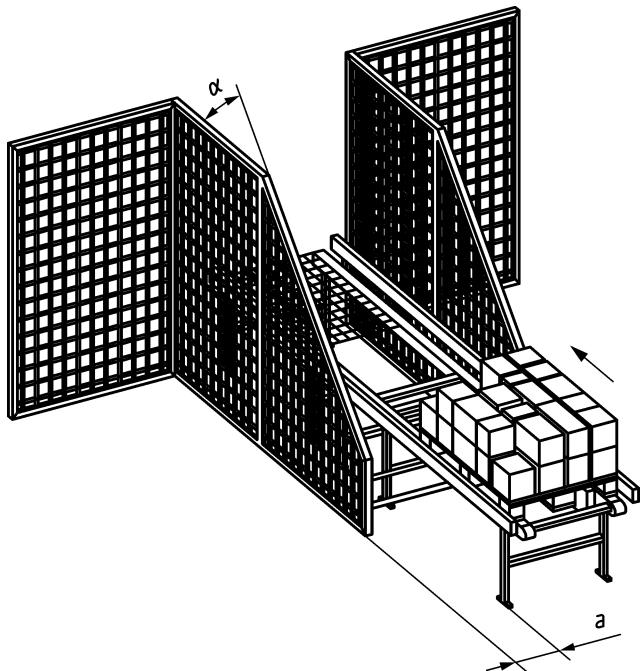


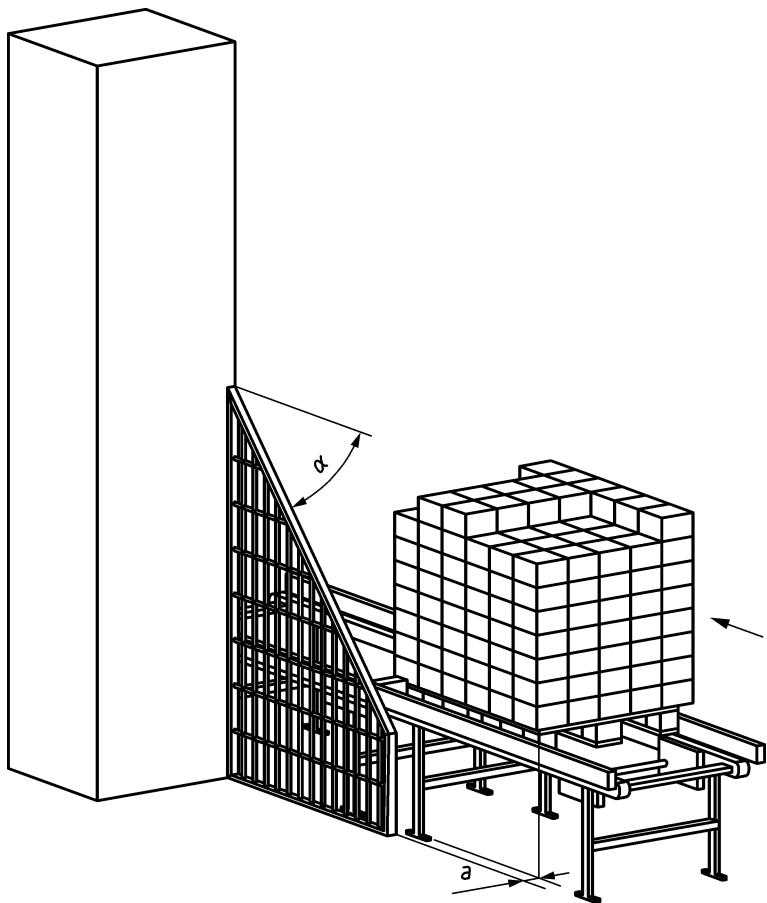
Figure C.18 — Possible positions of emergency-stop



Key

- α inclination to the horizontal
- a clearance between load and guard

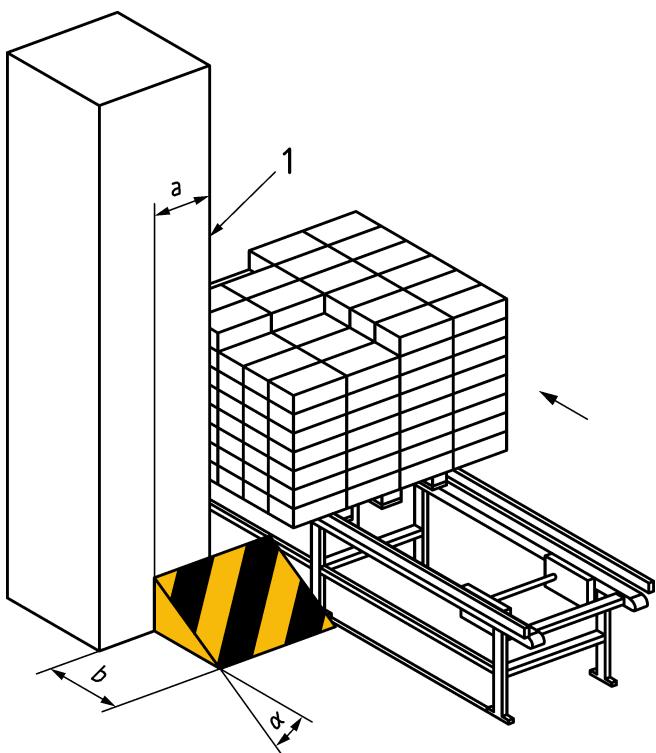
Figure C.19 — Guard with inclination



Key

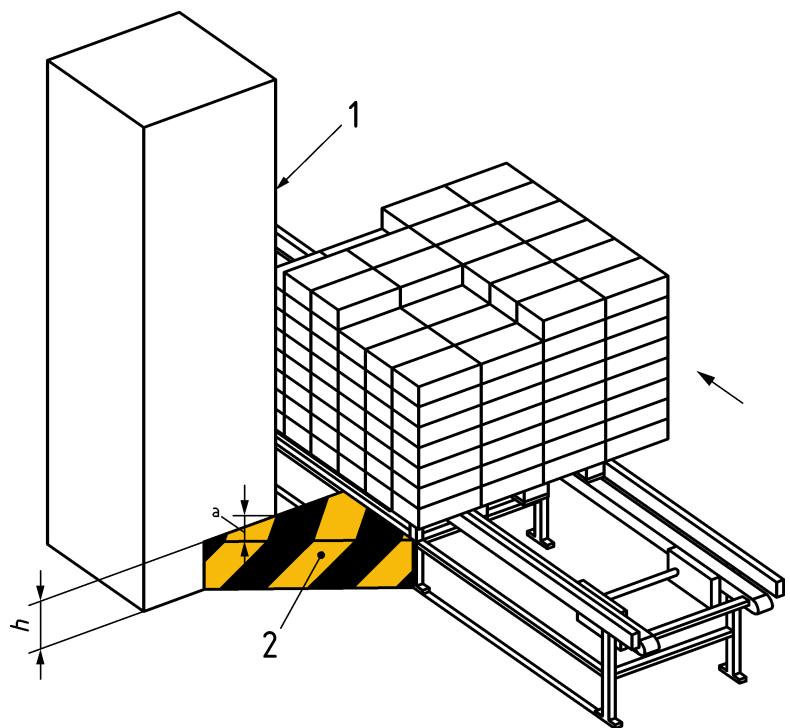
- α inclination to the horizontal
 a clearance between load and guard/fix adjacent object

Figure C.20 — Arrangement of the guard with inclination at the column

**Key**

- 1 crushing and shearing point
- a, b distance to crushing and shearing point
- α inclination of sloping plate

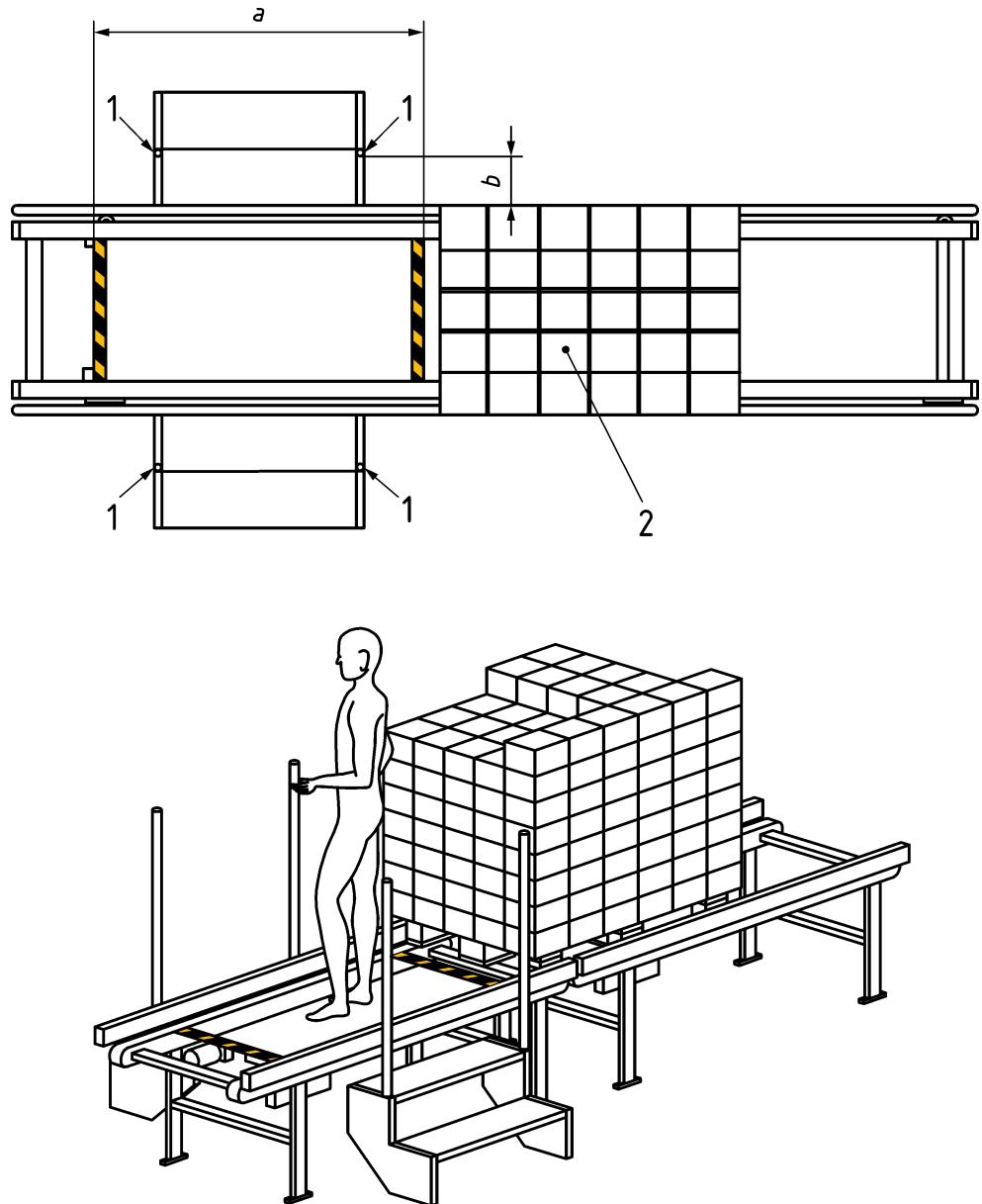
Figure C.21 — Sloping plate to impede persons standing at crushing and shearing point



Key

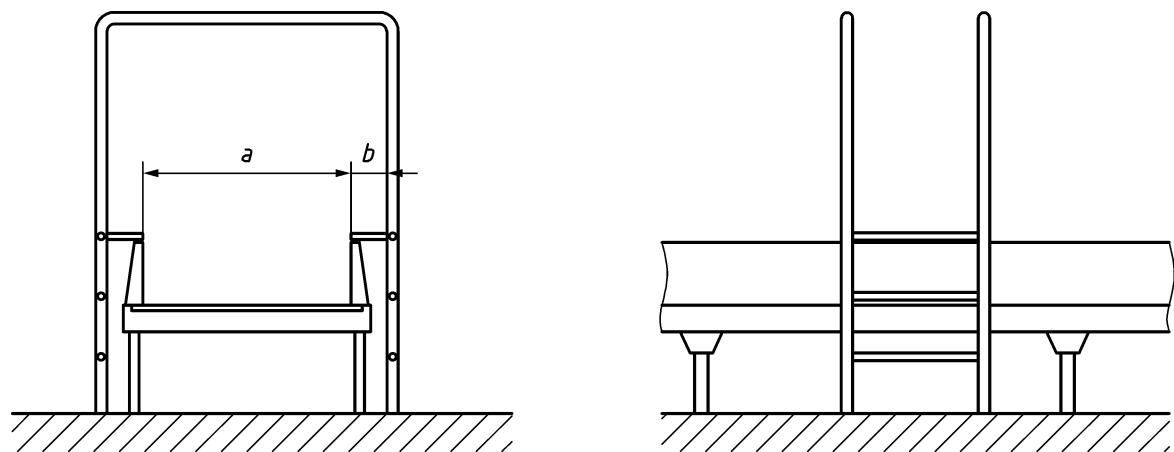
- 1 crushing and shearing point
- 2 foam block
- a minimum distance to crushing and shearing point
- h height of the foam block

Figure C.22 — Foam block to impede persons standing at crushing and shearing point

**Key**

- 1 post
- 2 load
- a width of the cross over passageway
- b distance between load and handrail or post

Figure C.23 — Cross over passageway – steps



Key

- a* width of the conveyor
- b* depth of the landing

Figure C.24 — Cross over passageway - ladders

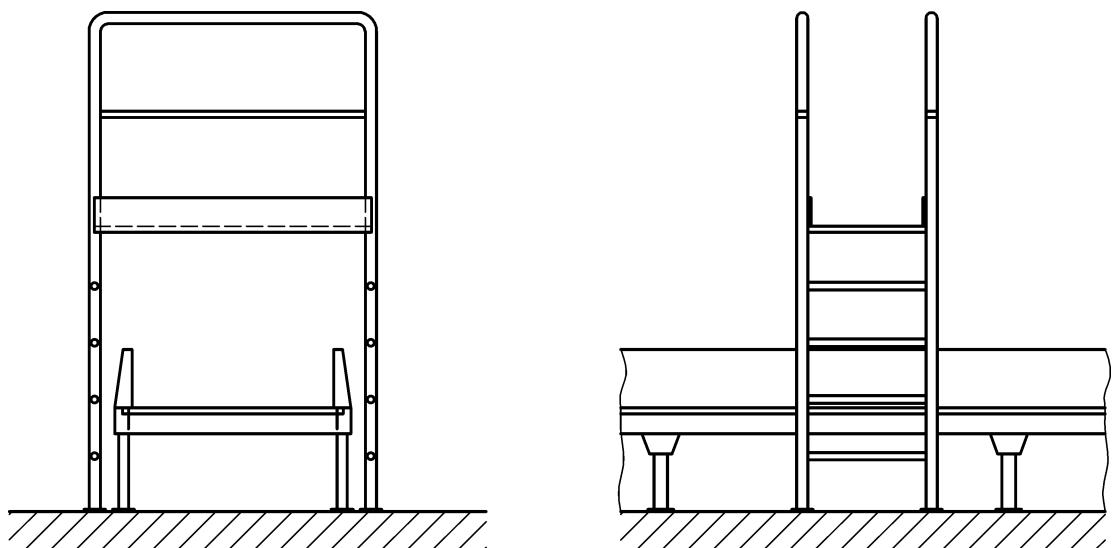
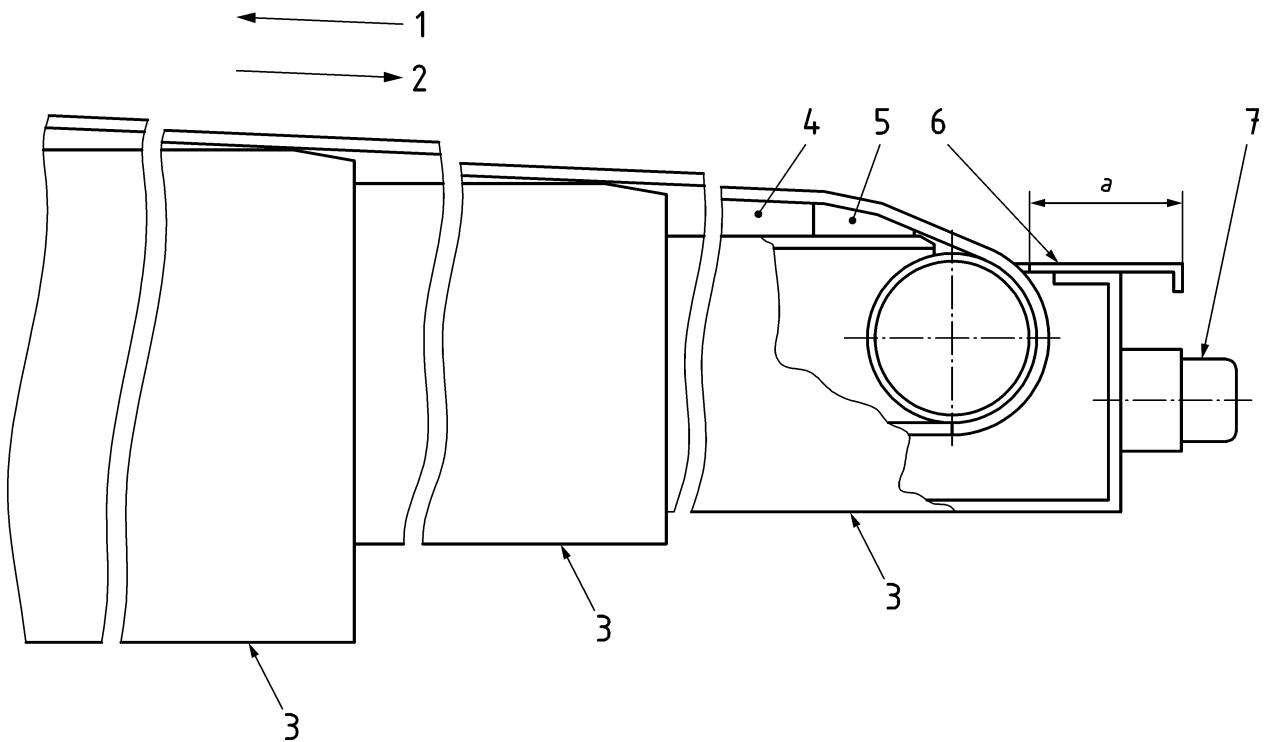
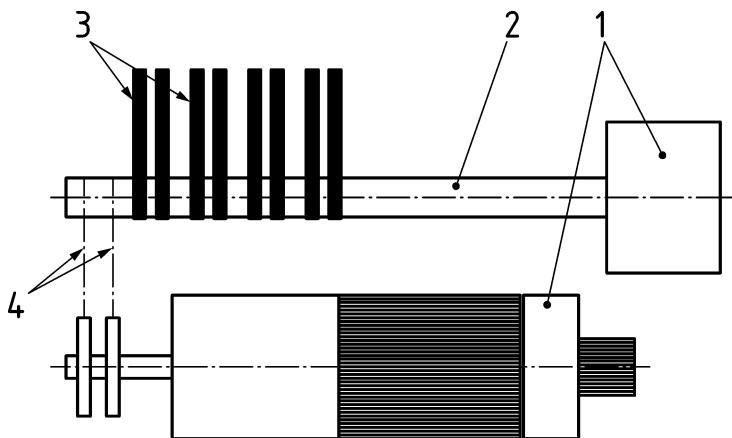


