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Ontw.

Nederlandse norm

NEN-EN 619 (en)

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

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Nederlands voorwoord

Voor de in deze norm vermelde normatieve verwijzingen bestaan in Nederland de volgende equivalenten:

vermelde norm	Nederlandse norm	titel
EN 81-3	NEN-EN 81-3	Veiligheidsregels voor het vervaardigen en het aanbrengen van liften - Deel 3: Elektrische en hydraulische klein-goederenliften (en,nl)
EN 292-1	NEN-EN 292-1	Veiligheid van machines - Basisbegrippen, algemene ontwerpbeginselen - Deel 1: Basisterminologie, methodologie (en,nl)
EN 292-2	NEN-EN 292-2	Veiligheid van machines - Basisbegrippen, algemene ontwerpbeginselen - Deel 2: Technische beginselen en beschrijvingen (en,nl)
EN 294	NEN-EN 294	Veiligheid van machines - Veiligheidsafstanden ter voorkoming van het bereiken van gevaarlijke zones met de bovenste ledematen (en,nl)
EN 341	NEN-EN 341	Persoonlijke beschermingsmiddelen tegen vallen - Afdalingsmaterieel (en)
EN 349	NEN-EN 349	Veiligheid van machines - Minimumafstanden ter voorkoming van het bekneld raken van menselijke lichaamsdelen (en,nl)
EN 418	NEN-EN 418	Veiligheid van machines - Noodstopvoorzieningen, functionele aspecten - Ontwerpbeginselen (en,nl)
EN 457	NEN-EN 457	Veiligheid van machines - Akoestische gevaarsignalen - Algemene eisen, ontwerpen en beproevingen (en)
EN 563	NEN-EN 563	Veiligheid van machines - Temperaturen van aan te raken oppervlakken - Ergonomische gegevens om temperatuurgrenswaarden voor hete oppervlakken vast te stellen. (inclusief correctieblad C1:1994) (en,nl)
EN 614-1	NEN-EN 614-1	Veiligheid van machines - Ergonomische ontwerpprincipes - Deel 1: Terminologie en algemene principes (en,nl)
EN 626-1	NEN-EN 626-1	Veiligheid van machines - Verlaging van de gezondheidsrisico's ten gevolge van gevaarlijke stoffen, afkomstig van machines - Deel 1: Grondbeginselen en specificaties voor fabrikanten van machines (en,nl)
EN 795:1996	NEN-EN 795:1996	Persoonlijke beschermingsmiddelen tegen vallen - Verankeringsvoorzieningen - Eisen en beproeving (en,nl)
EN 842	NEN-EN 842	Veiligheid van machines - Visuele gevaarsignalen - Algemene eisen, ontwerpprincipes en beproevingsmethoden (en,nl)
EN 953:1997	NEN-EN 953:1998	Veiligheid van machines - Afschermingen - Algemene eisen voor het ontwerp en de constructie van vaste en beweegbare afschermingen (en,nl)
EN 954-1	NEN-EN 954-1	Veiligheid van machines - Onderdelen van besturingssystemen met een veiligheidsfunctie - Deel 1: Algemene ontwerpbeginselen (en)
EN 982:1996	NEN-EN 982:1996	Veiligheid van machines - Veiligheidseisen voor hydraulische en pneumatische systemen en hun componenten - Hydrauliek (en,nl)
EN 983:1996	NEN-EN 983:1997	Veiligheid van machines - Veiligheidseisen voor hydraulische en pneumatische systemen en hun onderdelen - Pneumatiek (en,nl)
EN 1037	NEN-EN 1037	Veiligheid van machines - Voorkoming van onbedoeld starten (en)
EN 1050	NEN-EN 1050	Veiligheid van machines - Principes voor de risicobeoordeling (en,nl)

EN 1070	NEN-EN 1070	Veiligheid van machines - Termen en definities (en,fr,de)
EN 1088:1995	NEN-EN 1088:1996	Veiligheid van machines - Blokkeerinrichtingen gekoppeld aan afschermingen - Grondbeginselen voor het ontwerp en de keuze (en)
EN 1760-1	NEN-EN 1760-1	Veiligheid van machines - Drukgevoelige beschermingsvoorzieningen - Deel 1: Algemene principes voor het ontwerp en beproeving van drukgevoelige matten en vloeren (en)
EN ISO 14122-2:2001	NEN-EN-ISO 14122-2:2001	Veiligheid van machines - Permanente toegangsmiddelen tot machines - Deel 2: Werkbordessen en looppaden (en,nl)
EN ISO 14122-3:2001	NEN-EN-ISO 14122-3:2001	Veiligheid van machines - Permanente toegangsmiddelen tot machines - Deel 3: Trappen, trapladders en leuningen (en,nl)
prEN 13557:1999	NEN-EN 13557:1999 Ontw.	Hijskranen - Bedieningsorganen en bedieningsplaatsen (en)
EN 50081-1	-	-
EN 61000-6-2:1999	-	-
EN 60204-1:1997	NEN-EN-IEC 60204-1:2001	Veiligheid van machines - Elektrische uitrusting van machines - Deel 1: Algemene eisen (en,nl)
EN 60204-11:1998	-	-
EN 60529:1999/A1:2000	-	-
EN 61310-1	NEN-EN 61310-1	Veiligheid van machines - Signalering, aanduidingen en bediening - Deel 1: Eisen aan zichtbare, hoorbare en voelbare signalen (nl)
prEN 61496-2:1997	-	-
ISO/DIS 3864-1:1999	-	-
ISO 4309	-	-

EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

EN 619

October 2002

ICS 33.100.01; 53.040.10

English version

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

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

Stetigförderer und Systeme - Sicherheits- und EMV-Anforderungen an mechanische Fördereinrichtungen für Stückgut

This European Standard was approved by CEN on 8 March 2001.

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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 Management Centre has the same status as the official versions.

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Contents

Foreword

This document (EN 619:2002) has been prepared by Technical Committee CEN/TC 148, "Continuous handling equipment and systems" the secretariat of which is held by AFNOR.

This document has to be implemented at national level, either by publication of an identical text or by endorsement, by April 2003, and conflicting national standards have to be withdrawn by April 2003.

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

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

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this document: Austria, Belgium, the Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Malta, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and the United Kingdom.

This draft standard forms part of a series of five draft 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 and EMC requirements for equipment for mechanical handling of unit loads" ;*

— *EN 620 "Continuous handling equipment and systems - Safety and EMC 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 A, B, C, D, E, F and H are normative, the annexes G, ZA and ZB are informative.

Introduction

This European Standard is a type C standard as stated in EN 1070.

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

While producing this standard it was assumed that :

— only competent persons operate the machine ;

— components without specific requirements are :

  a) designed in accordance with the usual engineering practice and calculation codes, including all failure modes ;

  b) of sound mechanical and electrical construction ;

  c) made of materials with adequate strength and of suitable quality ;

  d) made of materials free of defects ;

— harmful materials, such as asbestos are not used as part of the machine ;

— components are kept in good repair and working order, so that the required characteristics remain despite wear ;

— by design of the load bearing elements, a safe operation of the machine is assured for loading ranging from zero to 100 % of the rated possibilities and during the tests ;

— dialogue has taken place between the user and the supplier concerning the conditions for the use and places of use of the machinery ;

— the working area is adequately lit ;

— the places of installation allow a safe use of the machine.

1 Scope

1.1 This European standard deals with the technical requirements to minimise the hazards listed in clause 4 and annex B. 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 authorised representative. This standard deals with safety related technical verification during commissioning.

1.2 This standard applies to mechanical handling devices 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.

1.3 Safety requirements and/or measures in this standard 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, specially brittle loads, explosives) operation on ships and earthquake effects and also contact with foodstuff. Hazards during decommissioning are not covered.

1.4 This European Standard deals with the technical requirements for electromagnetic compatibility (EMC).

1.5 This standard does not cover hazards during decommissioning and hazards generated by noise. It also does not cover operation in environments where the electromagnetic disturbances are outside the range of those specified in EN 61000-6-2.

This standard does not apply to conveying equipment and systems used underground or in public areas and to aircraft ground support equipment.

NOTE 1 Aircraft ground support equipment is covered by the standards of CEN/TC 247.

NOTE 2 Conveying equipment and systems used in public areas will be covered in an amendment.

NOTE 3 Hazards generated by noise will be dealt with in an amendment.

2 Normative references

This European Standard incorporates by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this European Standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies (including amendments).

EN 81-3, *Safety rules for the construction and installation of lifts - Part 3: Electric and hydraulic service lifts.*

EN 292-1:1991, *Safety of machinery - Basic concepts, general principles for design - Part 1 : Basic terminology, methodology*.

EN 292-2:1991, *Safety of machinery - Basic concepts, general principles for design - Part 2 : Technical principles and specifications*.

EN 294:1992, *Safety of machinery - Safety distances to prevent danger zones being reached by the upper limbs*.

EN 341, *Personal protective equipment against falls from a height - Descender devices*.

EN 349:1993, *Safety of machinery - Minimum gaps to avoid crushing of parts of the human body*.

EN 418:1992, *Safety of machinery - Emergency stop equipment - functional aspects - Principles for design*.

EN 457, *Safety of machinery - Auditory danger signals - General requirements, design and testing* (ISO 7731 :1986 modified).

EN 563, *Safety of machinery -Temperatures of touchable surfaces - Ergonomics data to establish temperature limit values for hot surfaces*.

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

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

EN 795:1996, *Protection against falls from a height – Anchor devices – Requirements and testing*.

EN 842*, Safety of machinery - Visual danger signals - General requirements, design and testing*.

EN 953:1997, *Safety of machinery - Guards - General requirements for the design and construction of fixed and movable guards*.

