



BSI Standards Publication

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

National foreword

This British Standard is the UK implementation of EN 619:2022. It supersedes BS EN 619:2002+A1:2010, which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee MHE/9, Continuous mechanical handling equipment.

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

It is the view of the UK committee that the scope of BS EN 619:2022 - specifically the generalisation over machinery elements attached to or integrated within the conveyor system is not adequately covered in the standard in order to remain compliant with Supply of Machinery (Safety) Regulations 2008. The committee recommends that where a specific type C designated standard is available for the machine, then that specific standard should be applied, otherwise the manufacturer must separately demonstrate how compliance with all relevant essential health and safety requirements have been achieved, including the overall integration.

As the committee has remaining concerns over the technical suitability of BS EN 619:2022 with respect to “transfer cars” where used in the corrugated board manufacturing processes, manufacturers must assess safety risks from first principles to comply with the Essential Health and Safety Requirements of the Supply of Machinery (Safety) Regulations 2008 and to ensure correct integration with feed and discharge conveyors, whilst work on a specific Publicly Available Specification (PAS) is undertaken.

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For the Great Britain market (England, Scotland and Wales), if UK Government has designated this publication for conformity with UKCA marking (or similar) legislation, it may contain an additional National Annex. Where such a National Annex exists, it shows the correlation between this publication and the relevant UK legislation. If there is no National Annex of this kind, the relevant Annex ZA or ZZ in the body

of the European text will indicate the relationship to UK regulation applicable in Great Britain. References to EU legislation may need to be read in accordance with the UK designation and the applicable UK law. Further information on designated standards can be found at www.bsigroup.com/standardsandregulation.

For the Northern Ireland market, UK law will continue to implement relevant EU law subject to periodic confirmation. Therefore Annex ZA/ZZ in the European text, and references to EU legislation, are still valid for this market.

UK Government is responsible for legislation. For information on legislation and policies relating to that legislation, consult the relevant pages of www.gov.uk.

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Date	Text affected
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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.

CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration. Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the CEN-CENELEC Management Centre or to any CEN member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the CEN-CENELEC Management Centre has the same status as the official versions.

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

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European foreword

This document (EN 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 Optoelectronic Protective Device (e.g. light barriers)
AOPDDR	Active Optoelectronic 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.

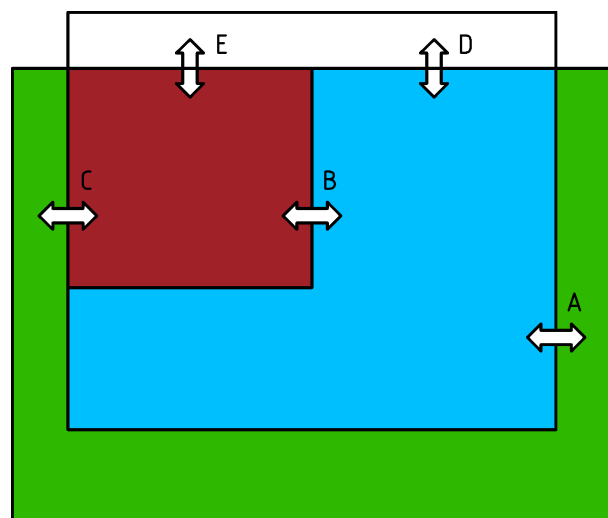
ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- 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 m × 0,14 m and 0,2 m × 0,2 m. This net or mat shall be capable of bearing a load of 100 kg applied on an area of 0,1 m × 0,25 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:

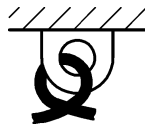


Figure 2 — Tie down point

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) carrousel (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 derailling 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 derailling 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 derailling 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 m × 0,6 m × 1,0 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 m/s²;
- where an end buffer is installed the maximum deceleration shall not exceed 4,0 m/s² 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 × 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