Figure C.25 — Cross over passageway - bridge with ladders

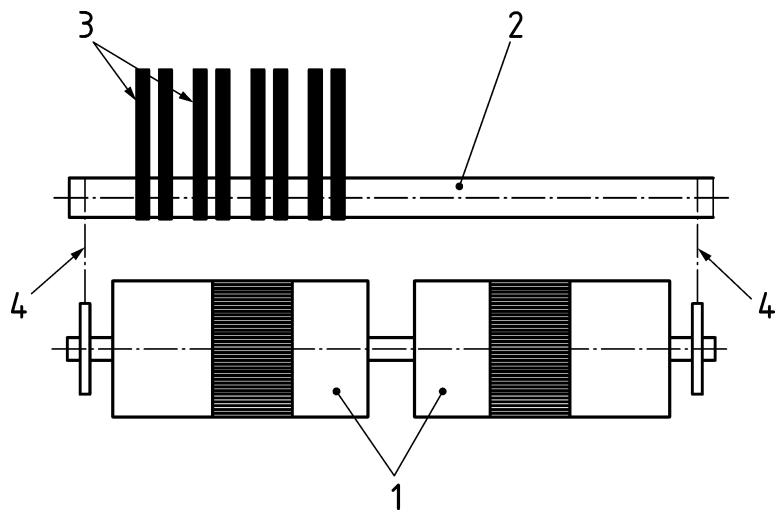
**Key**

- 1 belt movement unloading
- 2 belt movement loading
- 3 telescopic movement
- 4 gap
- 5 nip guard
- 6 extended nip guard
- 7 pressure sensitive device
- a distance between drawing-in point and the end of the conveyor

Figure C.26 — Telescopic conveyor with belt – typical safety measures

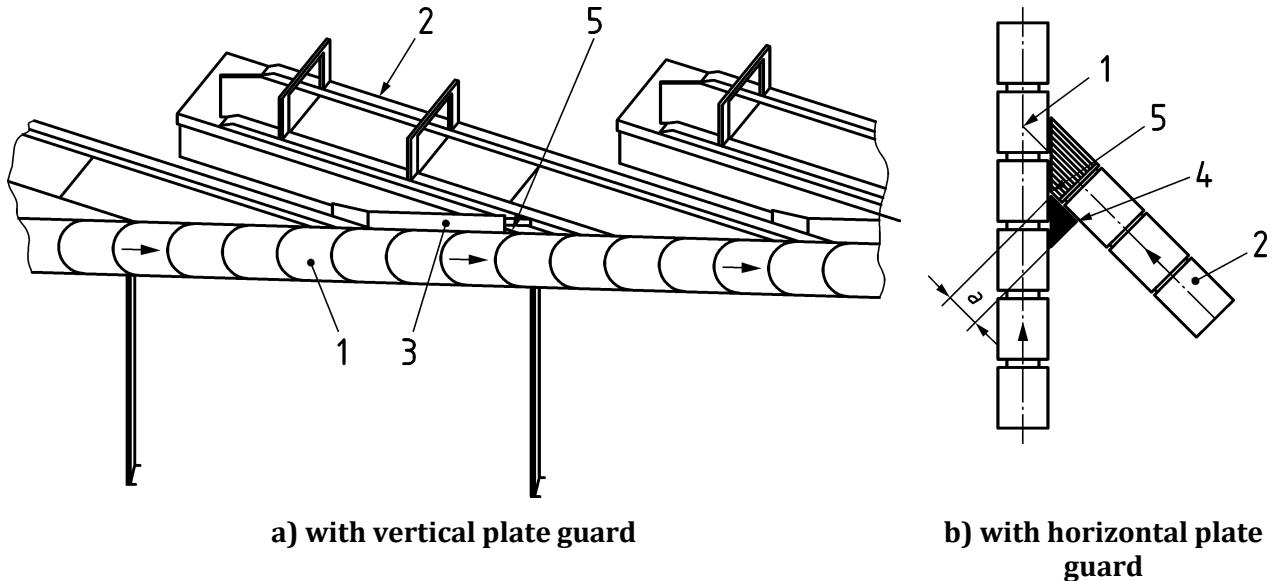
**Key**

- 1 safety brake
- 2 winding shaft
- 3 lifting elements
- 4 transmission elements

Figure C.27 — Redundant brakes, transmission elements and lifting elements**Key**

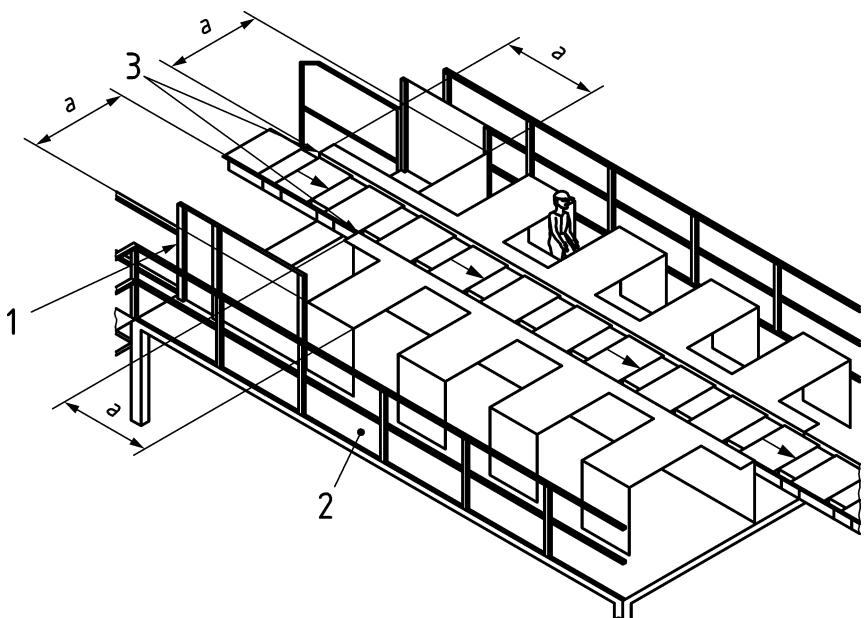
- 1 safety brake
- 2 winding shaft
- 3 lifting elements
- 4 transmission elements

Figure C.28 — Redundant motors, transmission elements and lifting elements

**Key**

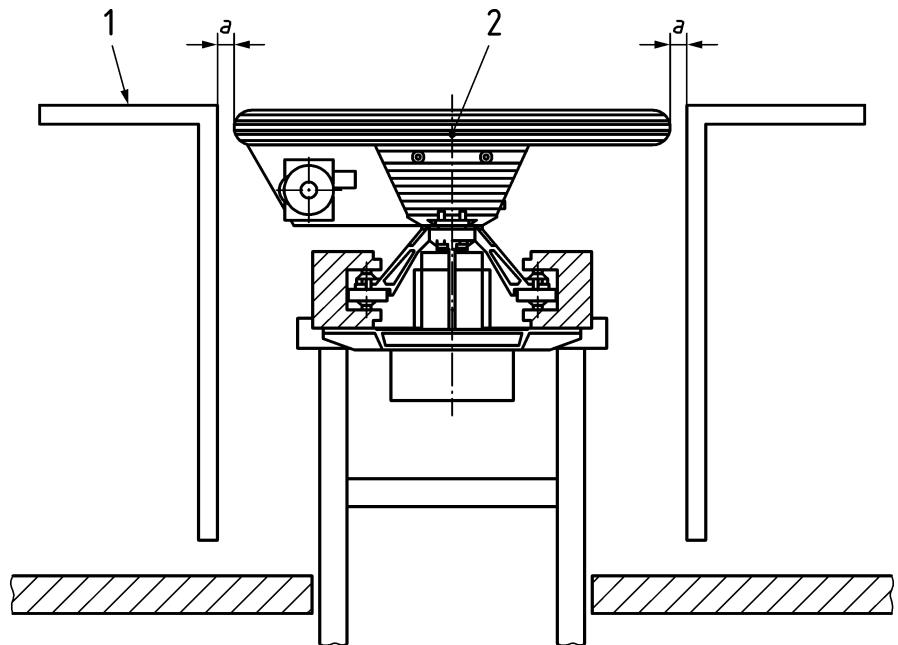
- 1 sorter
- 2 induction unit
- 3 vertical plate guard
- 4 horizontal plate guard
- 5 drawing-in point
- a distance to the drawing-in point

Figure C.29 — Sorter with vertical plate guard

**Key**

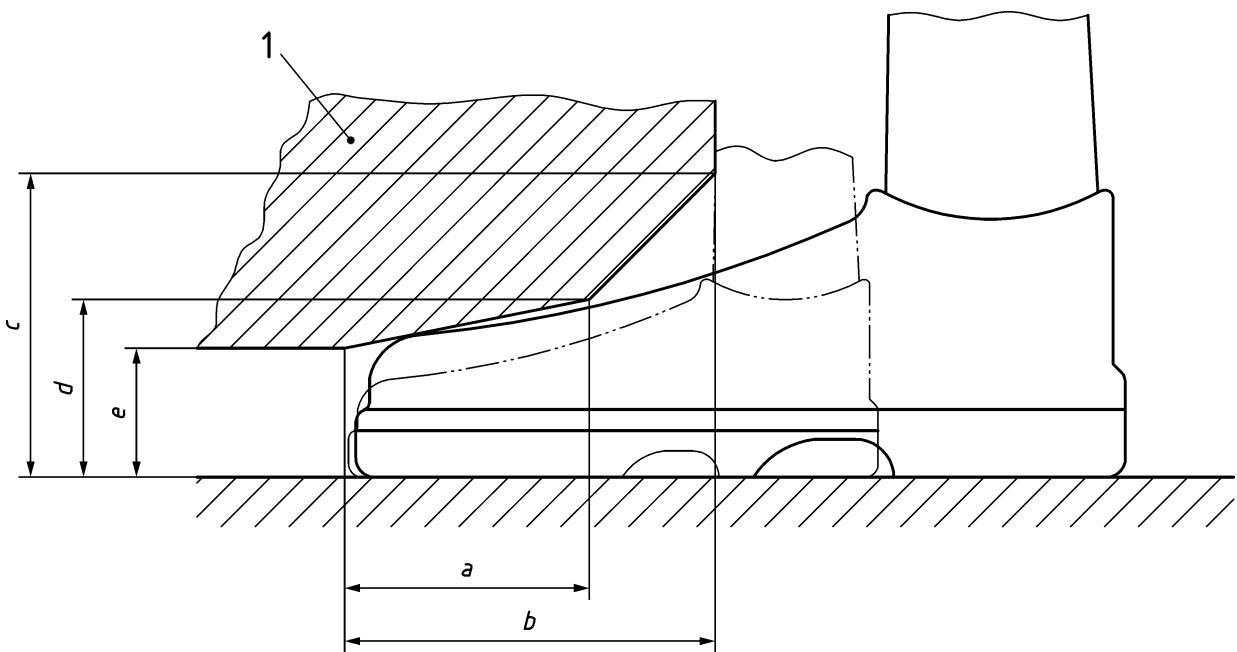
- 1 hazard area (safety guard ≥ 1 m height or platform ends)
- 2 platform
- 3 drawing-in-point
- a distance working place to the drawing-in point

Figure C.30 — Manual infeed and safety distances to crushing / drawing-in-point

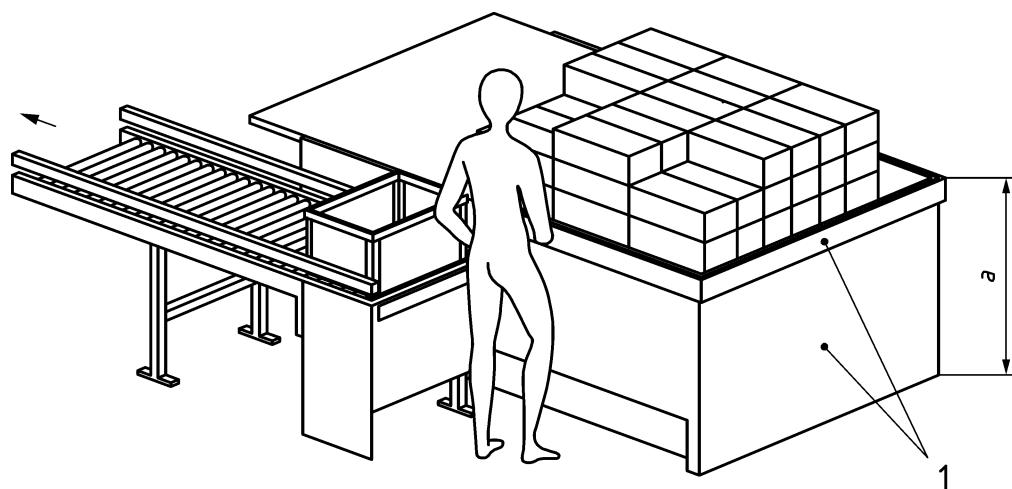
**Key**

- 1 worktable
- 2 moving part of sorter
- a gap between sorter tray and static part

Figure C.31 — Cross section for manual infeed on cross belt

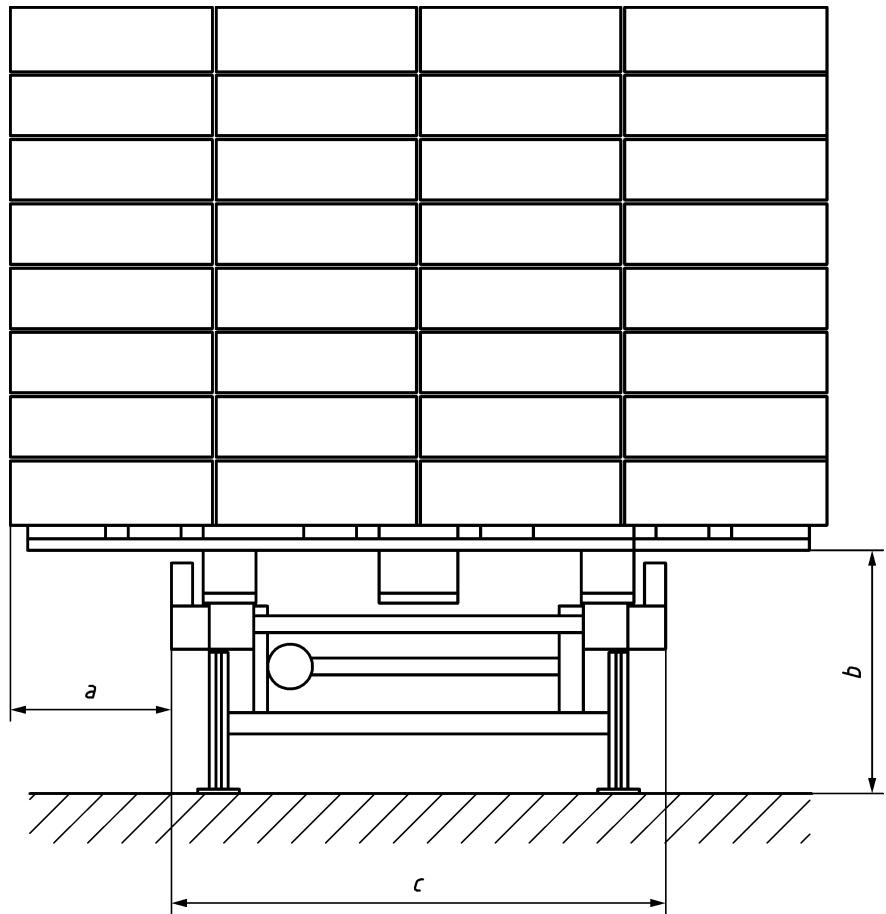
**Key**

- 1 frame cross-section
- $a \geq 100$ mm
- $b \geq 150$ mm
- $c \geq 120$ mm
- $d \geq 70$ mm
- $e \geq 50$ mm

Figure C.32 — Shape to prevent foot-injuries**Key**

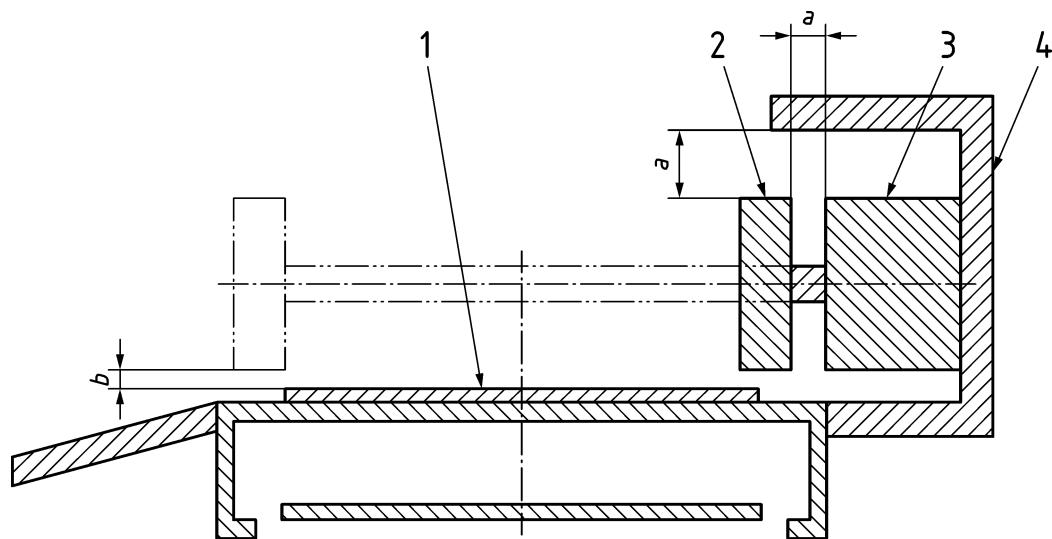
- 1 guard
- a height of guard

Figure C.33 — Height of guard at working places

**Key**

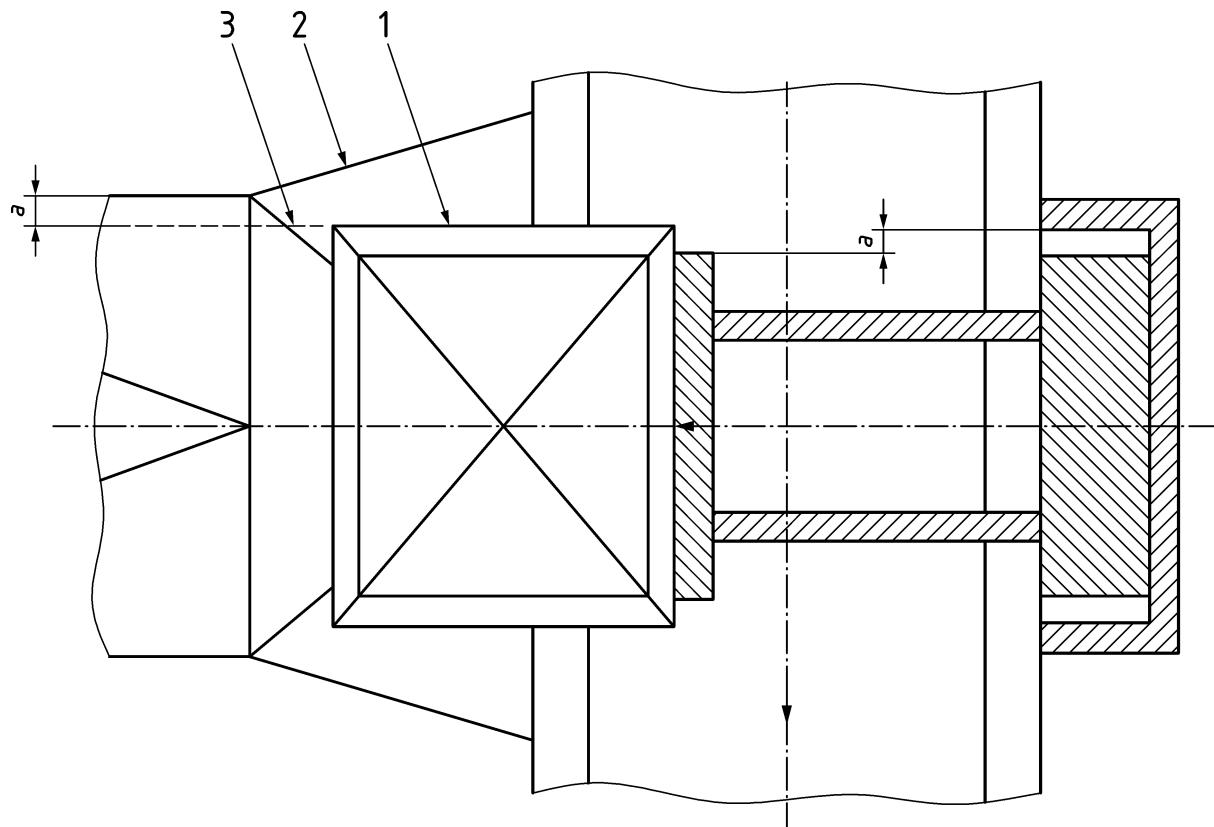
- a* overhang of load exceeding the width of the conveyor
- b* height between load and floor
- c* width of the conveyor