EN 954-1, *Safety of machinery - Safety related parts of control systems : Part 1 : General principles for design.*

EN 982:1996, *Safety of machinery -Safety requirements for fluid power systems and their components – Hydraulics*.

EN 983:1996, *Safety of machinery -Safety requirements for fluid power systems and their components – Pneumatics*.

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

EN 1050, Safety of machinery – Principles for risk assessment.

EN 1070, Safety of machinery, Terminology

EN 1088:1995, *Safety of machinery - Interlocking devices associated with guards -Principles for design and selection*.

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

EN ISO 14122-2:2001, *Safety of machinery - Permanent means of access to machines and industrial plants - Part 2 : Working platforms and walkways (ISO 14122-2:2001)*.

EN ISO 14122-3:2001, *Safety of machinery - Permanent means of access to machines and industrial plants - Part 3 : Stairways, stepladders and guard-rails (ISO 14122-3:2001)*.

prEN 13557: 1999, Cranes - Controls and control stations

EN 50081-1, *Electromagnetic compatibility - Generic emission standard - Part 1 : Residential, commercial and light industry*.

EN 61000-6-2:1999, *Electromagnetic compatibility (EMC) - Part 6-2: Generic standards - Immunitiy for industrial environments.*

EN 60204-1:1997, *Safety of machinery - Electrical equipment of machines - Part 1 : General requirements* (IEC 60204-1:1997 + prA1 1998).

EN 60204-11:1998, *Safety of machinery - Electrical equipment of machines - Part 11: General requirements for voltages above 1000 V a.c. or 1500 V d.c. and not exceeding 36 kV.*

EN 60529: 1999, *Degrees of protection provided by enclosures (IEC 60529: 1989/A1: 1999)*
A1: 2000

EN 61310-1, *Safety of machinery - Indication, marking and actuation - Part 1 : Requirements for visual, auditory and tactile signals* (IEC 61310-1:1995).

prEN 61496-2:1997, *Safety of machinery - Electrosensitive protective equipment - Part 2 : Particular requirements for equipment using active optoelectronic protective devices*.

ISO/DIS 3864-1:1999, *Safety colours and safety signs – Part 1 Safety signs in workplaces and public areas – Design principles*.

ISO 4309, *Cranes - wire ropes - code of practice for examination and discard*.

NOTE Specific references may be added to this standard after the EN B-standards are completed.

3 Terms and definitions

For the purposes of this standard the terms and definitions in EN 1070 and the following terms and definitions apply:

3.1
working area
area, as intended by the manufacturer, where persons work at or operate conveyors under normal conditions (inspection, maintenance and cleaning are excluded)

NOTE For manufacturers information relating to intended use see Introduction “dialogue”.

3.2
traffic area
area, as intended by the manufacturer, which is accessible to or reachable by all persons without opening a guard, activating a trip device or using additional means

NOTE For manufacturers information relating to intended use see Introduction “dialogue”.

3.3
transport area
area or space required by the moving element of a conveyor and its load

NOTE For manufacturers information relating to intended use see Introduction “dialogue”.

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 Traction elements can also be carrying elements, e.g. the chain of a drag chain conveyor.

3.5
carrying element
parts of a conveyor which carry the loads

NOTE Carrying elements can also be traction elements, e.g. the chain of a drag chain conveyor.

3.6
belt conveyor
conveyor with an endless belt acting as a carrying and traction element. The belt is supported by rollers or slides on a surface (Figure A.1)

3.7
chain conveyor
conveyor with single or multiple strand, endless chains

3.7.1
drag chain conveyor
conveyor with chains as traction or carrying elements (Figure A.2), possibly with pushers attached to the chains

3.7.2
plate or link conveyor
conveyor with chains as traction elements and rods, battens, plates, or troughs as carrying elements for holding loads (Figure A.3)

3.8
single strand drag chain conveyor
conveyor with a single strand chain or wire rope in a duct beneath or above the ground as a traction element directly connected with transport cars (Figure A.4)

3.9
overhead conveyor
conveyor in which carrying elements are hanging on overhead tracks and are attached e.g. directly to either the traction chains or ropes or to separate trolleys powered by chain driven pusher dogs (Figure A.5)

3.10
swing tray, fixed tray and similar conveyors
conveyor in which the carrying element is attached with one or more chain strands that run in parallel as traction elements (Figure A.6)

3.11
roller conveyor, wheel conveyor and ball transfer table
conveyor in which some or all of the rollers, wheels or balls are driven (Figure A.8) or can rotate freely (Figure A.7)

3.12
self-propelled overhead conveyor
overhead conveyor with individually driven carrying elements (Figure A.9)

3.13
transfer car
mechanically guided car for transferring unit loads which is taken from a conveyor, pushed laterally and delivered to another conveyor or to another device (Figure A.10).

3.14
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 carrying element (Figure A.11)

NOTE These are not to be considered as goods lifts according to EN 81-3.

3.15
horizontal transfer device
permanently installed unit in the path of conveyors which diverts the unit loads at the same conveying level in a direction deviating from the original conveying direction e.g. turntable (Figure A.12)

3.16
competent 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

4 Hazards

The most important hazards are given in this clause. For a full list of hazards see annex B.