Figure C.34 — Clearance between load and floor for loads exceeding the width of the conveyor

**Key**

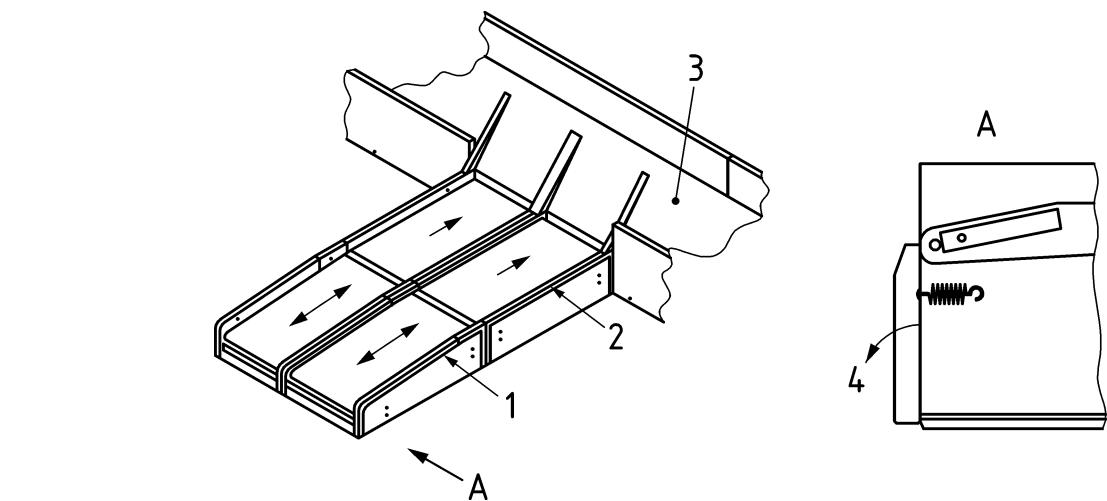
- a gap between pusher – element and housing/pusher mechanism
- b gap between pusher – element and belt/frame
- 1 conveyor
- 2 pusher element
- 3 pusher mechanism
- 4 pusher mechanism housing

Figure C.35 — Pusher, cross-section

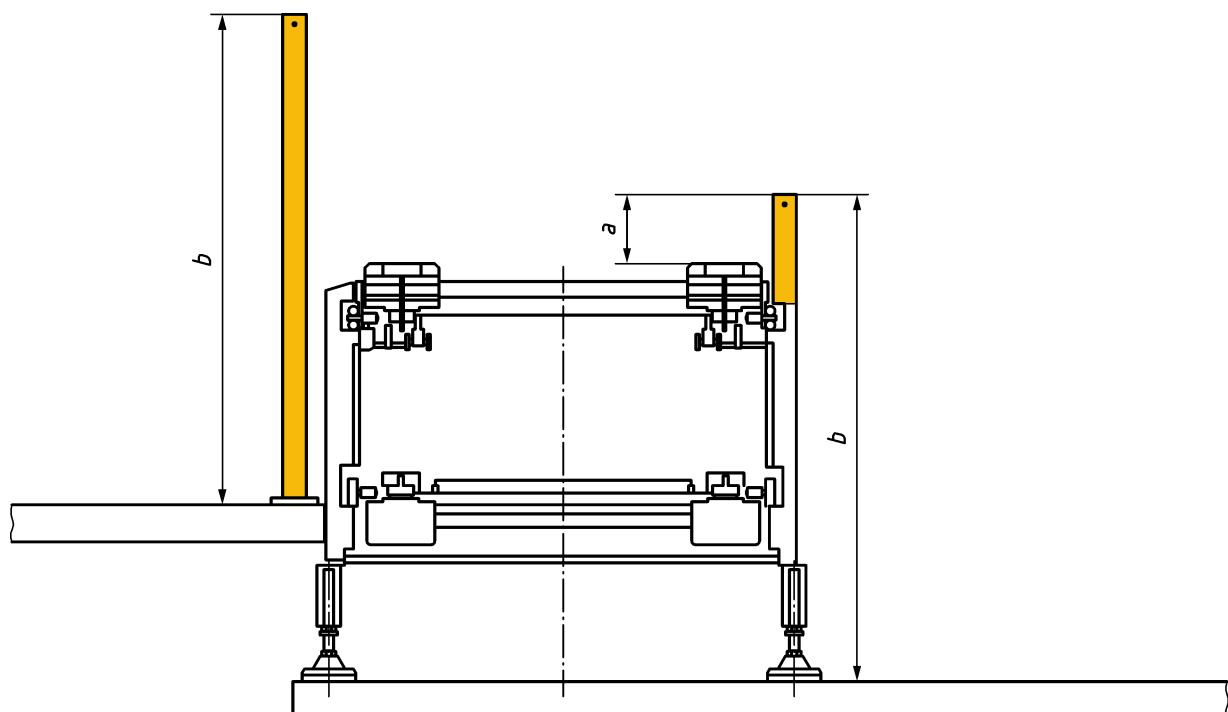
**Key**

- a* distance between pusher-element and housing (sideways)
- b* distance between side panel and pusher element/unit load
- 1 unit load
- 2 side panel discharge
- 3 projected path unit load (design)

Figure C.36 — Pusher, top-view

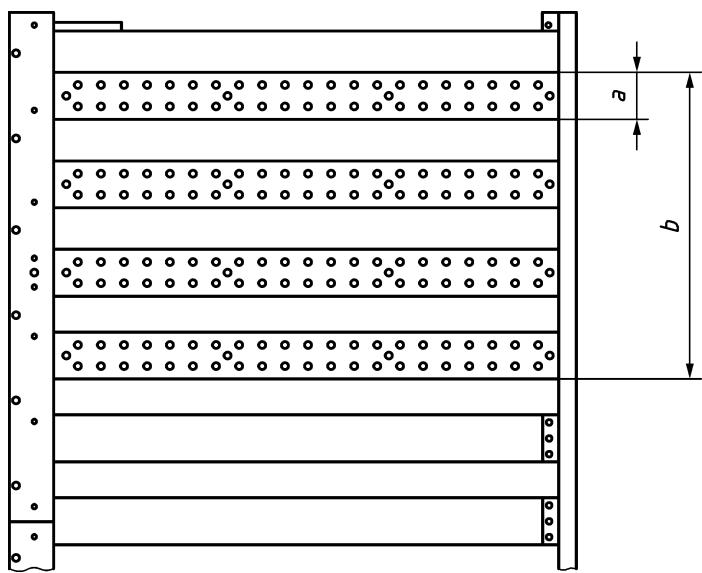
**Key**

- 1 weighing and labelling belt conveyor
- 2 feeding belt conveyor
- 3 collector belt conveyor
- 4 pivoting direction of the movable front guard

Figure C.37 — Check-in conveyor – protection of drawing-in point by movable guard**Key**

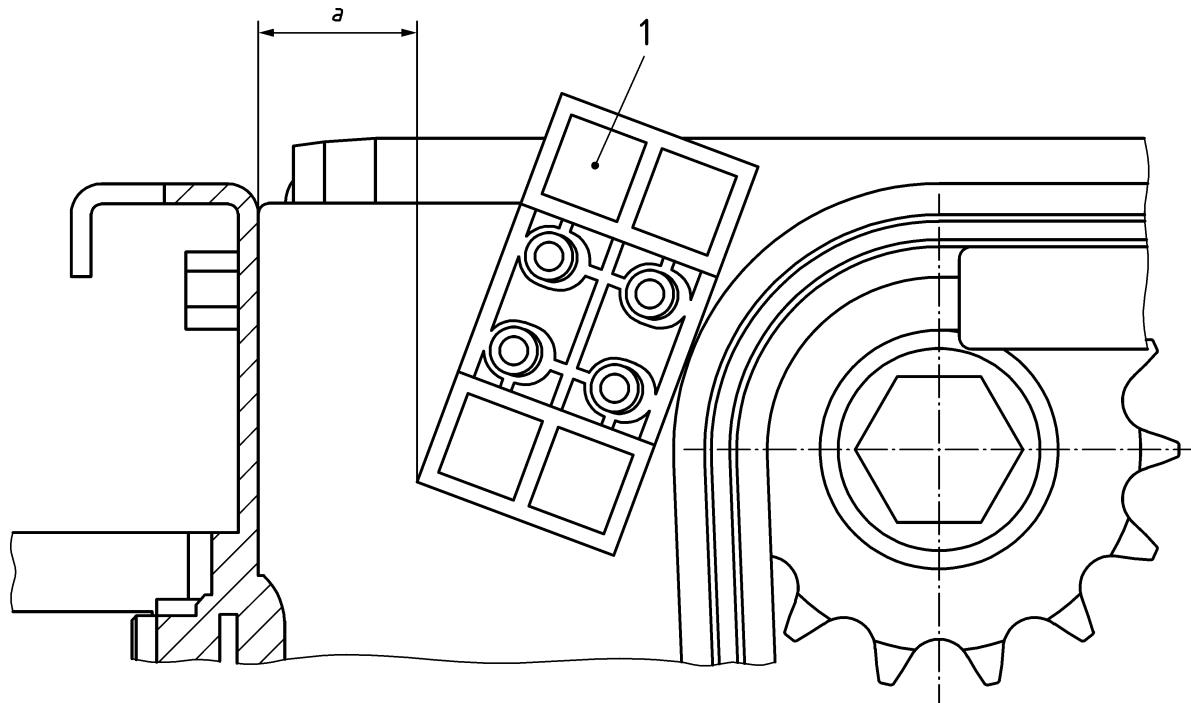
- a* distance between top of the shoe and top of the sideguarding
- b* height of the sideguarding

Figure C.38 — Sideguard at a line-sorter with shoe-system

**Key**

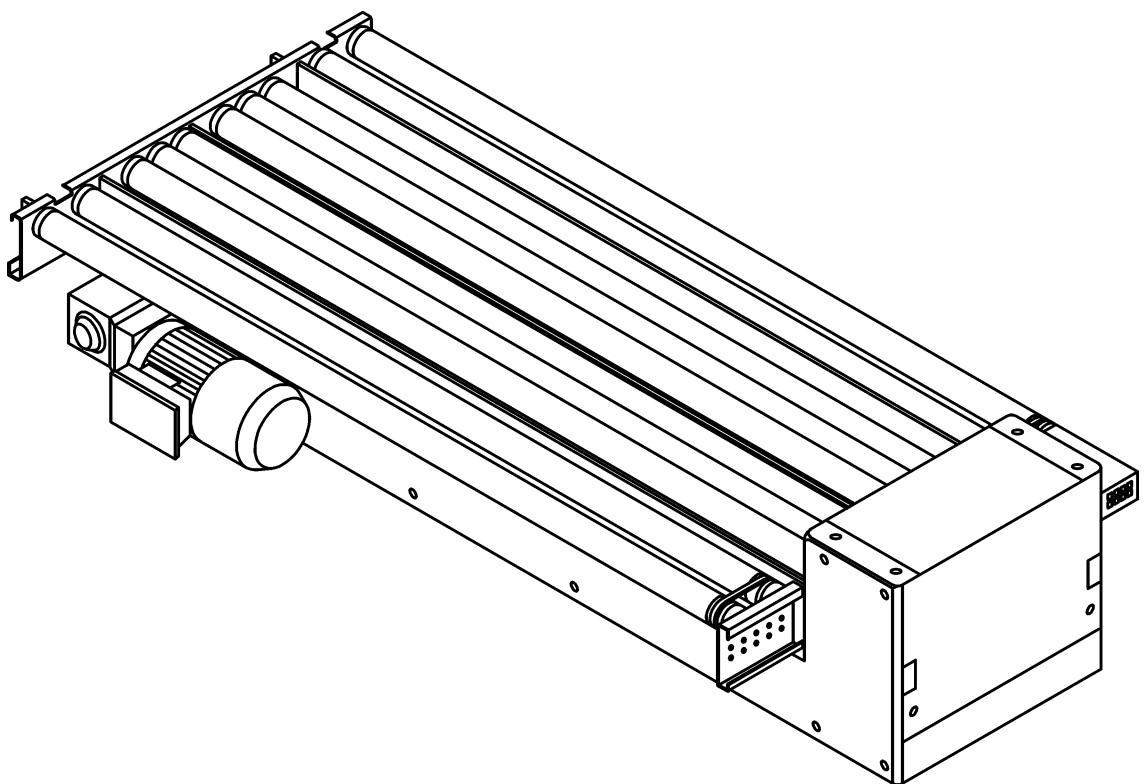
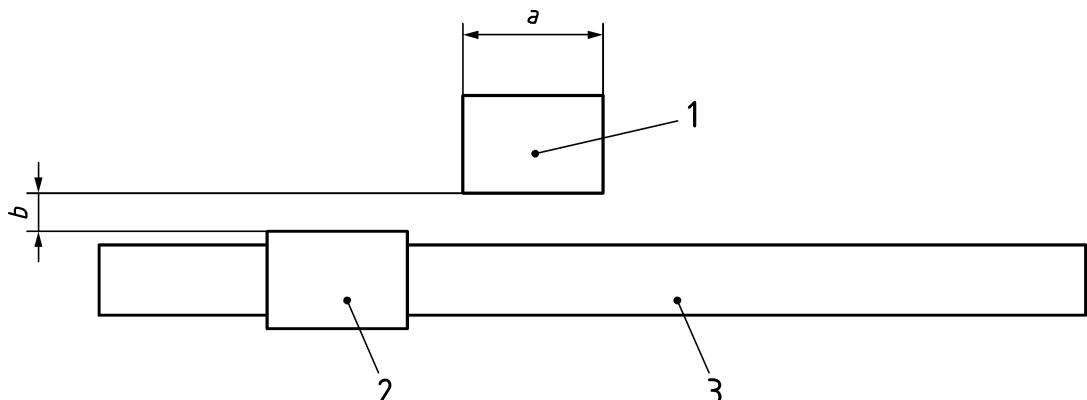
- a infill plate width
- b total width of the cross over passageway

Figure C.39 — Infill plates at cross over passageway of roller conveyor

**Key**

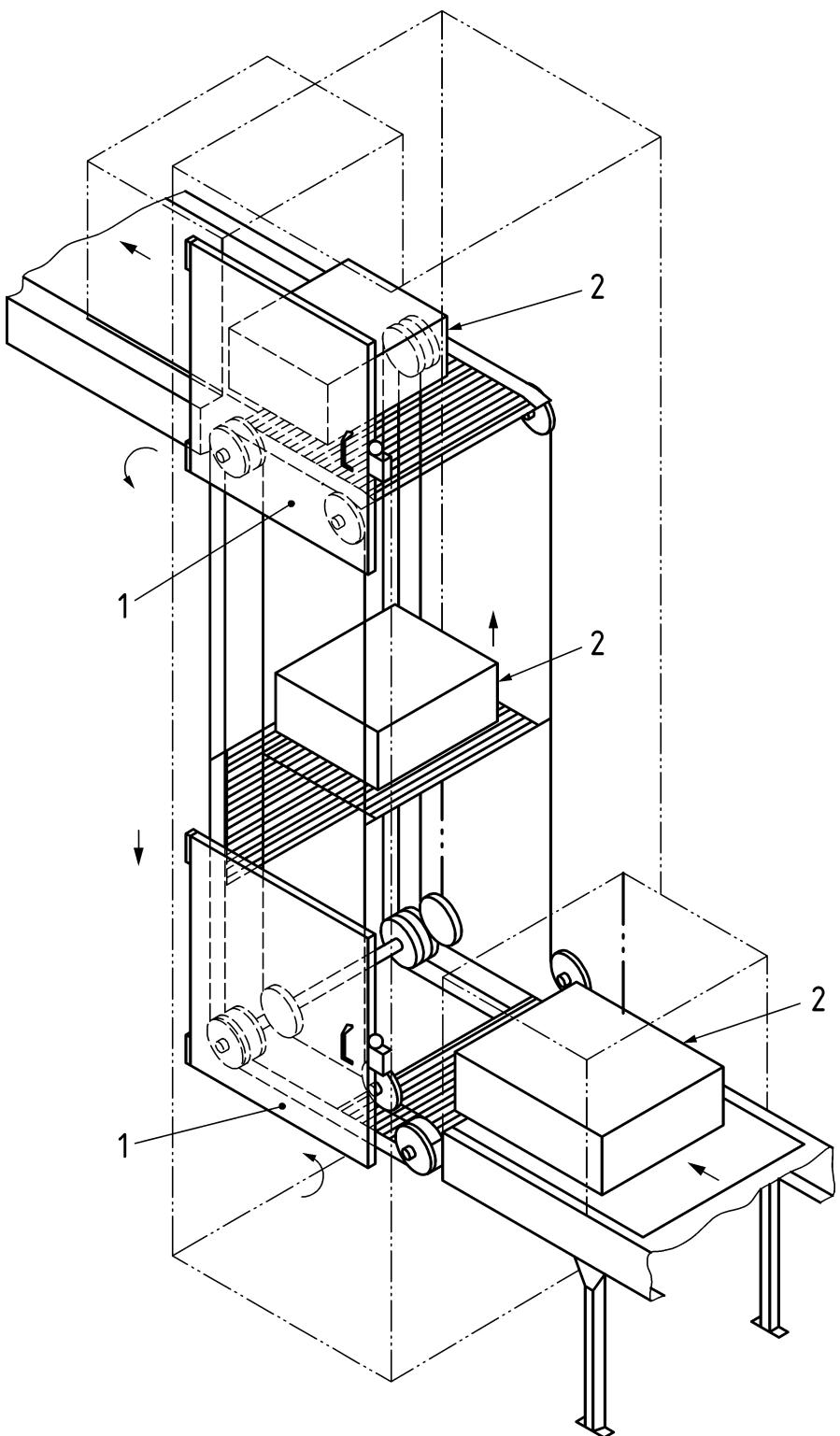
- 1 cam
- a gap between cam and fixed parts

Figure C.40 — Cam of chain pusher

**Figure C.41 — Chain pusher****Key**

- 1 adjacent object
- 2 conveyed load
- 3 conveyor
- a size of adjacent object
- b distance between fixed object and conveyed load

Figure C.42 — Minimum distance between fixed adjacent objects and conveyed load

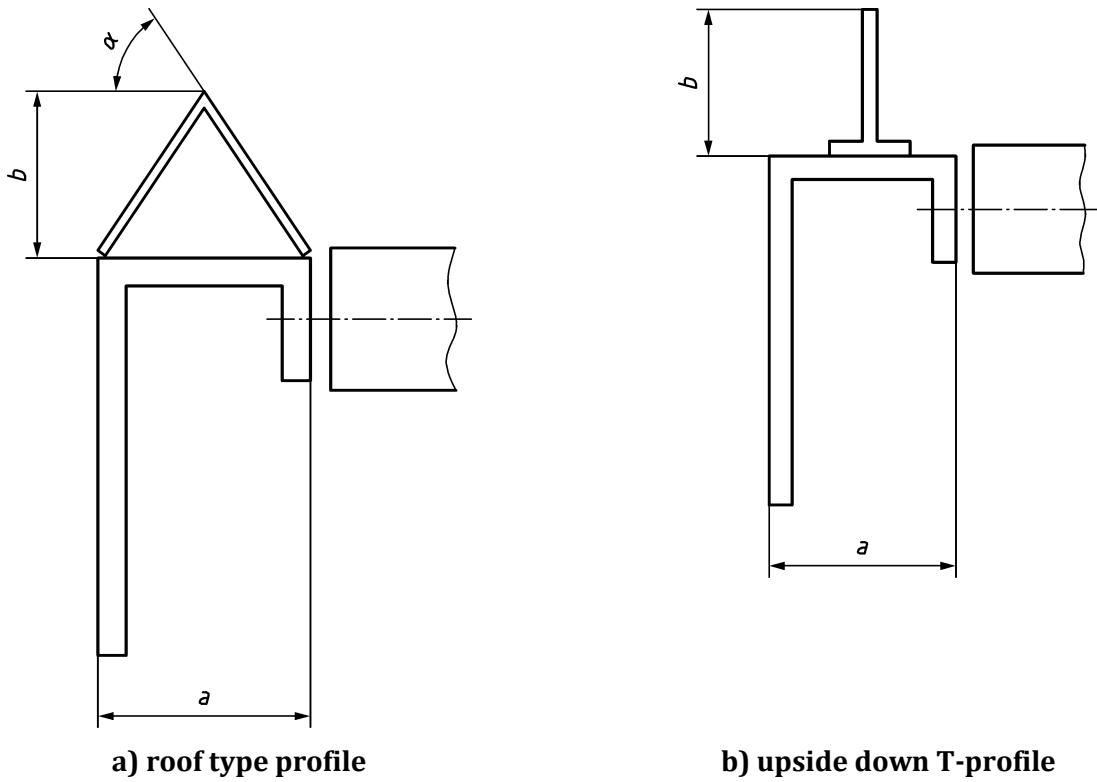
**Key**

- 1 interlocking movable guard
- 2 load

Figure C.43 —Circulating conveyor with interlocking guards

Annex D (normative)

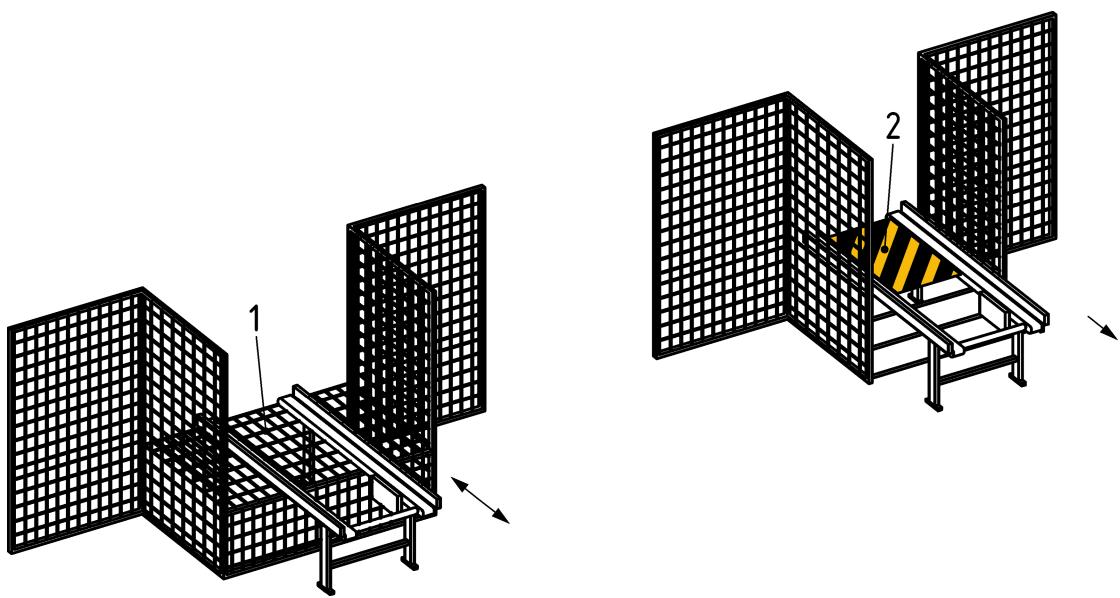
Typical examples to prevent access to restricted and danger areas or to stop the dangerous movements



Key

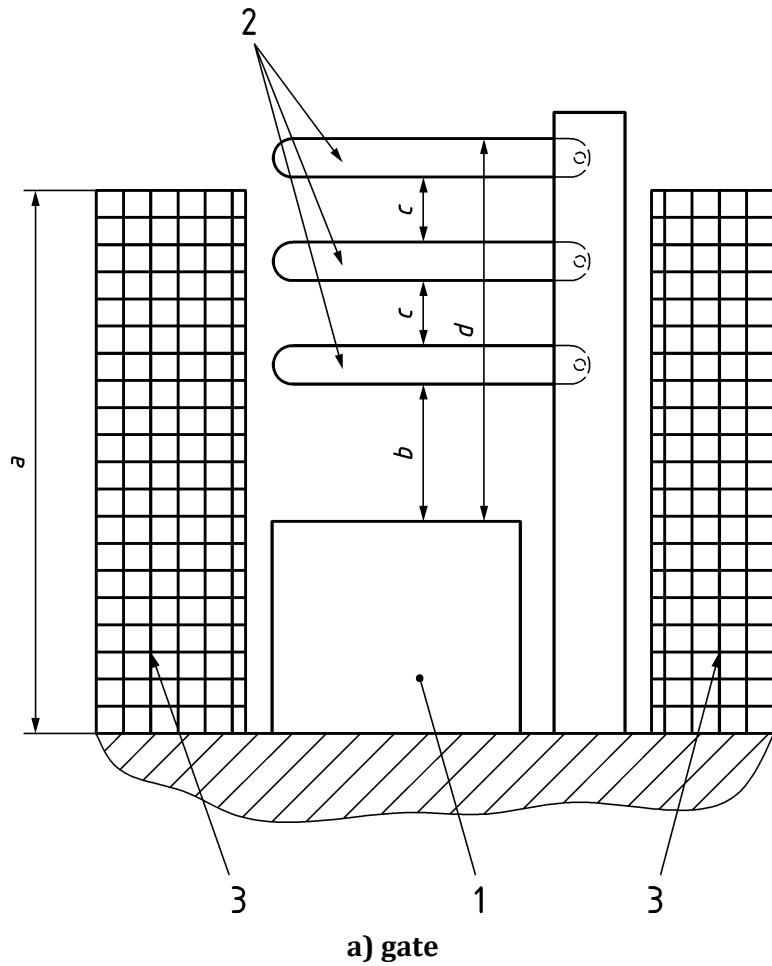
- a width of the frame
- b height of the profile
- α angle of roof type profile to the horizontal

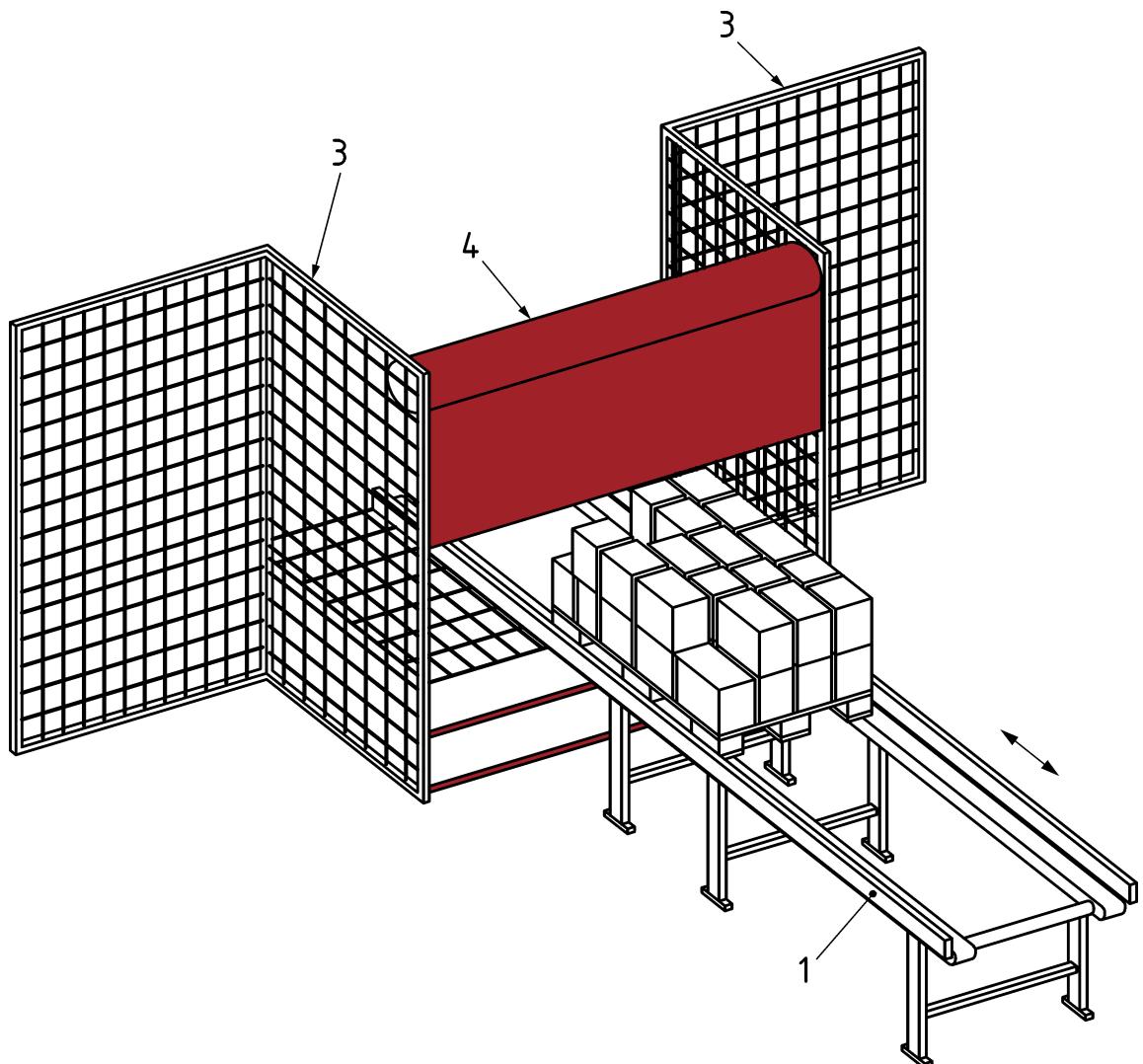
Figure D.1 — Design of frame surface

**Key**

- 1 steel wire or fibre rope net; appropriate only for requirements of 4.2.9
2 pressure sensitive device

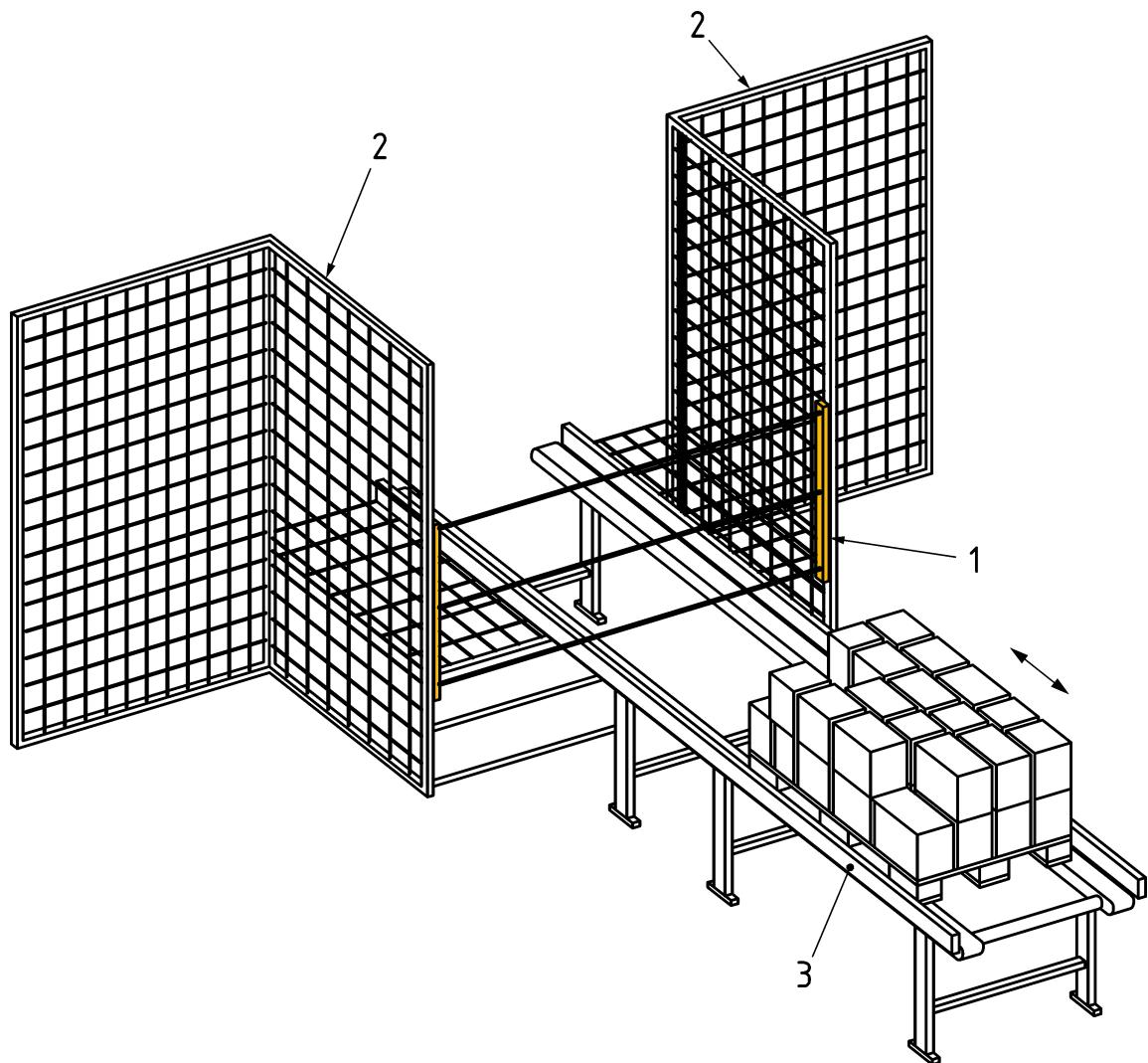
Figure D.2 — Area between chains of twin chain conveyors



**b) roller shutter gate****Key**

- 1 conveyor
- 2 booms
- 3 fixed guards
- 4 roller shutter gate
- a* height of the fixed guard
- b* gap between conveying level and the first boom
- c* gap between the booms
- d* height of the gate

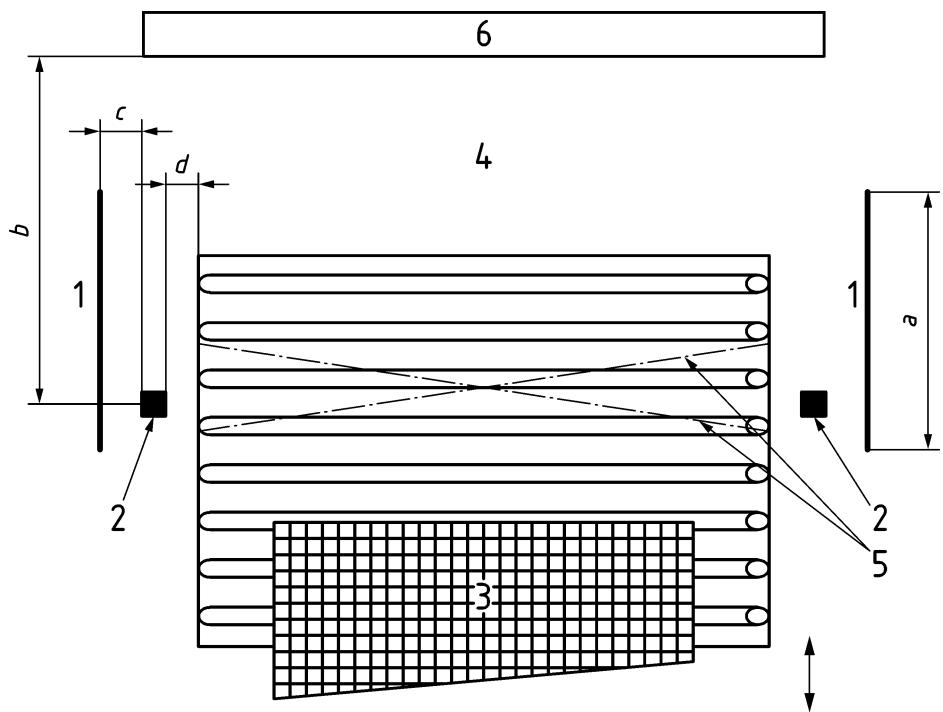
Figure D.3 — Guards; gate and roller shutter gate



Key

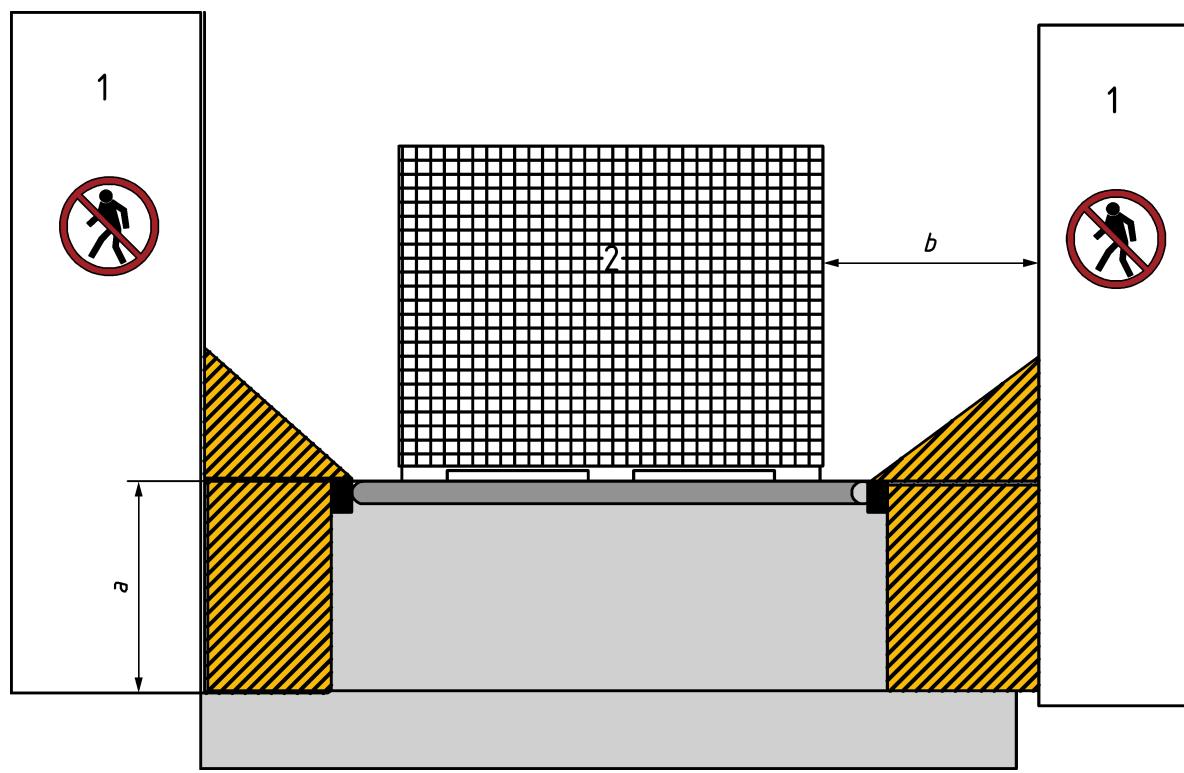
- 1 ESPE
- 2 fixed guards
- 3 conveyor

Figure D.4 — Entry/Exit point with ESPE

**Key**

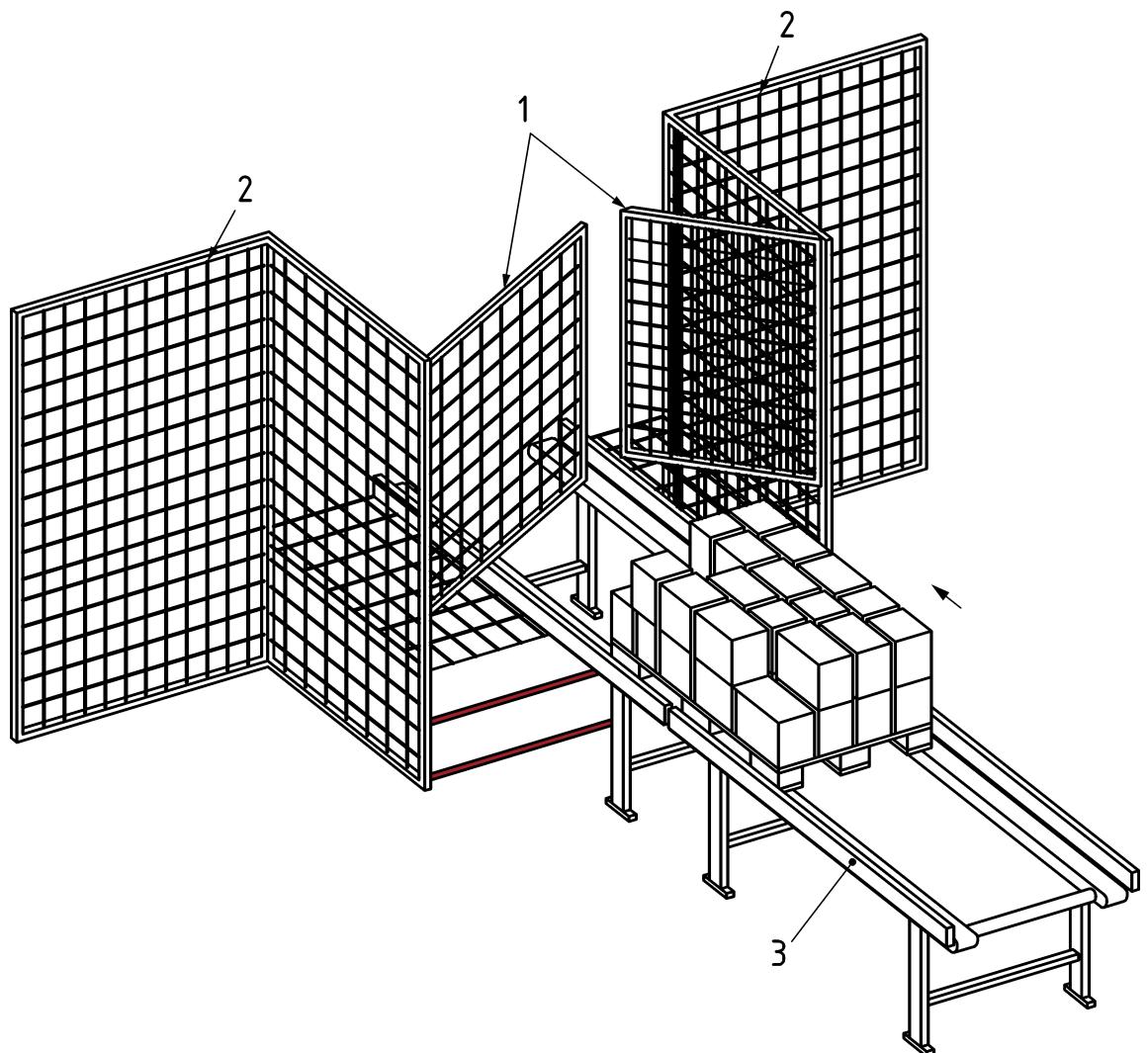
- 1 fixed guard
- 2 column of the ESPE
- 3 product
- 4 conveyor
- 5 muting beams
- 6 hazard zone
- a length of fixed guard
- b safety distance
- c gap between column of the ESPE and the guard
- d gap between column of the ESPE and the conveyor