NOTE The hazards described below usually occur in conveyor installations in combination, e.g. crushing, shearing and drawing-in points in the case of conveyors with pusher dogs.

4.1 Mechanical hazards

Common examples of mechanical hazards are shown in annex C.

4.1.1 Crushing and shearing hazards

Hazards may occur where parts can be moved against one another or against fixed parts or past one another or past other fixed parts so that persons or parts of their bodies can be crushed or sheared (e.g. Figure C1 and C2).

4.1.2 Entanglement hazards

Hazards may occur where projecting sharp edges, teeth, wedges, screws, lubricating nipples, shafts, shaft ends or the like move so that persons, parts of their bodies or their clothing can be caught and carried along.

4.1.3 Drawing-in hazards

Hazards may occur where parts move so that a constriction is formed in which persons, parts of their bodies or their clothing can be drawn in.

Examples of drawing in points are as follows :

— between the traction or carrying elements or attached pushers and fixed parts of the conveyor or of the surroundings (e.g. Figure C4 and C5) ;

— at the traction or carrying elements in the area of direction changing points ;

— between the traction or carrying elements and supporting rollers, if the traction or carrying element cannot deviate by at least 0,05 m upwards (e.g. Figure C3a);

— at contact points of pushers on slide ways ;

— at transfer points of conveyors as well as at chutes, roller and gravity tables (e.g. Figure C3b and C3c).

4.1.4 Impact hazards

Hazards may occur where parts move in relation to persons so that injury of persons or parts of their bodies is caused by impact (e.g. Figure C6).

4.1.5 Falling objects

Hazards may occur as a result of falling of the machine or parts of the machine or unit loads.

4.1.6 Slip, trip and fall hazards

Hazards may occur e.g. depending on design of gangway and platforms.

4.2 Electrical hazards

Electrical hazards may arise e.g. from :

— direct or indirect contact with live parts as a result of damage to insulation ;

— from electrostatic charging (due to the nature of the material) ;

— incorrect isolation switching of the supply to the system or individual sections and as a result of material or moisture ingress into electrical systems.

4.3 Hazards due to thermal influences

4.3.1 Thermal hazards may arise from touching heat sources.

4.3.2 Health-damaging effects may result from a hot or cold working environment.

4.4 Hazards due to neglecting ergonomic principles in machine design

Hazards may arise e.g. from :

— poor design of control devices and working places ;

— overstress of personnel with regard to speed and effort.

4.5 Hazards caused by failure of energy supply, breaking down of machinery parts or other functional disorders

4.5.1 Hazards can occur in the case of failure of energy supply if conveyors or loads reverse or fall back unintentionally. If rollers break on a self propelled overhead conveyor, the trolley can derail.

4.5.2 Hazards due to component failure may occur e.g. breakage of roller on a self propelled overhead conveyor which can cause the trolley to fall.

4.5.3 Hazards may arise as a result of unexpected ejection of machine parts or fluids e.g. failure of hydraulic or pneumatic components.

4.5.4 On large installations, hazards, e.g. hydraulic, pneumatic, electrical, mechanical, may arise due to incorrect assembly on site as a result of inadequate erection or assembly instructions.

5 Safety requirements and/or measures

Machinery shall comply with the safety requirements and/or measures of this clause and in addition with EN 292-1 and EN 292-2 for hazards relevant but not significant which are not dealt with in this standard.

Where for safety reasons areas containing continuous handling equipment are completely enclosed, entrance into this area shall only be possible via interlock gates. This interlock shall give a stop command when actuated. Restarting of the equipment shall only be under control of those persons utilising a key dependence system.

When stopping occurs by e.g. tripping of safety devices, buffers, end stops, the stopping distance shall be as short as possible but compatible with the safety of the system.

5.1 Measures for protection against mechanical hazards

5.1.1 Measures for protection against crushing and shearing hazards

5.1.1.1 General

In the working and traffic area danger zones between powered and fixed components of horizontal or vertical transfer points, feed points, diverting points, horizontal and vertical transfer devices and gates shall be safeguarded. This shall be achieved e.g. by providing a continuous maximum gap of 5 mm between moving and fixed components (see Figure D.1).

Alternatively, the danger zones shall be safeguarded e.g. by fences (wire mesh in accordance with EN 294), interlocking doors or gates or trip devices (photo electric devices, pressure sensitive mats). If the load creates a danger zone, its most unfavourable position shall be taken into account.

See EN 1088, EN 1760-1 and prEN 61496-2:1997.

NOTE See also EN 953.

5.1.1.2 Enclosed units

Loading and unloading openings of enclosed units shall be designed in such a way that they prevent access to danger areas. If they are not, danger areas shall be safeguarded by inlet or outlet tunnel guards or interlocking guards as defined in 3.2 of EN 1088:1995. If the load creates a danger zone its most unfavourable position shall be

taken into account. Tunnel guards shall be dimensioned using EN 294 for guidance. An example of protective devices at loading and unloading openings is shown in Figure D.2.