Figure D.5 — Entry/Exit point with ESPE

**Key**

- 1 fixed guard
- 2 load
- a conveying level
- b distance between load and fixed guard

Figure D.6 — Preventing measures

**Key**

- 1 swinging doors
- 2 fixed guards
- 3 conveyer

Figure D.7 — Swinging doors

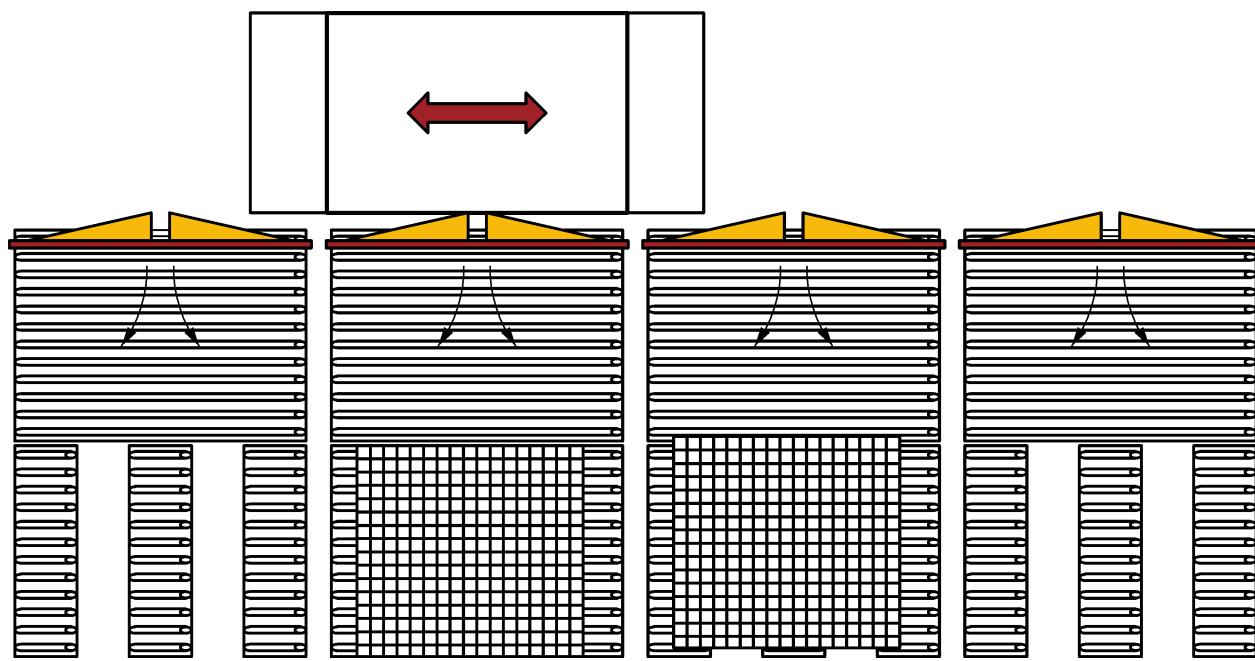
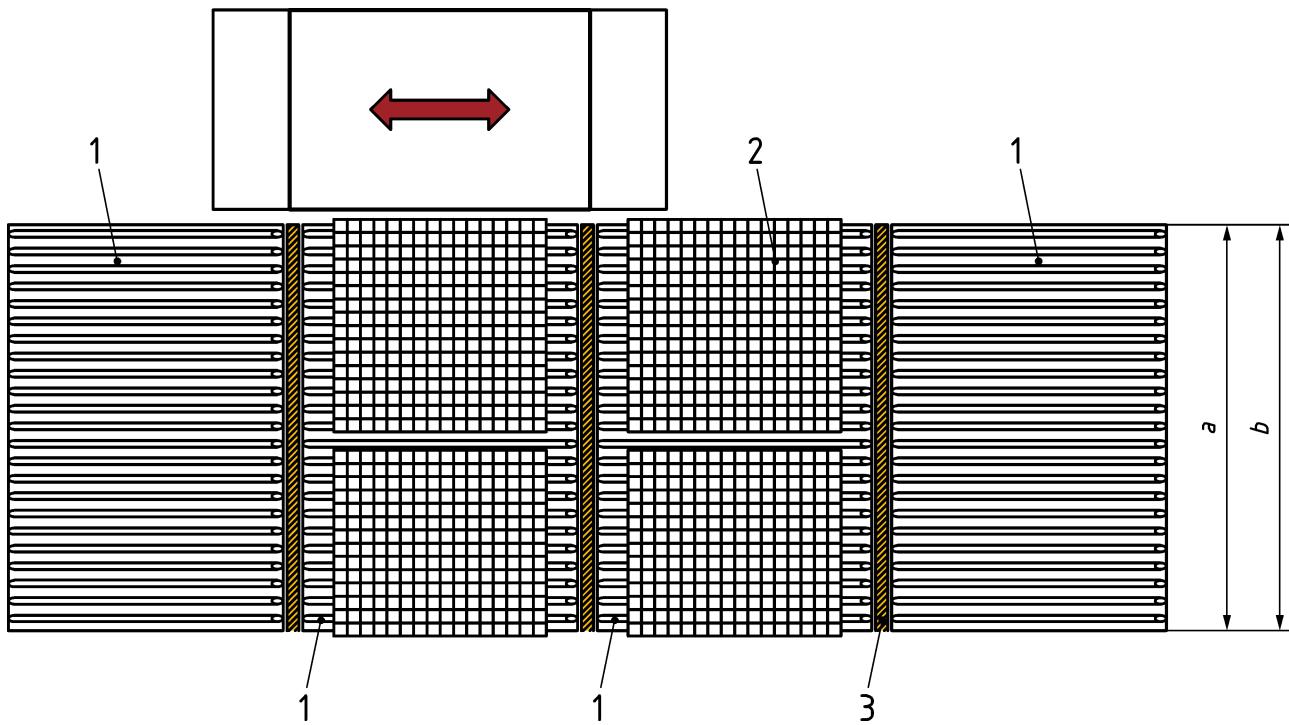
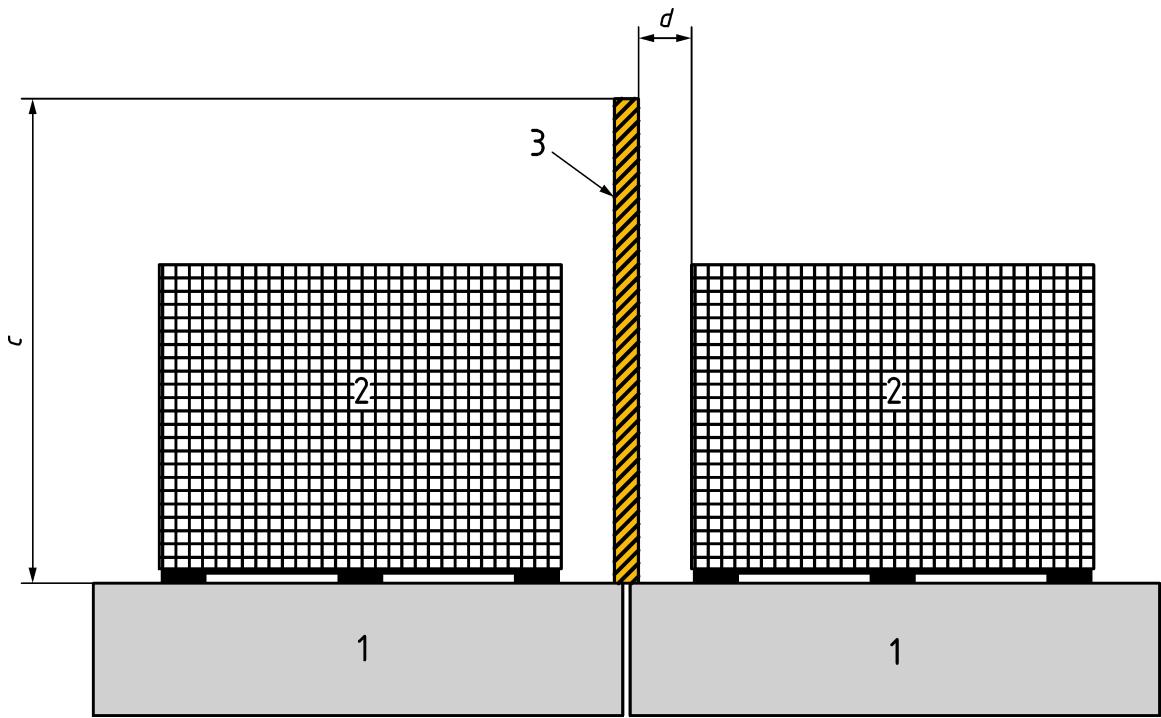


Figure D.8 — Swinging doors top view

**Key**

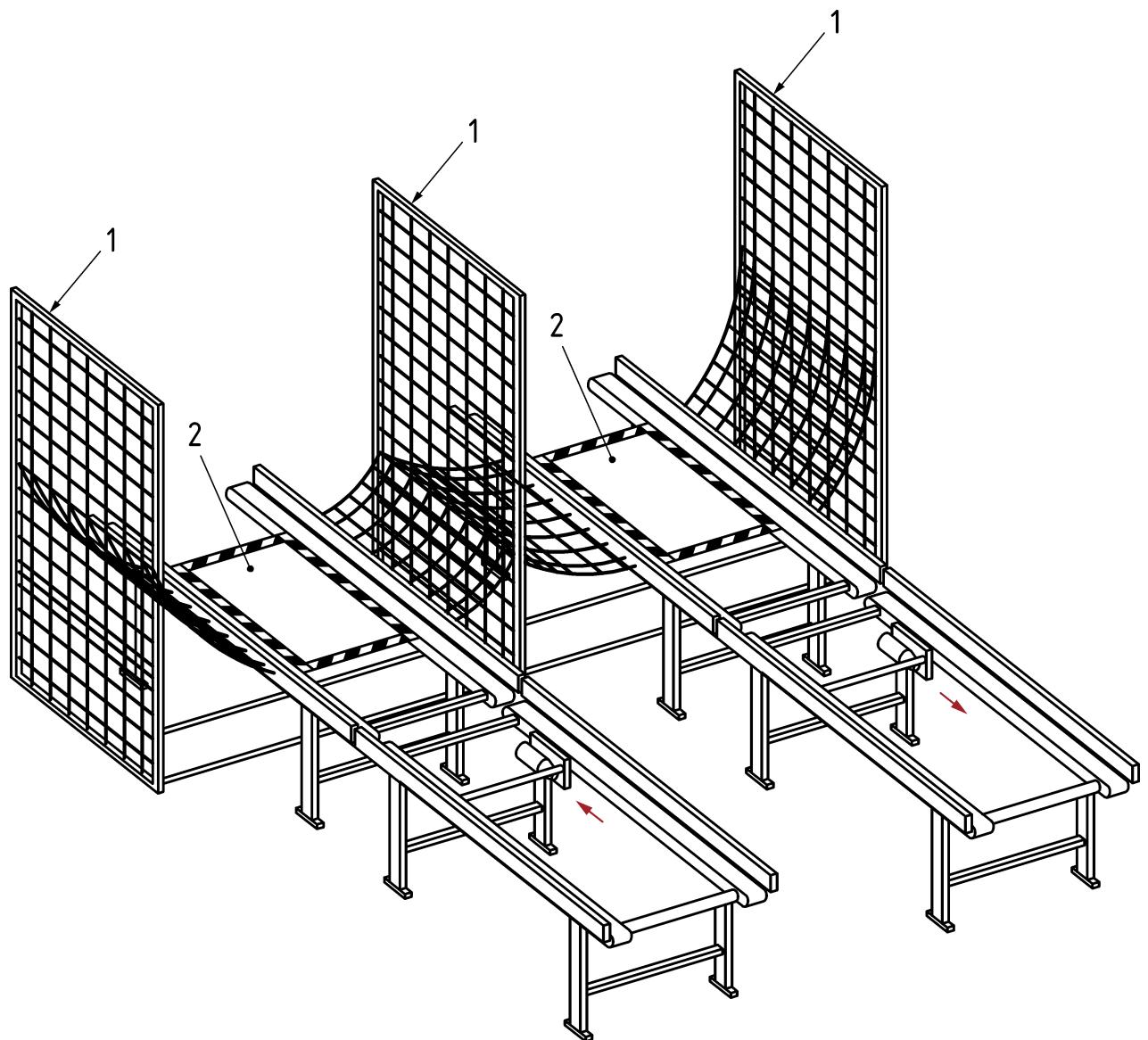
- 1 gravity roller conveyor
- 2 load
- 3 separating plate
- a length of separating plate
- b roller conveyor length

Figure D.9 — Transfer car with gravity roller conveyors with separating plates – top view

**Key**

- 1 gravity roller conveyor
- 2 load
- 3 separating plate
- c height of separating plate
- d distance between load and separating plate

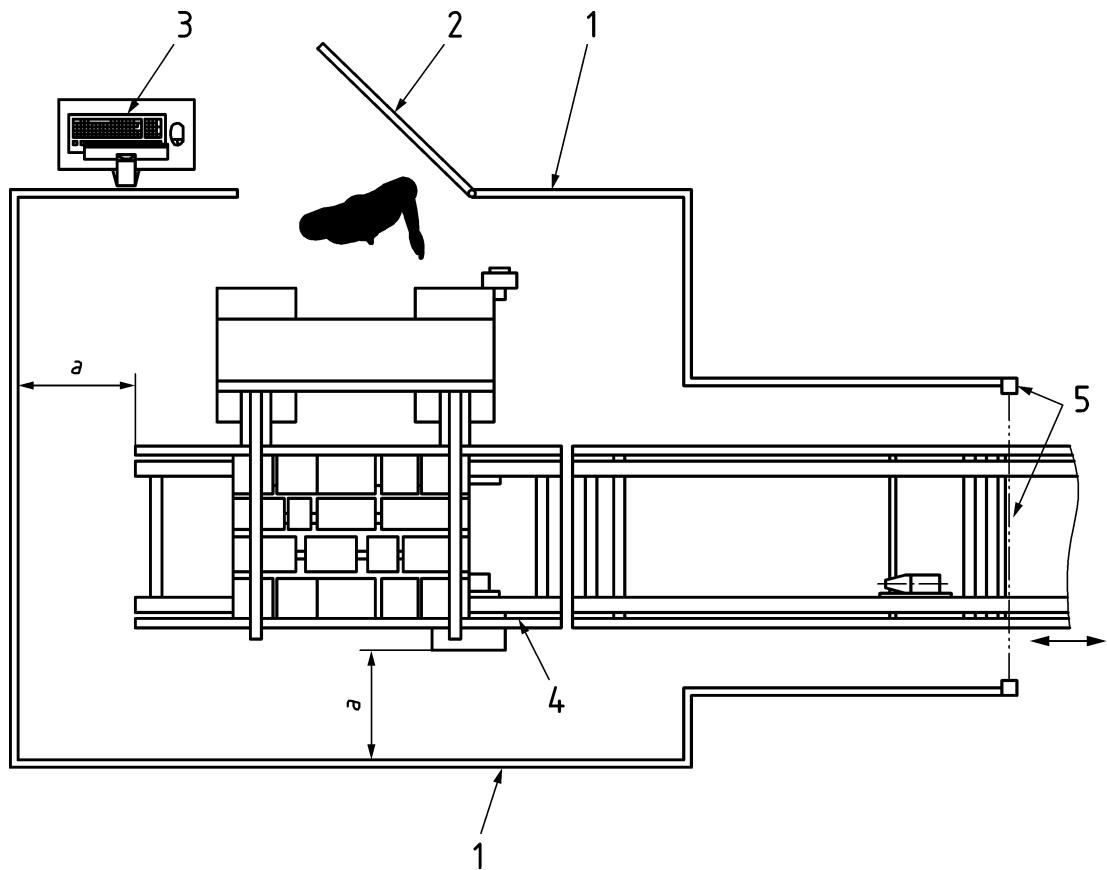
Figure D.10 — Transfer car with gravity roller conveyors with separating plates – front view



Key

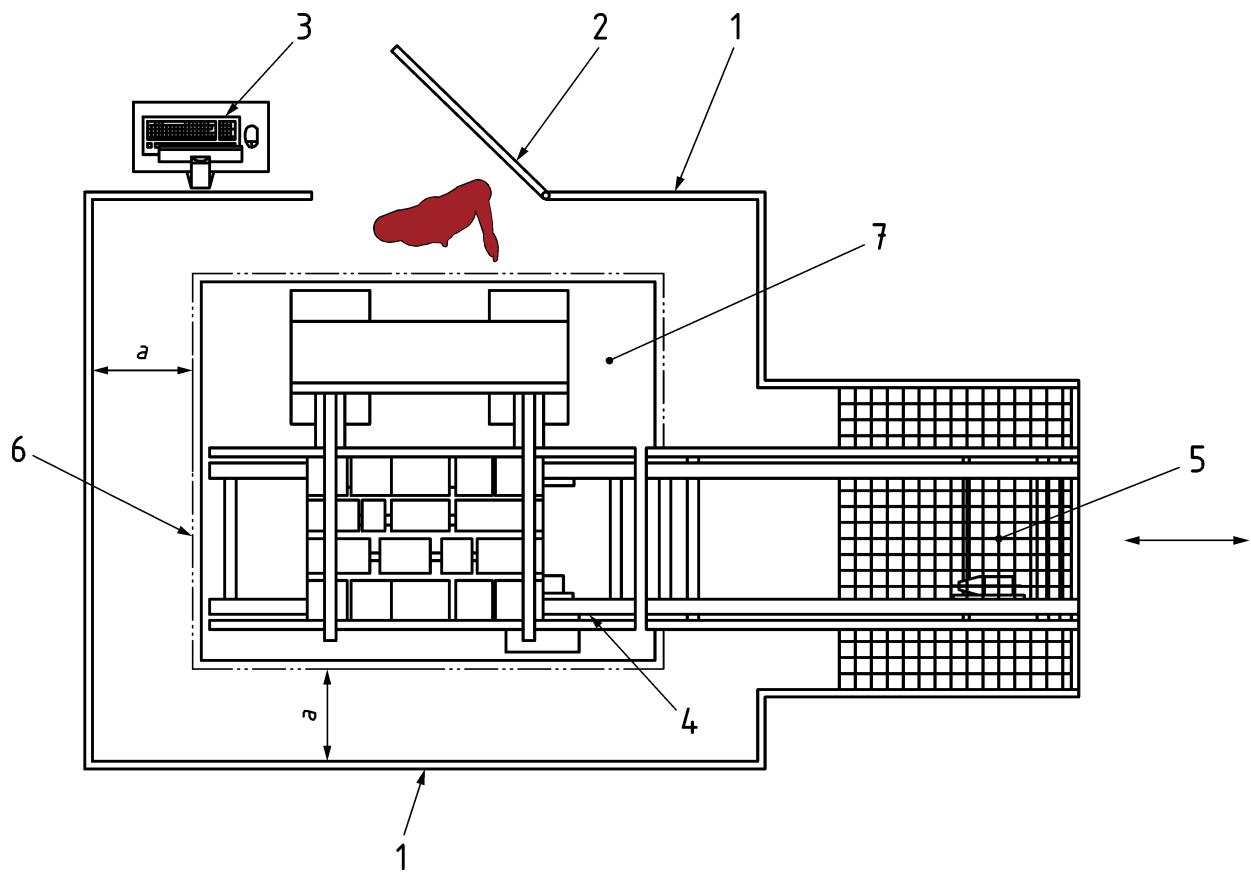
- 1 fixed guards
- 2 pressure sensitive device

Figure D.11 — Chain conveyor with pressure sensitive devices

**Key**

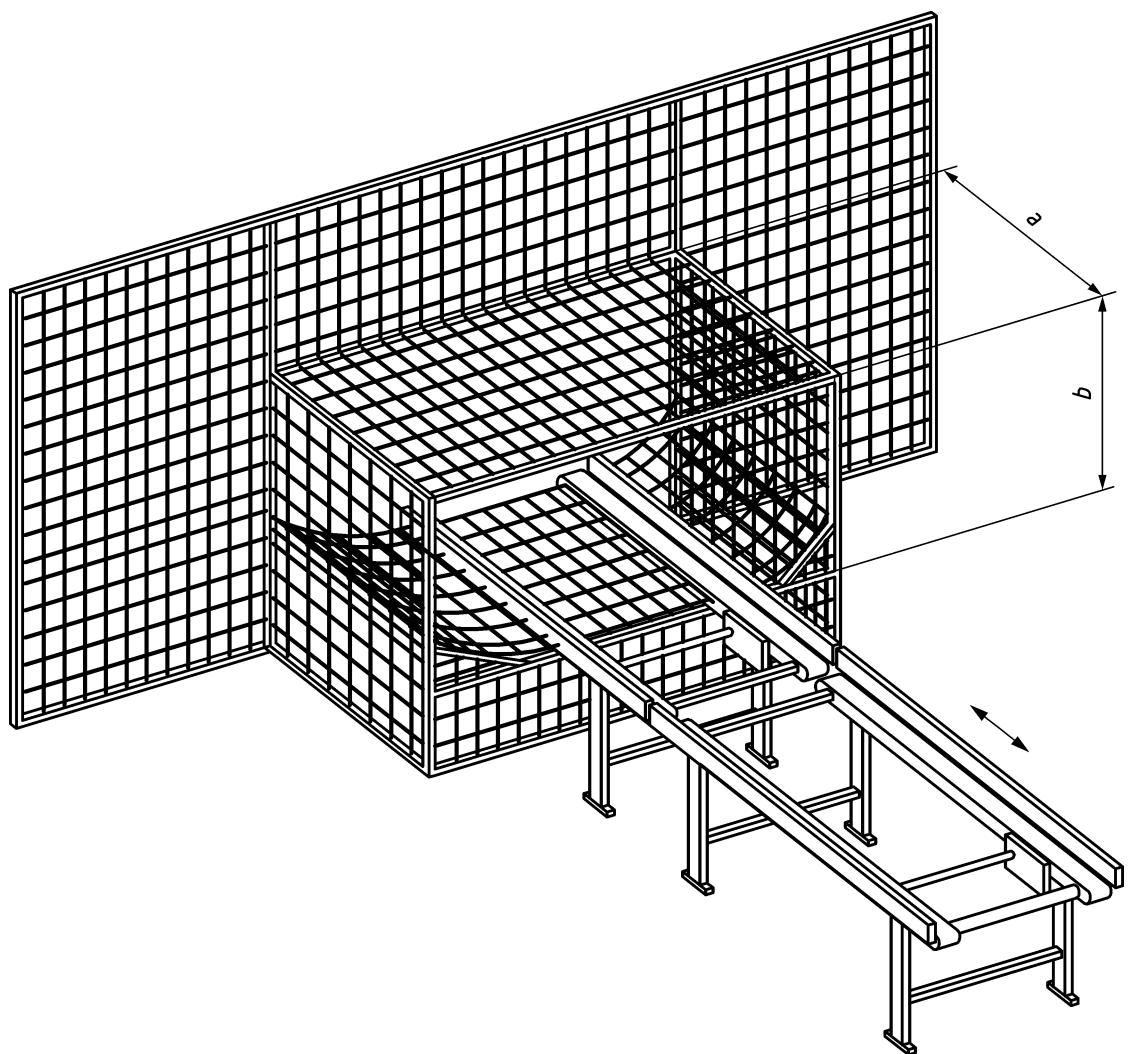
- 1 guard
- 2 access door
- 3 control panel
- 4 lifting carriage
- 5 active optoelectronic protective device (AOPD)
- a space between guards and VTD

Figure D.12 — Vertical transfer device floor level, traffic area, with ESPE

**Key**

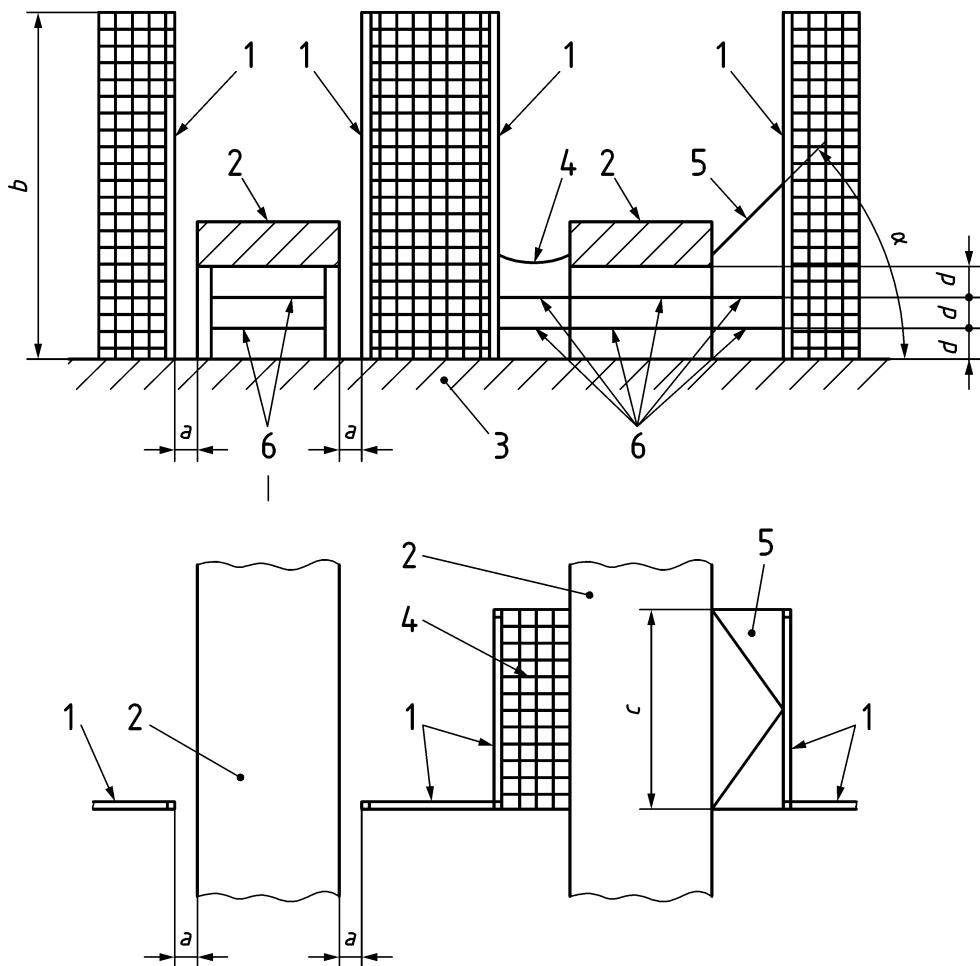
- 1 guard
- 2 access door
- 3 control panel
- 4 lifting carriage
- 5 netting to prevent access to danger area
- 6 guard rail
- 7 aperture in the floor
- a space between guards and guard rail

Figure D.13 — Vertical transfer device upper level, restricted area

**Key**

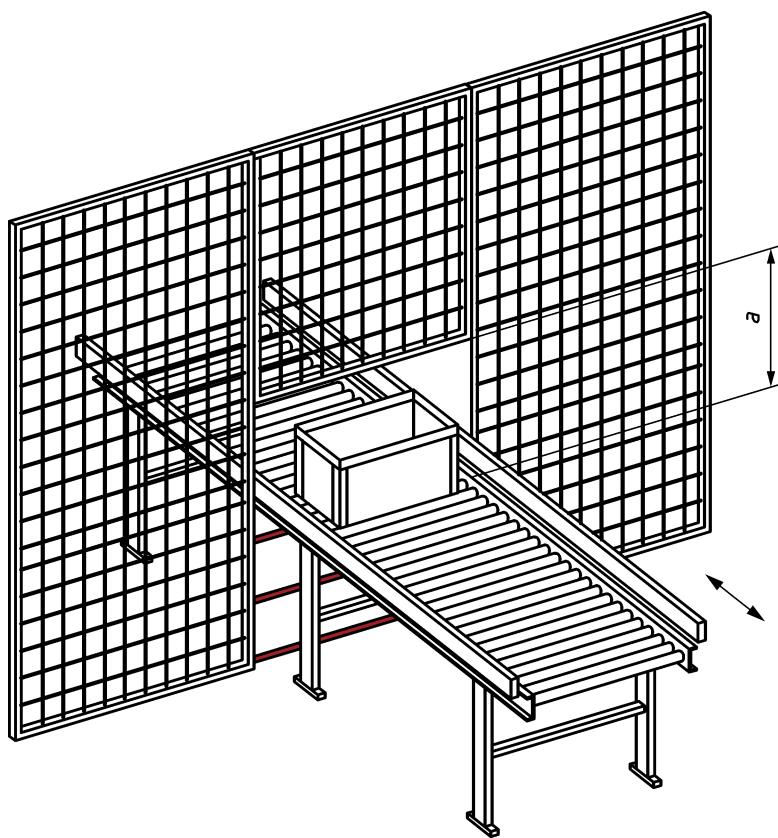
- a* length of the tunnel
b height of the opening

Figure D.14 — Prevention of access to danger areas by tunnel

**Key**

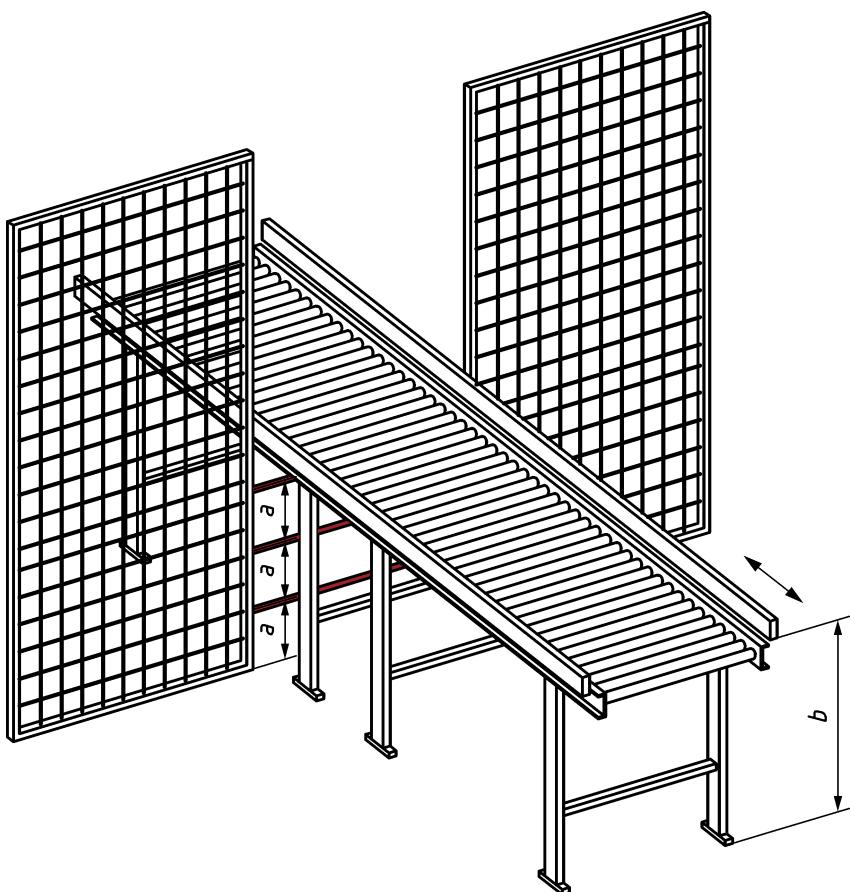
- 1 fixed guard
- 2 conveyor
- 3 floor
- 4 net or mat
- 5 sloping plate
- 6 fixed elements
- α angle of the sloping plate
- a gap between conveyors or between conveyor and adjacent objects
- b height of the fixed guard
- c length of the system to prevent access
- d gap between fixed elements below and beside the conveyor

Figure D.15 — Prevention access beside and below the conveyor (front and top view)

**Key**

a distance between conveying level and top of the opening

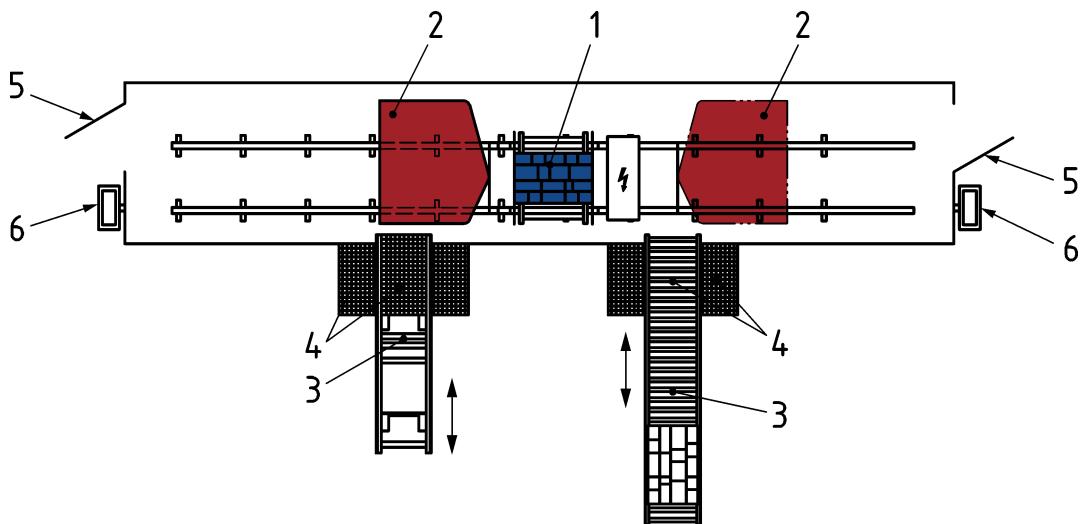
Figure D.16 — Prevention of access to danger areas by height of the opening



Key

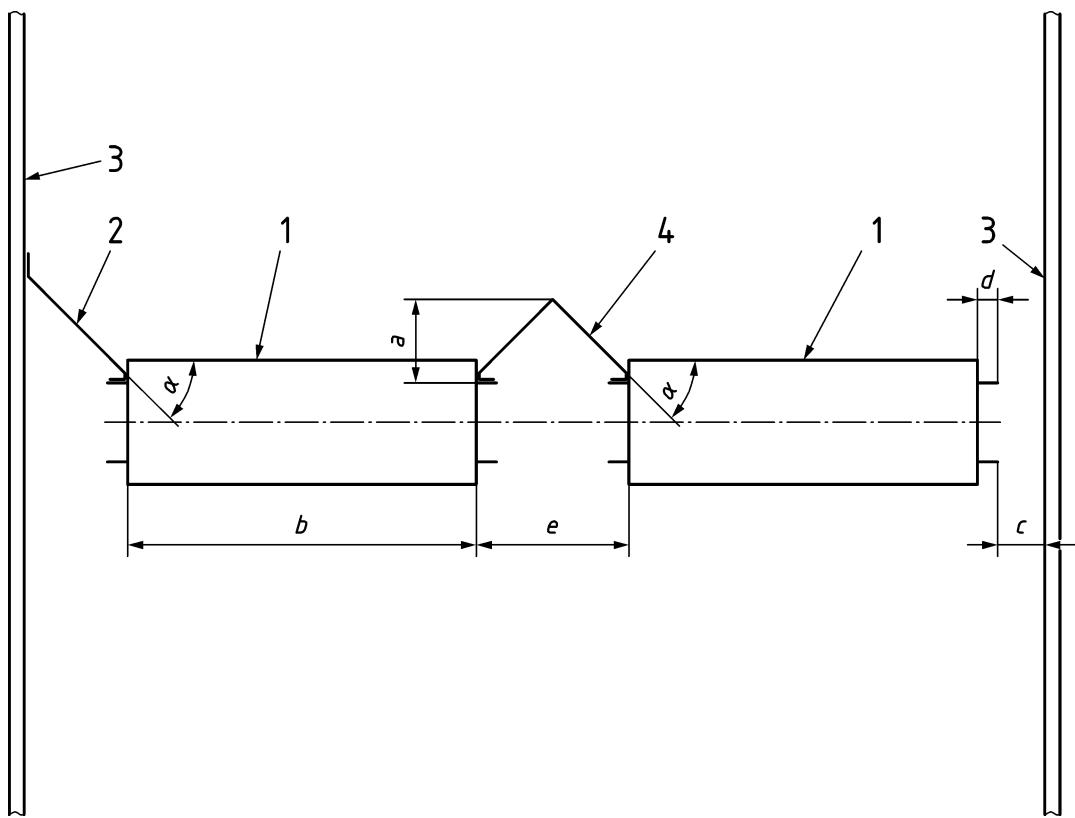
- a* gaps below the conveyor
- b* conveying height