5.1.1.3 Lateral safety distances for conveyors

In the working and traffic area danger zones (as identified by risk assessment) between conveyed loads and fixed adjacent objects shall be avoided by minimum gaps in accordance with Table 1 of EN 349:1993 or shall be safeguarded e.g. by trip devices.

5.1.1.4 Lateral safety distances for all overhead conveyors

In the working and traffic areas, a lateral minimum gap of 0,5 m up to a height 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 D.3).

5.1.1.5 Specific lateral safety distances for self-propelled overhead conveyors

Outside the working and traffic area, a continuous safety space in which persons can find protection from approaching vehicles shall be present at least on one side next to each transport area of rail-mounted overhead conveyors. The safety space shall be at least 2,5 m high and 0,5 m wide (see Figure D.3).

Fixed obstructions in the safety space of a self-propelled overhead conveyor with a maximum speed of 1,0 m/s are permitted if safety spaces of at least 1 m long by 2,5 m high by 0,5 m depth are located at maximum intervals of 10 m (see Figure D.4).

5.1.1.6 Safety distances under self-propelled overhead conveyors

The following safety distances shall be maintained under self-propelled overhead conveyors, including the suspended conveyed materials, in the working and traffic area down to the floor or up to fixed objects :

— at least 0,12 m between the ground and mobile units in the working and traffic area (see Figure D.5) ;

— at least 0,5 m, above parts of structures or machines and above other traffic and transport means which move under self-propelled overhead conveyors where persons can be injured by crushing hazards (see Figure D.6) ;

— at least 2,5 m above permanent work places and traffic routes for persons (see Figure D.6) provided no other safety measures are taken, e.g. underguarding with a minimum height of 2,1 m.

5.1.1.7 Safety distances between mobile units of self-propelled overhead conveyors

In working and traffic areas the carrying elements of self-propelled overhead conveyors shall be stopped so as to leave a clearance in the direction of travel between two mobile units and/or their loads of at least 0,5 m up to a height of 2,5 m above the floor of the working level of the personnel (see Figure D.5). Swinging of the mobile units shall be taken into account.

Where these safety conditions are not achieved e.g. incline/decline areas of overhead conveyors then guarding, e.g. handrail, fences, etc shall be provided according to Table 4 of EN 294:1992.

5.1.1.8 Prevention of access beneath vertical transfer devices

Vertical transfer devices capable of being lowered to a height of less than 2,5 m shall be provided with means of preventing access of persons to the area beneath the carrying elements and/or their loads. This may be achieved e.g. by the provision of an interlocked door or guard.

5.1.1.9 Safety clearances in vertical transfer devices

For maintenance purposes above the lifting element of a vertical transfer device, a clear volume of 0,5 m x 0,6 m x 0,8 m high shall be provided by construction or ensured by a built-in blocking device. For maintenance purposes below, these dimensions shall be 0,5 m x 0,6 m x 1,0 m high. If the accessible volume is less than the dimensions above all maintainable components shall be reachable from the outside.

5.1.2 Measures for protection against entanglement hazards

Fixed guards as defined in 3.2 of EN 953:1997 shall be provided to prevent reaching entanglement danger zones.

5.1.3 Measures for protection against drawing-in hazards

5.1.3.1 Danger zones at transmission parts

In working and traffic areas, safeguards for hazards arising at rotating shafts and couplings, chains and chain wheels, gears and power transmissions, belts, pulleys and rough moving surfaces shall be made by means of fixed guards or interlocking guards and in accordance with the requirements of EN 294:1992, Table 4, EN 1088:1995, 3.2 and as defined in EN 953.

5.1.3.2 Drawing-in points at traction and carrying elements or pushing elements

In the working and traffic area drawing-in points, crushing and shearing points which arise because of the return of the traction and carrying elements or because of the movement of the pushing elements shall be avoided by design or safeguarded up to a height of at least 2,5 m.

Hazards are considered to be avoided by design if :

— a safety distance of at least 0,05 m is maintained where there is a risk of fingers and hands being caught ;

— a safety distance of at least 0,12 m is maintained where there is a risk of arms or feet being caught ;

— a safety distance of 0,5 m is maintained where there is a risk of bodies being caught.

Drawing-in points shall be guarded e.g. by the use of :

— nip guards directly at the drawing-in point which shall have a gap of 5 mm at the most (see Figure D.7) ;

— plate guards directly below the tracks of pushers (see Figure D.8) ;

— other measures e.g. guards, such as covers, fences, barriers, tunnels or trip devices such as pressure sensitive mats, photo electric devices. Safety distances shall be in accordance with EN 294:1992, Table 1.

5.1.3.3 Diverting points of traction elements

In the working and traffic area drums, wheels and rollers on which the traction elements are diverted by more than 3° and sprockets shall be protected by nip guards or fixed distance guards (see Figures D.7 and D.9).

5.1.3.4 Danger zones between drag chain conveyors and conveyed unit loads

In the working area, danger zones (see Figure C.2b) between conveyed unit loads and fixed parts between the chains of drag chain conveyors shall be safeguarded e.g. by complete panelling of the area above cross beams close below the transport level.

5.1.3.5 Wheels or rollers of tow carts

In the working and traffic areas wheels or rollers of tow carts moved by conveyors shall be arranged or protected so that foot injuries are prevented. Tow carts shall be designed in such a way that the measures are in accordance with those given in Figure D.10. If the drawing-in hazard extends to the full width of the tow cart the protection shall cover this width.

5.1.3.6 Rollers of overhead conveyors

In working and traffic areas rollers moving in tracks at a height less than 2,5 m above the ground shall be protected e.g. by wheel guards or other guards (see Figure D.11).

5.1.3.7 Contact points on driven roller conveyors

In the working and traffic area contact points between the drive element and driven rollers or pressure rollers area on driven roller conveyors shall be safeguarded by fixed guards (see Figure D.12). For a free space between rollers of less than 8 mm safeguarding is not required on the topside.

5.1.3.8 Drawing-in points on driven roller conveyors

In the working and traffic area drawing-in points at belt, sprocket or chain drives of driven roller conveyors shall be safeguarded by fixed guards (see Figure D.13).

5.1.3.9 Danger zones between roller conveyors and conveyed unit loads

In the working area danger zones 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 of 5 mm at the most remains (see Figure D.14).

5.1.3.10 Drawing in points at supporting rollers

Drawing in points between carrying and traction elements and supporting rollers of belt conveyors shall be safeguarded if the carrying and traction elements cannot be deflected by at least 0,05 m upwards.

Supporting rollers of belt conveyors at working areas, e.g. picking stations, shall be covered completely.

5.1.4 Measures for protection against striking/collision hazards

5.1.4.1 Cross over passageways

In working and traffic areas it shall be ensured that persons crossing conveyors are not endangered by the moving conveyed loads.

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. One or more safety measures shall be provided as appropriate, e.g. :

— cross over with infill plates ;

— bridge ;

— trip devices e.g. opto-electronic devices (see prEN 61496-2:1997) or pressure sensing mats (EN 1760-1) ;

— interlocking guards ;

— stop/start devices.

In any event, it shall be ensured that machinery can only be restarted by the voluntary actuation of a control provided for this purpose.

5.1.4.2 Prevention of access to danger zones

Access to specific danger zones which may arise by conveying elements such as transfer cars or vertical transfer devices shall be prevented (see 5.1.1.1 and 5.1.4.6). Where it is foreseeable that conveyor load entry/exit points may be misused to gain access to danger zones, access shall be prevented or deterred in accordance with a risk assessment.

Appropriate safeguarding measures shall be provided (see annex F).

5.1.4.3 Crossings of fixed track conveyors and other means of transportation

If there is a risk of collision between power driven fixed track conveyors such as transfer cars or self propelled overhead conveyors and other devices of the system at crossings, measures which counteract the risk of collision shall be provided :

— in the case of transfer cars with automatic control or controlled from a central position, crossings in the transport area shall be provided with automatic cut-off or barriers ;

— on the case of self propelled overhead conveyors at crossings in transport areas, devices shall be provided which prevent simultaneous driving over the crossing such as signal devices for mutual communication or control devices for stopping the driving mechanisms.

5.1.4.4 Path of mobile conveyors or tow carts

If the path of power driven mechanically guided, mobile conveyors or tow carts connected to traction elements is arranged in the working and traffic areas, there shall be devices which protect persons against the dangers caused by approaching mobile units. Such protective devices are, for instance :

— automatically acting trip devices which stop the mobile unit when an obstruction is encountered or approached ;

— mechanical device which separates the cart from the traction element in case of collision.

5.1.4.5 Crossings of self-propelled overhead conveyors and traffic areas

In the working and traffic area a lateral safety distance of at least 1,0 m shall be maintained for self-propelled overhead conveyors when the transport area passes by doors, gates, passages or stairway exits.

5.1.4.6 Transport area of transfer cars

The transport area of power driven transfer cars shall be separated from working and traffic areas by fencing at least 2,0 m high and/or other means e.g. trip devices to prevent personnel from entering the danger areas or to be endangered by the movement of the transfer cars. For prevention of access through or on conveyors leading to these areas see 5.1.4.2.

Opening of access doors shall be interlocked with all dangerous movements of the machine.

If separation of the transport area from working and traffic areas is not possible, safety measures shall be provided on transfer cars and connected conveyors preventing persons from being injured, e.g. :

— for transfer cars, trip devices, either mechanically actuated (e.g. extended sensors or extended suspended flaps or bumpers) or non-mechanically actuated (e.g. ultrasonic or laser equipment) ;

— interfaceing conveyors, deterring devices or continuous frontal guards parallel to the travel of the car.

For examples of such protective measures see Figure D.17.