Figure D.17 — Prevention of access to danger areas by minimum conveying height

**Key**

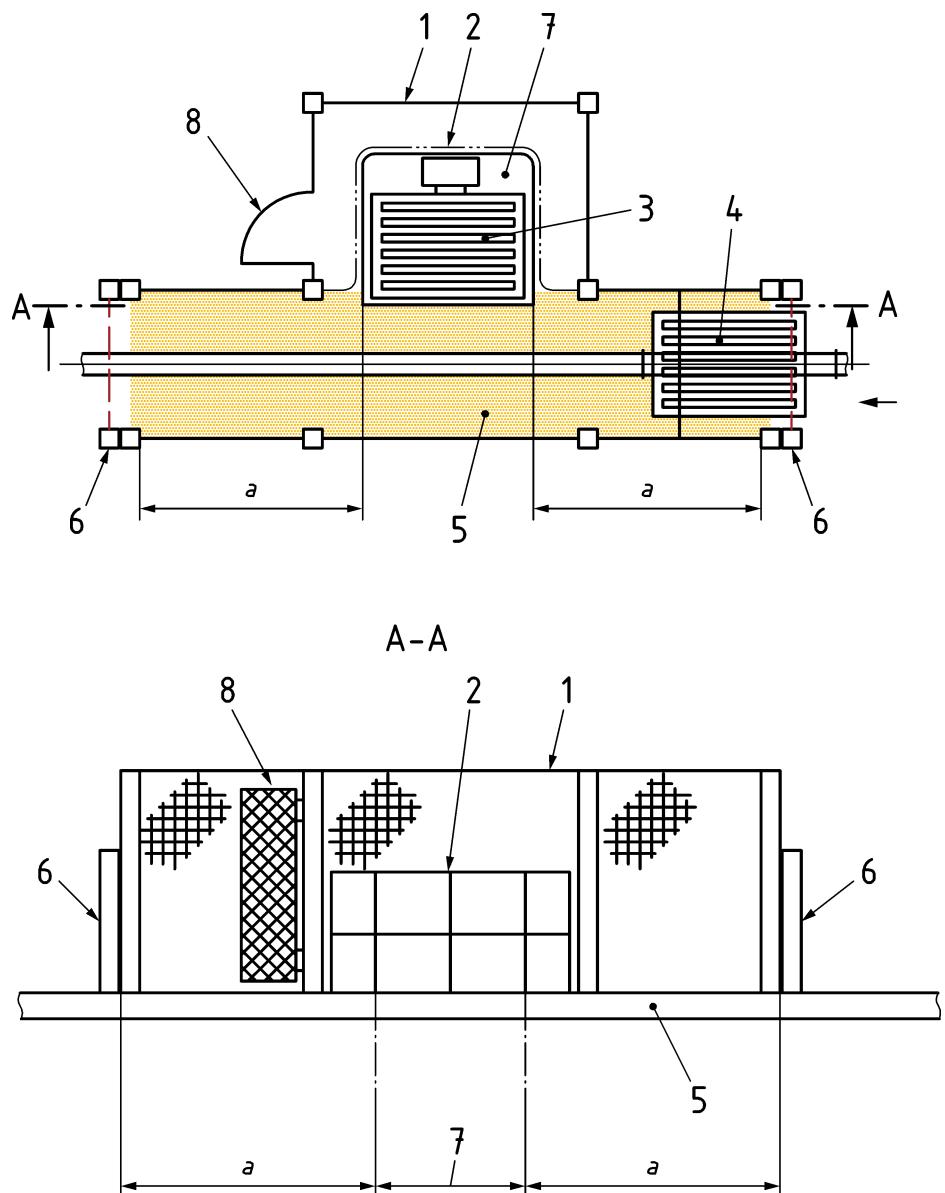
- 1 transfer car
- 2 laser scanner
- 3 connecting conveyor
- 4 preventing access according 4.2.9
- 5 access door
- 6 control panel

Figure D.18 — Transfer car with laser scanner

**Key**

- 1 roller
- 2 sloping plate
- 3 fixed guard
- 4 roof type profile
- α angle of sloping plate and roof type profile
- a height of the roof type profile
- b roller length
- c distance between conveyor and fixed guard
- d width of the conveyor frame
- e distance between the rollers

Figure D.19 — Preventing access by design of gravity roller conveyors

**Key**

- 1 fixed guards
- 2 guard rail
- 3 vertical transfer device
- 4 overhead conveyor
- 5 especially designed flooring
- 6 sensitive protecting device
- 7 opening in the flooring
- 8 access door
- a distance to the falling edge

Figure D.20 — Especially designed floor at vertical transfer devices to prevent falling

Annex E (normative)

Noise test code

E.1 General

This noise test code specifies all the information necessary to carry out efficiently and under standardized conditions the determination, declaration and verification of the noise emission characteristics of mechanical handling devices as defined in Clause 3. The determination of these quantities is necessary for:

- manufacturers to declare the noise emitted;
- comparing the noise emitted by machines of the same design intended to carry out the same function with equivalent performance characteristics;
- purposes of noise control at the source at the design stage.

The use of this noise test code ensures reproducibility of the determination of the noise emission characteristics within specified limits determined by the grade of accuracy of the basic noise measurement method used.

Typical conveying systems consist of a composition of several conveyor types. This noise test code provides a method of determination of the noise emission of all types of single conveyor types, in particular:

- turntables (including in- and outfeed conveyors);
- transfer cars (including in- and outfeed conveyors);
- vertical transfer devices (including in- and outfeed conveyors).

The measurement of the over-all noise emission of a composition of several conveyors is not intended by this noise test code.

Noise emission measurements are intended to be conducted at the manufacturer's place unless this is not practical. In the latter case it is recommended that measurements are conducted on site by the manufacturer in cooperation with the user.

E.2 Determination of A-weighted emission sound pressure level

The A-weighted emission sound pressure level of the conveyor shall be measured in accordance with EN ISO 11201:2010 (grade 2). In order that EN ISO 11201:2010 is applicable, it may be necessary to adapt the measurement on site so that all preconditions of EN ISO 11201:2010 are fulfilled.

These values shall be either measured at the manufacturer's site or after the conveyor has been commissioned or those assessed with reference to comparative emission data for similar conveyors. Similar conveyors are conveyors of the same design intended to carry out the same function with equivalent performance characteristics. The parameters describing the performance are specified in this Annex E.

In the current absence of technical knowledge of the uncertainty, the measurement uncertainty shall be taken equal to: 3 dB(A) ; detailed information on uncertainty can be found in Clause 11 and Annex C of EN ISO 11201:2010.

NOTE 1 Dialogue between the user and the supplier will help to achieve a mutual understanding of the noise issue e.g. measurements made jointly by the supplier and the user during commissioning will provide useful noise emission data to both parties.

NOTE 2 The noise exposure levels on site are influenced by a number of factors in addition to the conveyor including: adjustment of the conveyor; properties and condition of the load; filling degree of the case (box); geometry and surface of the building; climatic conditions; external noise sources. Therefore additional measurements by the user for use in workplace noise assessments after the warehouse is in full operation can be useful.

E.3 Measurement positions

E.3.1 Operator positions

If the conveyor has a directly interacting working place during normal operation the noise measurement of the conveyor shall be carried out there. This is the case for the conveyor shown on Figure E.1. The measurement shall be done in the absence of the operator.

Noise emission values measured shall be recorded, reported and declared.

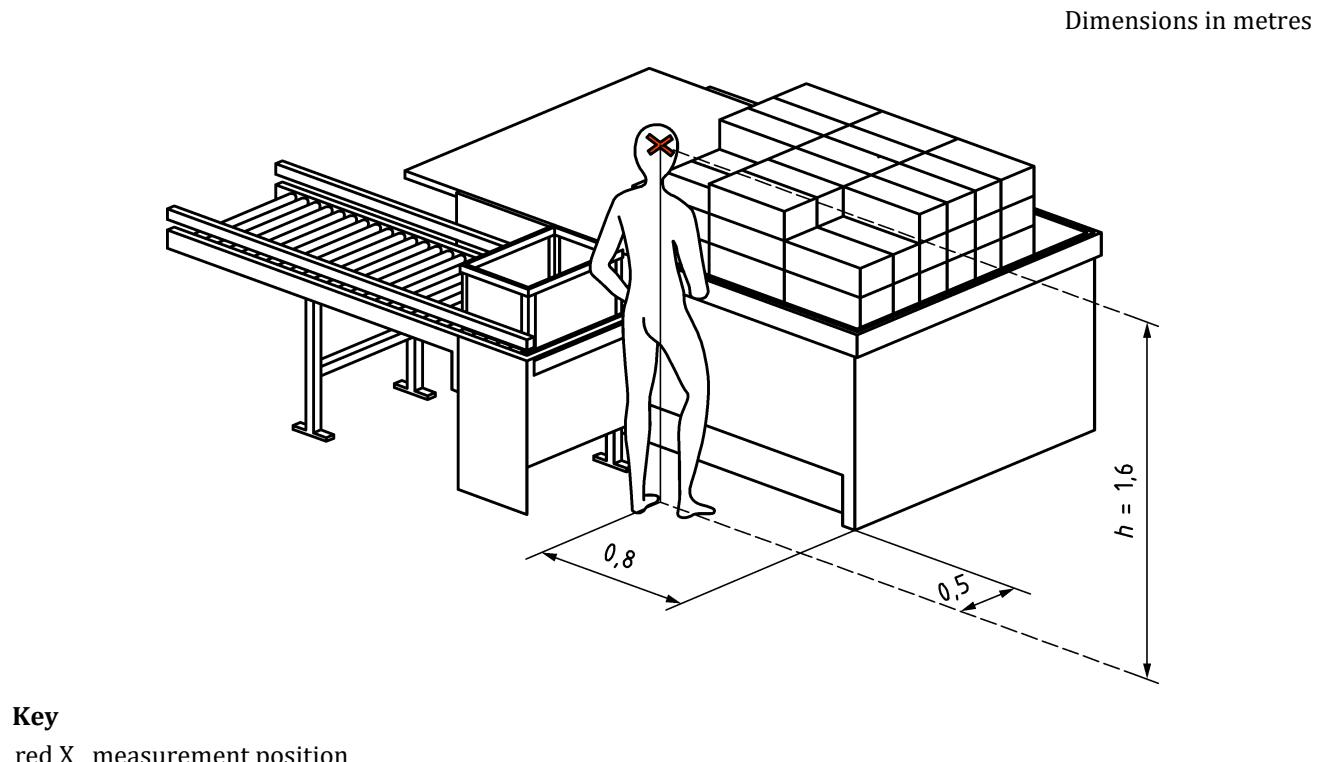


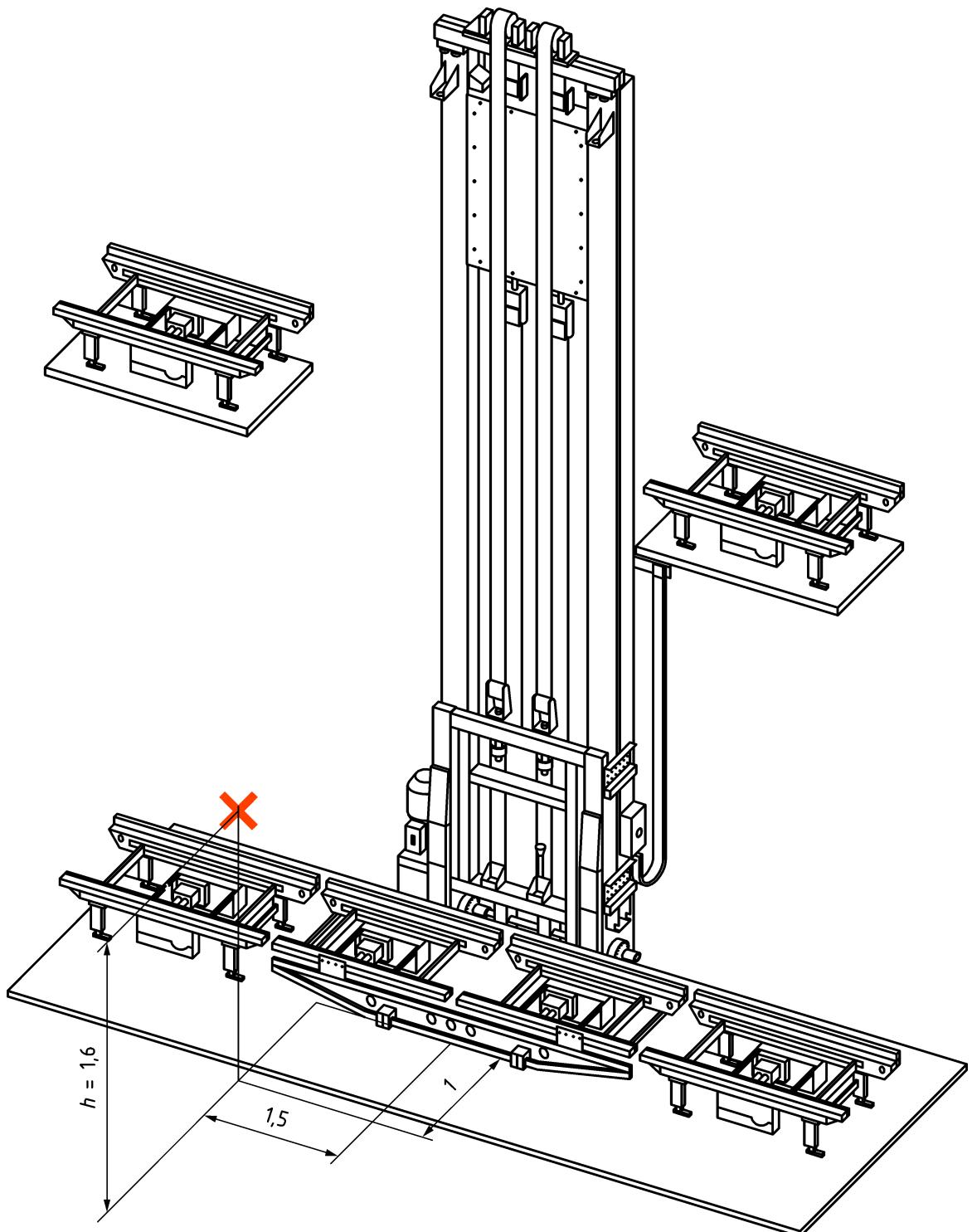
Figure E.1 — Operator's position

E.3.2 Positions if working places are undefined

Where such working places are undefined or cannot be defined, the measuring place shall be the most unfavourable (noisy) and the nearest practicable place (1,0 m from the surface of the machinery) where people can be exposed and at a height of 1,60 m from the floor or access platform. This is the case for the two conveyor modules shown in the Figures E.2 and E.3.

Noise emission values measured shall be recorded, reported and declared.

Dimensions in metres

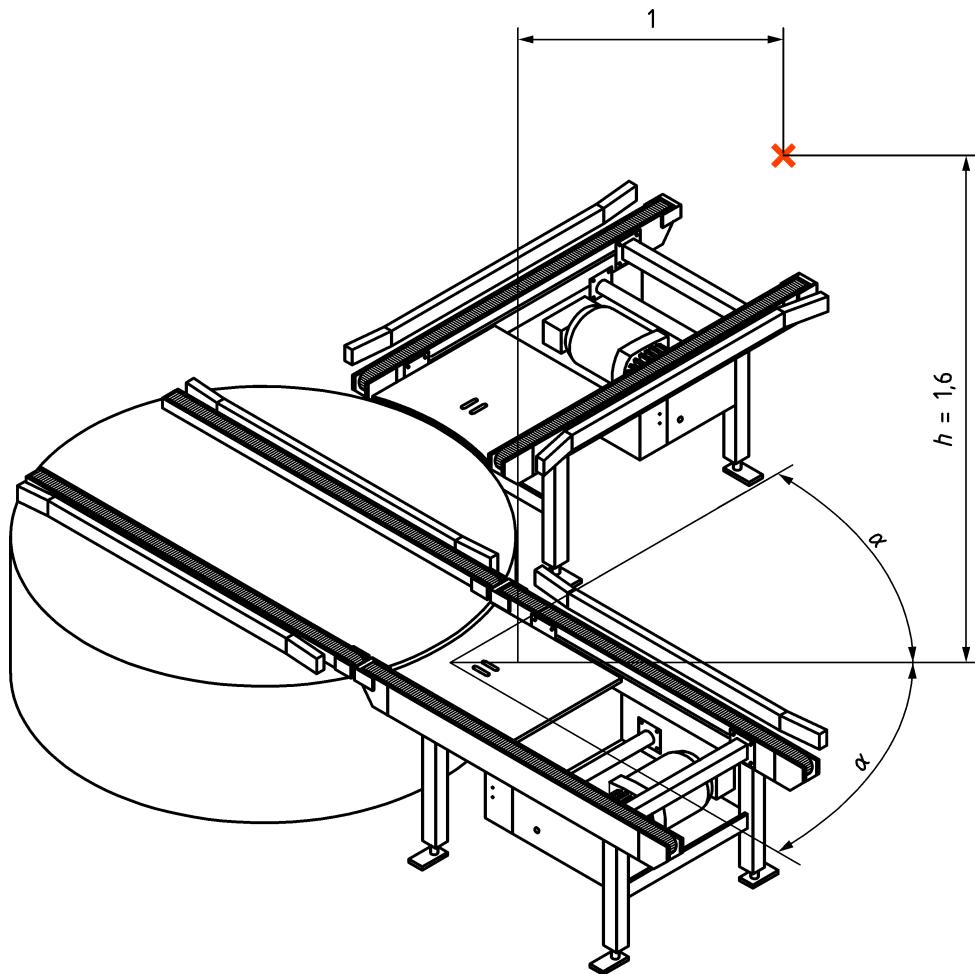


Key

red X measurement position

Figure E.2 — Measurement position at vertical transfer device

Dimensions in metres

**Key**

red X measurement position

Figure E.3 — Measurement position at turntable**E.3.3 Additional measurement positions**

When the A-weighted emission sound pressure level measured according to E.3.1 and E.3.2 exceeds 80 dB(A), the A-weighted sound power level of the machine should be determined. However, conveyors exceeding 80 dB(A) are considered as very large machines and therefore the determination of the A-weighted sound power level shall be replaced by the measurement of A-weighted emission sound pressure levels at additional measurement positions around and/or along the conveyor. The distance between those measurement positions shall be maximum 2 m. An example for measurement positions at a line sorter is shown in Figure E.4.

Noise emission values measured shall be recorded, reported and declared.

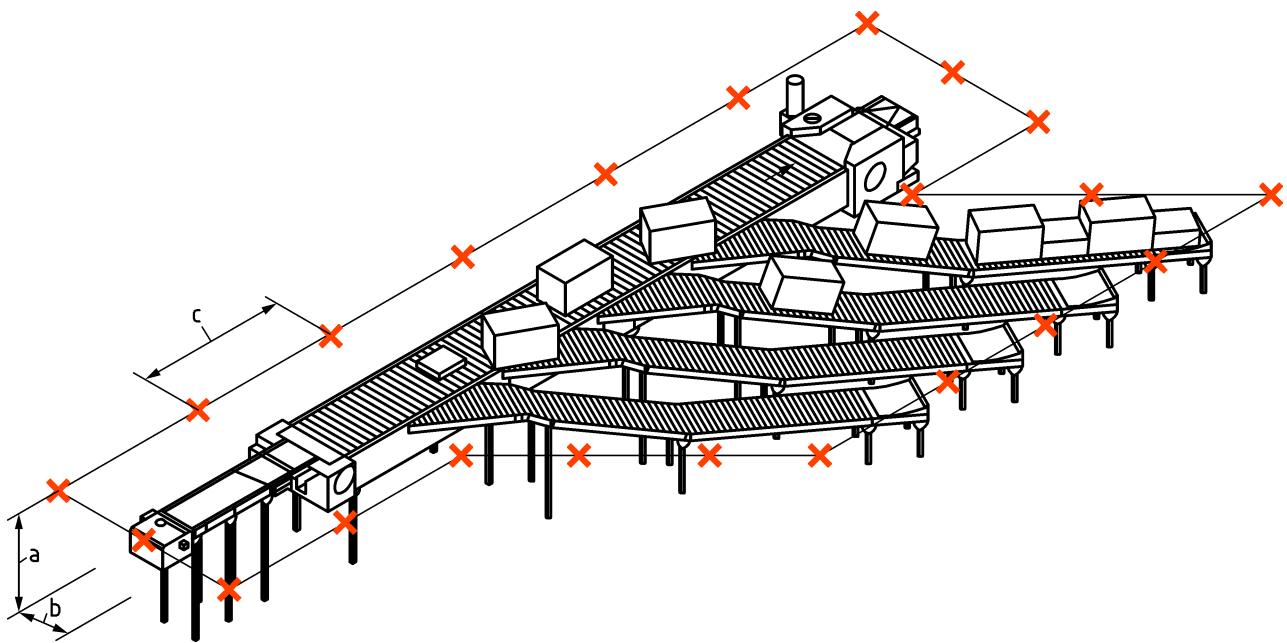


Figure E.4 — Measurement positions at a line-sorter on a path when the value measured according to E.3.1 or E.3.2 exceeds 80 dB(A)

E.4 Operating conditions during measurements

The measurement of the A-weighted emission sound pressure level shall be done under the following conditions:

- during measurement, as far as possible, all external noise emitting sources shall be out of operation (e.g. other conveying systems and ventilation systems);
- the load carrying elements as intended by the manufacturer shall be used (e.g. pallet, bin, tray);
- the original type of load if conveyed without carrying element shall be used (e.g. tyres);
- the unit load weight shall be the maximum load weight the conveyor is designed for;
- the load itself shall not emit noise (e.g. by using sandbags);
- the conveyor shall run at the most unfavourable conditions e.g. at maximum speed and maximum acceleration and deceleration the conveyor is designed for.