5.1.5 Measures for protection against hazards due to falling objects

5.1.5.1 Measures for protection against falling of the equipment or parts of it

5.1.5.1.1 Falling of load holding devices or counterweights

In the working and traffic area measures shall be provided to protect persons against falling of load holding devices, take up devices or counterweights. Possible measures are :

— guards preventing access to the area beneath the load holding device, take up device or counterweight ;

— safety gear or mechanical stops which guarantee a vertical clearance of at least 2,5 m.

5.1.5.1.2 Parts which can be hinged

Parts of conveyors which can be hinged 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.

5.1.5.1.3 End stops on conveyors

At any end of tracks and rails end stops shall be fitted taking energy into account. For those line sections in which maintenance work has to be performed on carrying elements, manually operated end stops shall be provided.

5.1.5.1.4 Dropping and/or derailing of rail guided conveyors

Rail guided conveyors such as transfer cars, selfpropelled overhead conveyors and overhead conveyors shall be provided with measures against derailing and/or dropping. Measures may be :

— supporting devices (e.g. in case the axles of rollers become insufficient) ;

— designs of rails.

5.1.5.1.5 Loosening of trolleys

The unintended loosening of trolley couplings or suspension gear shall be prevented (e.g. by fasteners protected by lock nuts or taper pins).

5.1.5.1.6 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 trolleys. Measures may be :

— appropriate electrical interlocking systems complying with category 1 of EN 954-1 ;

— automatically acting mechanical end stops ;

— mechanical interlocking systems complying with category 1 of EN 954-1 ; or

— combinations of this measures.

5.1.5.1.7 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 e.g. by mechanical or electrical control with :

— position controls ;

— profile controls of the edges of the transfer devices ;

— interlocking systems complying with category 1 of EN 954-1.

5.1.5.1.8 Switching off for vertical transfer devices

If vertical transfer devices are equipped with safety gear or with more than one lifting element for the load holding device without safety gear, these shall be installed so that power is removed from the equipment on actuation of the safety gear or on breakage of any single lifting element.

5.1.5.1.9 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 (see annex E).

The limiting of lowering speed may be achieved by :

— check valves arranged directly at the working cylinder ;

— flow limiting valves, chokes, at the working cylinder, diaphragms.

5.1.5.2 Measures for protection against falling of unit loads

5.1.5.2.1 General

In the working and traffic areas, particularly at horizontal transfer points, conveyors shall be installed so that persons are not injured by falling conveyed load. Measures may be side guards and/or underguards such as rope nettings, wire meshes, plates or barriers. These measures shall be designed to arrest the downward movement of the rated load and support it.

5.1.5.2.2 Inclined conveying routes

The inclination of the conveying route and the type of the conveying element shall be designed so that sliding back and/or unintentional dropping out of conveyed material is prevented.

5.1.5.2.3 Conveying rate of linked systems

In the case of linked systems, the conveying rate of the discharging part of the system shall be equal to or greater than that of the delivering unit. Stations for manual unloading of loads shall be safeguarded against overfeeding.

For protection against overfeed of accumulating conveyors, chutes, hoppers, etc. blockage detectors shall be provided to inhibit further supply until the blockage has been relieved.

Where hazards can occur at unloading points as a result of unit loads moving down inclines against stops, arrangements shall be made to decelerate such unit loads prior to their reaching the offloading position taking the specific conditions of the load into account.

5.1.5.2.4 Removable carrying elements for overhead conveyors or self propelled overhead conveyors

The safety factors in relation to the static load for the calculations for removable carrying elements shall be 2 against permanent deformation and 3 against breakage.

For wire ropes and roller chains the safety factor shall be 4 against breakage.

5.1.6 Measures for protection against hazards due to component failure

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.

5.1.7 Measures for protection against slipping, tripping and falling hazards

5.1.7.1 Shafts, pits or passages through the ceiling

Shafts, pits or passages through the ceiling for conveyors shall be safeguarded, e.g. by guard-rail complying with 7.1 of EN ISO 14122-3:2001.

5.1.7.2 Underfloor chains

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

5.1.7.3 Crossings on roller conveyors

All crossings serving as traffic routes directly on roller conveyors shall have a minimum infill tread width of 0,1 m with an anti-slip covering (e.g. checkered plates, expanded metal, grids) having a total width of at least 0,5 m of the roller conveyor section.

5.1.7.4 Conveyors on which persons may travel

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 when the conveyor is arranged at floor level ; or

— conveying speed of 0,15 m/s is not exceeded, when the conveyor is arranged at 0,3 m maximum above floor level ; or

— the sides are safeguarded by panelled rail guards (see 7.1 of EN ISO 14122-3:2001) with speed limitation of 0,5 m/s.

Other conveyors are not intended for this purpose.

5.1.7.5 Walkways, working platforms and passageways

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

Where equipment is not directly accessible from ground or floor, provision shall be made for carrying out maintenance and repair work in such a way as to avoid putting employees at risk. If repair and maintenance is not intended to be carried out from fixed platforms (see EN ISO 14122-2:2001) the design shall ensure that this is possible by means of movable platforms, elevating platforms or scaffolding.