There are two possibilities with regard to the measuring sequence:

- 1) Continuous measurement with a duration of at least 30 s and at least 5 unit loads passing the measuring section. It shall be carried out at the intended performance of the conveyor (e.g. for an intended performance of 180 units/hour, total 5-unit-cycle has a duration of 100s).

- 2) Measurement of at least 5 single cycles (the travel from the load infeed points to the load outfeed points) with a single cycle duration according to the intended performance. (e.g. for an intended performance of 180 units/hour, the single cycle has a duration of 20 s). The sound pressure level to be indicated according 6.1.9 shall be the arithmetic average of the single cycle values.

The second possibility shall be applied when a continuous measurement is not possible, e. g for vertical transfer devices and transfer cars.

The type of connecting conveyors shall be recorded, reported and declared.

E.5 Information to be recorded

The information to be recorded includes the information to be recorded as specified in EN ISO 11201:2010 and all of the technical requirements of this noise test code. Any deviations from this noise test code or from the basic standard on which it is based are to be recorded together with the technical justification for such deviations.

E.6 Information to be reported

The information to be included in the test report is at least that which is required to prepare a noise emission declaration or to verify the declared values.

E.7 Noise emission declaration

The noise emission declaration shall be made in accordance with Annex A of EN ISO 4871:2009. It shall be a dual number declaration (measured value and associated uncertainty given separately).

Following information shall be provided:

- 1) the noise test code (Annex E of EN 619:2022) and the basic standard used for the measurement (EN ISO 11201:2010);
- 2) the A-weighted emission sound pressure level and the value of the associated uncertainty, where this exceeds 70 dB(A) (where this level does not exceed 70 dB(A), this fact shall be indicated). Where the A-weighted emission sound pressure level exceeds 80 dB(A), according to MD 2006/42/EC 1.7.4.2 (u) all single measurements that have been recorded around the module shall be declared;
- 3) description of the conveyor including e.g. dimensions, capacity, maximum speed;
- 4) description of the type of connecting conveyors;
- 5) description of the measurement procedure (i.e. the noise declaration shall indicate which measuring sequence has been used, including indication of the length of the cycle);
- 6) location of the measurement points;
- 7) warning that the values obtained according to this noise test code are likely to be exceeded at real installation site;
- 8) precise operating conditions (parameters as mentioned in E.4);
- 9) confirmation that all requirements of the noise test code have been fulfilled. If this is not the case, any unfulfilled requirements shall be identified (incl. technical justifications for deviations).

E.8 Example of a dual-number noise declaration for a vertical transfer device

Vertical transfer device, type VTD 0815	
maximum speed: 0,3 m/s	
total height: 7,5 m	
transportation unit: pallets with a rated load of 800 kg	
infeed conveyor: roller conveyor type RC 4711 with a conveying height of 0,6 m above floor level	
outfeed conveyor: carrying chain conveyor type CCC 4321 with a conveying height of 0,5 m above 5,5 m level	
operating cycle: from the load infeed point to the outfeed point; measuring time: 5 cycles for a total duration of 100s.	
measuring point: at a height of 1,6 m above floor level in a distance of 1,0 m to the connecting point roller conveyor/vertical transfer device.	
Measuring sequence: according to E.4 2) of EN 619:2022	
DECLARED DUAL-NUMBER NOISE EMISSION VALUES [dB(A)]	
In accordance with EN ISO 4871	
A-weighted emission sound pressure level, L_{pA} , at lower floor level	74,3
Uncertainty, K_{pA} ,	3,0
Values determined according to noise test code given in Annex E of EN 619:2022 using the basic standard EN ISO 11201:2010 (grade 2)	
NOTE The sum of a measured noise emission value and its associated uncertainty represents an upper boundary of the range of values which is likely to occur in measurements	
WARNING: <i>In situ</i> noise levels at workplaces will be higher than those measured according to the noise test code given in Annex E of EN 619:2022, depending on the environmental noise.	

NOTE The value of the A-weighted emission sound pressure level given is for illustration only.

Annex F (informative)

List of significant hazards on conveyors and conveyor systems

This annex contains in Table F.1 the hazards and hazardous situations, as far as they are dealt with in this European Standard, identified by risk assessment significant for this type of machinery and which require action to eliminate or reduce risk.

Table F.1 — List of significant hazards

	Hazards	Hazard location	Requirements Sub-clauses
1	Mechanical hazards		
1.1	Crushing hazard	General	4.2.1
		Shearing/crushing between load and a fixed adjacent object	4.2.1.1.4
		Cross over passageways	4.10.2
		Crushing and shearing points between conveyors and conveyed unit loads	4.20.2
		Height adjustable telescopic conveyor	4.20.6.1
		Rail bound mobile telescopic conveyors	4.20.6.2
		Telescopic conveyors with platforms	4.20.6.3
		Safety distances for overhead conveyors	4.20.8.2
		Maintenance vehicles for overhead conveyors	4.20.8.10
		Transfer cars with short distance picking places	4.20.9.3.3
		Pushers	4.20.12.2
		Sorters	4.20.13
1.2	Shearing hazard	Shearing/crushing between load and a fixed adjacent object	4.2.1.1.4
		Cross over passageways	4.10.2
		Crushing and shearing points between conveyors and conveyed unit loads	4.20.2.2
		Crushing and shearing points between roller conveyors and conveyed unit loads	4.20.2.1
		Crushing and shearing points between carrying chain or multi belt conveyors and conveyed unit loads	4.20.2.2
		Height adjustable telescopic conveyors	4.20.6.1
		Pushers	4.20.12.2
1.3	Entanglement hazard	Entanglement points	4.2.1.1.7, 6.1.3
1.4	Drawing-in or trapping hazard	Drawing-in points	4.2.1.1.6
		Sorters	4.20.13
		Safety measures at induct points	4.20.13.1
		Conveyors in public areas of airports	4.20.14

	Hazards	Hazard location	Requirements Sub-clauses
1.5	Impact hazard	Maximum speed for risk due to movement of unit loads	4.2.1.2
		Safety measures for the use of service vehicles for loop-sORTERS	4.20.13.3
		Lifting elements in case of working places under, on or at overhead conveyors	4.20.8.4.2
1.6	Friction or/abrasion hazard	Prevention of sharp edges sharp angles and rough surfaces	4.2.7
1.7	High pressure fluid or gas ejection hazard	Hydraulic and pneumatic systems and equipment	4.6
1.8	Falling or ejection of parts (of machinery and processed material/work pieces)	Protection against falling or ejected objects	4.2.6
		Interruptions of tracks of overhead conveyors	4.20.8.7
		Falling of lifting carriage or counterweights of vertical transfer devices above working places, traffic area and restricted area	4.20.11.5
		Vertical transfer devices	6.1.7
1.9	Loss of stability (of machinery and machine parts)	Stability against overturning for mobile conveyors	4.2.5
1.10	Slip, trip and fall hazards in relationship with machinery (because of their mechanical nature)	Preventing access to danger areas across the load entry/exit points from restricted areas, traffic areas and working places or stopping the dangerous movement	4.2.8
		Cross over passageways	4.10.2
		Telescopic conveyors with platforms	4.20.6.3
		Working on overhead conveyors or on the load in assembly lines	4.20.8.4.4
		Access to vertical transfer device	4.20.11.1
		Vertical transfer devices where riding on the lifting carriage is intended	4.20.11.10
		Safety measures for the use of service vehicles for loop-sORTERS	4.20.13.3
		Chutes at sorters	4.20.13.4
2	Electrical hazards	Measures for protection against electrical hazards	4.3
3	Thermal hazards for example resulting in:		
3.1	Burns and scalds, by a possible contact of persons, by flames or explosions and also by the radiator of heat sources	Protection against thermal hazards	4.8
4	Hazards generated by noise: — Hearing damage, physiological disorders — Accidents due to non-perception of oral messages and alert acoustic signals	Noise reduction at design stage	4.9
		Noise test code	Annex E

	Hazards	Hazard location	Requirements Sub-clauses
5	Hazards generated by neglecting ergonomic principles in machine design (mismatch of machinery with human characteristics and abilities)	Ergonomic requirements in machine design	4.14
		Telescopic conveyors with platforms	4.20.6.3
6	Hazards caused by failure of energy supply, breaking down of machinery parts and other functional disorders, for example		
6.1	Failure of energy supply (of energy and/or control circuits)	Failure of the power supply	4.19
6.2	Failure, malfunction of control system (unexpected start-up, unexpected overrun)	Interlocking devices associated with movable guards	4.2.1.1.2
		Work at machines with open guards	4.11.1
		Instructions for maintenance	6.1.4
6.3	Errors of fitting	General	6.1.1
7	Hazards caused by (temporary) missing and/or incorrectly positioned safety related measures/means, for example		
7.1	All kinds of guard	Open topped guards	4.2.1.1.1
		Drawing-in points	4.2.1.1.6
7.2	All safety related (protection) devices	Interlocking devices associated with movable guards	4.2.1.1.2
		Sensitive protective devices	4.2.1.1.3
7.3	Starting and stopping devices	Start and restart function	4.16
		Stop functions and stop control devices	4.17
7.4	Safety signs and signals	Marking	6.2
7.5	All kinds of information or warning devices	Information for use	6
7.6	Energy supply disconnecting devices	Means of disconnection	4.3.2
		Emergency stopping	4.18
		Instructions for use and maintenance	6.1.3, 6.1.4
7.7	Emergency devices	Restricted area	4.1.2
		Work at machines with open guards	4.11.1
		Emergency stopping	4.18

Annex ZA
 (informative)

**Relationship between this European Standard and essential requirements
of Directive 2006/42/EC aimed to be covered**

This European Standard has been prepared under a Commission's standardization request "M/396 Mandate to CEN and CENELEC for Standardisation in the field of machinery" to provide one voluntary means of conforming to essential requirements of Directive 2006/42/EC of the European Parliament and of the Council of 17 May 2006 on machinery and amending Directive 95/16/EC (recast).

Once this standard is cited in the Official Journal of the European Union under that Directive, compliance with the normative clauses of this standard given in Table ZA.1 confers, within the limits of the scope of this standard, a presumption of conformity with the corresponding essential requirements of that Directive, and associated EFTA regulations.

**Table ZA.1 — Correspondence between this European Standard and Annex I of Directive
2006/42/EC**

The relevant Essential Requirements of Directive 2006/42/EC	Clause(s)/subclause(s) of this EN	Remarks/Notes
1.1.2 a	4, 5, 6	
1.1.2.c	4, 5, 6	
1.1.2 d	4, 5, 6	
1.1.2 e	4, 5, 6	
1.1.3	4.6 Hydraulic and pneumatic systems and equipment	
1.1.4	4.11.2 Lighting	
1.1.5	4.12 Transport of machines 4.13 Lifting of machines or parts of the plant	
1.1.6	4.14 Ergonomic requirements in machine design 4.20.6.1 Height adjustable telescopic conveyors	

The relevant Essential Requirements of Directive 2006/42/EC	Clause(s)/subclause(s) of this EN	Remarks/Notes
1.2.1	4.11.1 Work at machines with open guards 4.16 Start and restart function 4.17 Stop functions and stop control devices 4.18 Emergency stopping 4.21, Table 3 Safety related parts of control systems /performance level	
1.2.2		Not covered
1.2.3	4.16 Start and restart function	
1.2.4.1	4.17 Stop functions and stop control devices	
1.2.4.3	4.18 Emergency stopping	
1.2.4.4		Not covered
1.2.5	4.11 Provisions for maintenance	
1.2.6	4.19 Failure of the power supply	
1.3.1	4.2.5 Stability against overturning for mobile conveyors 4.12 Transport of machines 4.13 Lifting of machines or parts of the plant	

The relevant Essential Requirements of Directive 2006/42/EC	Clause(s)/subclause(s) of this EN	Remarks/Notes
1.3.2		Structure strength not covered
	4.2.4.1 Strength calculation for non fixed load lifting attachments	
	4.2.4.2 Strength of ropes, chains and belts for lifting purposes	
	4.20.8.4.2 Lifting elements in case of working places under, on or at overhead conveyors	
	4.20.11.11 Vertical transfer devices where standing on and/or under the lifting carriage is intended	
1.3.3	4.2.6 Protection against falling or ejected objects	
	4.20.11.5 Falling of lifting carriage or counterweight of vertical transfer devices above working places, traffic area and restricted area	
	4.20.11.6 Falling of lifting carriage or counterweight of vertical transfer devices on storey floors	
	6.1.7 Instruction handbook for vertical transfer devices	
1.3.4	4.2.1.2 Maximum speed for risk due to movement of unit loads	
	4.2.7 Prevention of sharp edges, sharp angles and rough surfaces	

The relevant Essential Requirements of Directive 2006/42/EC	Clause(s)/subclause(s) of this EN	Remarks/Notes
1.3.7	4.2.1 General requirements for protection against moving parts	
	4.2.8 Preventing access to danger areas across the load entry/exit points or stopping the dangerous movement	
	4.2.9 Preventing access across the load entry/exit points to the restricted area	
	4.2.10 Requirements for separating plates, nets, mats and roof type profiles	
	4.11 Provisions for maintenance	
	4.20.1 Vertical switch conveyors	
	4.20.3 Nip points on belt driven roller conveyors	
	4.20.9.3 Transfer cars with guards	
	4.20.9.4 Transfer cars without separation	
	4.20.9.5 Transfer cars without separation in restricted areas	
	4.20.9.6 Transfer cars with onboard operator	
	4.20.11 Vertical transfer devices	
	4.20.12 Horizontal transfer device	
	4.20.13 Sorters	

The relevant Essential Requirements of Directive 2006/42/EC	Clause(s)/subclause(s) of this EN	Remarks/Notes
1.3.8	4.2 Protection against mechanical hazards 4.20.2 Crushing and shearing points between conveyors and conveyed unit loads 4.20.4 Plate conveyors 4.20.5 Underfloor chain conveyors 4.20.8 Overhead conveyors 4.20.9 Transfer cars 4.20.11 Vertical transfer devices 4.20.14 Conveyors in public areas of airports	
1.3.9	4.2.3 Measures for protection against unintended movement 4.10.2 Cross over passageways 4.20.8.4.3 Inadvertent motion at working places under, on or at overhead conveyors	
1.4.1	4.2.1.1 General requirements for guards and sensitive protective devices	
1.4.2.1	4.2.1.1.1 Guards	
1.4.2.2	4.2.1.1.2 Interlocking devices associated with movable guards	
1.4.3	4.2.1.1.2 Interlocking devices associated with movable guards 4.2.1.1.3 Sensitive protective devices	
1.5.1		Not covered

The relevant Essential Requirements of Directive 2006/42/EC	Clause(s)/subclause(s) of this EN	Remarks/Notes
1.5.2	4.5 Electrostatic charges	
1.5.3	4.6 Hydraulic and pneumatic systems and equipment	
1.5.4	6.2.5 Marking of couplings in hydraulic or pneumatic systems	
1.5.5	4.8 Protection against thermal hazards	
	4.11.1 Work at machines with open guards	
1.5.8	4.9 Noise reduction at design stage	
	Annex E Noise test code	
1.5.14		Not covered
1.5.15	4.10.2 Cross over passageways	
	4.20.6.3 Telescopic conveyors with platforms	
	4.20.8.4.4 Working on overhead conveyors or on the load in assembly lines	
	4.20.9.3.3 Transfer cars with short distance picking places	
	4.20.11.1 Access to vertical transfer device	
	4.20.11.10 Vertical transfer device where riding on the lifting carriage is intended	
	4.20.13.3 Safety measures for the use of service vehicles for loop-sorters	
	4.20.13.4 Chutes at sorters	

The relevant Essential Requirements of Directive 2006/42/EC	Clause(s)/subclause(s) of this EN	Remarks/Notes
1.6.1	4.11.1 Work at machines with open guards	
	4.20.7 Rail bound conveyors	
	4.20.8.10 Maintenance vehicles for overhead conveyors	
	4.20.8.11 Maintenance requirements for self-propelled overhead conveyors	
	4.20.10 Destination Coded Vehicle – systems and rail-guided floor track conveyors	
	4.20.11.4 Safety clearances in vertical transfer devices	
	4.20.12.1 Turntable (turning the conveyor)	
1.6.2	4.10 Means of access	
	4.20.13.4 Chutes at sorters	
1.6.3	4.7 Measures for isolation and energy dissipation	
	4.20.8.11 Maintenance requirements for self-propelled overhead conveyors	
1.6.4	4.10 Means of access	
	4.20.1 Vertical switch conveyors	
1.7.1		Not covered
1.7.2	6.2.8 Signs at conveying systems	
1.7.3	6.2.1 Rating plate	
1.7.4	6.1 Instruction handbook	

The relevant Essential Requirements of Directive 2006/42/EC	Clause(s)/subclause(s) of this EN	Remarks/Notes
3.2	4.20.6 Telescopic conveyors (boom conveyors)	
	4.20.8.10 Maintenance vehicles for overhead conveyors	
	4.20.9.6 Transfer cars with onboard operator	
3.3.1	4.20.9.6 Transfer cars with onboard operator	
3.3.2	4.20.9.6 Transfer cars with onboard operator	
	4.20.8.10 Maintenance vehicles for overhead conveyors	
3.4.1	4.2.5 Stability against overturning for mobile conveyors	
	4.20.6 Telescopic conveyors (boom conveyors)	
3.6		Not covered
4.1.2.1		Not covered
4.1.2.2		Not covered
4.1.2.3		Not covered
4.1.2.4	4.2.4.2 Strength of ropes, chains and belts for lifting purposes	
	4.20.8.4.2 Lifting elements in case of working places under, on or at overhead conveyors	
4.1.2.5		Not covered

The relevant Essential Requirements of Directive 2006/42/EC	Clause(s)/subclause(s) of this EN	Remarks/Notes
6.1.1	4.2.4.1 Strength of non-fixed load lifting attachments	
	4.2.4.2 Strength of ropes, chains and belts for lifting purposes	
	4.20.8.4.2 Lifting elements in case of working places under, on or at overhead conveyors	
6.2	4.20.6 Telescopic conveyors	
	4.20.8.10 Maintenance vehicles for overhead conveyors	
	4.20.11.10 Vertical transfer device where riding on the lifting carriage is intended	
	4.20.13 Sorters	

WARNING 1 — Presumption of conformity stays valid only as long as a reference to this European Standard is maintained in the list published in the Official Journal of the European Union. Users of this standard should consult frequently the latest list published in the Official Journal of the European Union.

WARNING 2 — Other Union legislation may be applicable to the products falling within the scope of this standard.

Bibliography

- [1] EN 81-3:2000+A1:2008,⁵ *Safety rules for the construction and installation of lifts — Part 3: Electric and hydraulic service lifts*
- [2] EN 12195-1:2010,⁶ *Load restraining on road vehicles — Safety — Part 1: Calculation of securing forces*
- [3] ISO 3864-1:2011, *Graphical symbols — Safety colours and safety signs — Part 1: Design principles for safety signs and safety markings*
- [4] IEC/TS 60079-32-1:2013+A1:2017, *Explosive atmospheres — Part 32-1: Electrostatic hazards, guidance*
- [5] ISO/TS 15066:2016, *Robots and robotic devices — Collaborative robots*
- [6] EN ISO 11200:2014,⁷ *Acoustics — Noise emitted by machinery and equipment — Guidelines for the use of basic standards for the determination of emission sound pressure levels at a work station and at other specified positions (ISO 11200:2014)*

⁵ As impacted by EN 81-3:2000+A1:2008/AC:2009.

⁶ As impacted by EN 12195-1:2010/AC:2014.

⁷ As impacted by EN ISO 11200:2014+A1:2020.

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