5.2 Measures for protection against electrical hazards

5.2.1 Electrical equipment

The electrical equipment of conveyors shall be provided in accordance with all applicable clauses of EN 60204-1, together with the particular requirements below.

If the equipment is for use in electrical supply conditions outside the range of EN 60204-1:1997, clause 4.3, or prEN 60204-11:1998, clause 4, the manufacturer shall make any necessary design modifications, take any necessary safety precautions and/or state any operational restrictions in the operating manual.

NOTE Electrical equipment includes materials, fittings, devices, appliances, fixtures, apparatus and the like, used as part of, or in connection with, the electrical installation of the conveyor, including the means of isolation from the supply. This includes electronic equipment, the means of disconnection from the supply and all wiring on and from the conveyor to the means of disconnection from the supply.

5.2.1.1 Means of disconnection

Provision shall be made to prevent unexpected start-up and electric shock when work is being carried out on a conveyor or its electrical equipment, see EN 1037 and 5.4 and 5.5 of EN 60204-1:1997. A disconnecting device shall be provided which satisfies the requirements of EN 60204-1:1997, clause 5.3.2 a), b), c) or d) and clause 5.3.3.

If 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.

Where parts of the electrical equipment remain live after switching off the disconnecting device (e.g. due to interconnections between sections of a conveyor system) such parts shall be marked, and/or identified and/or protected against direct contact as appropriate (see 5.3.5 and 6.2 of EN 60204-1:1997).

5.2.1.2 Environment

The supplier shall select and install equipment which is suitable for the intended working environment. Enclosures (cabinets, boxes, compartments) for the electrical equipment shall provide suitable protection e.g. 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 (see EN 60529).

Equipment shall be designed to withstand the vibration and bumping normally occurring on conveyors, without failing to danger.

If the conveyor is intended for use in conditions outside the range of EN 60204-1:1997, clause 4.4, e.g. ambient temperature, humidity, altitude, corrosive atmosphere, the manufacturer shall take account of this in the design.

5.2.1.3 Wiring practices

Wiring practices used in mechanical handling equipment and from mechanical handling equipment to the means of disconnection from the supply, including any work carried out on site, shall meet the requirements of clauses 13 and 14 of EN 60204-1:1997. This includes identification techniques and wiring methods used both inside and outside enclosures. In particular, where practicable, wiring external to enclosures shall not be located in proximity to combustible materials, or located where it may be subject to mechanical damage. Where this is unavoidable, wiring shall be suitably protected, e.g. in armoured cable, rigid metal conduit, flexible conduit, electrical metallic tubing, metal raceway or other suitable means.

5.2.2 Electrostatic charges

Hazards including shock and fire may be caused by electrostatic charges. If it has been identified that persons may be directly or indirectly endangered by such charges, suitable protective measures shall be taken (e.g. earth bonding, brush contact or discharge element for moving items, provision of suitably conductive conveyor belting and pulleys).

NOTE Provisions for electrostatic hazards are under consideration by CENELEC/TC44X.

5.3 Safety requirements related to EMC

NOTE Clause 5.3 is related to the Machinery Directive, clause 8 to the EMC Directive.

The continuous handling equipment shall also 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 61000-6-2. 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 61000-6-2 the performance criteria as specified in EN 61000-6-2 shall apply ;

b) with regard to all the performance criteria specified in EN 61000-6-2 (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 1037) ;

   — blocking of an emergency stop command or resetting of the emergency stop function (see EN 418 and EN 60204-1) ;

   — inhibition of the operation of any safety/interlocking device, if chosen according to subclauses :

      — 5.1.1.1, 5.1.1.2, 5.1.1.8 ;

      — 5.1.3.1, 5.1.3.2 ;

      — 5.1.4.1, 5.1.4.3, 5.1.4.4, 5.1.4.6 ;

      — 5.1.5.1.6, 5.1.5.1.7 ;

      — 5.1.5.2.3 ;

      — 5.7.5, 5.7.6 ;

      — 5.7.7.3 ;

      — 5.8.1, 5.8.2, 5.8.3 ;

— any reduction in fault detection capability of safety related control systems with electronic components according to clause 5.7.7.1, 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 60204-1:1997, clause 4.4.2

5.4 Measures for protection against hazards due to thermal influences

Where materials conveyed or any part of the equipment itself which, on contact with persons, can lead to burns or scalds, (e.g. the temperature of hot surfaces exceeds the values defined by EN 563 based on a one second contact time) suitable measures shall be taken to prevent contact with the conveyed materials or with hot surfaces e.g. screens, fixed guards, fixed distance guards.

5.5 Measures for protection against hazards generated by materials conveyed (contact with or inhalation of harmful fluids, gases, mists, fumes and dust)

The European Standard EN 626-1 applies.

Equipment shall be designed and constructed for the intended environmental conditions (see Introduction).

If dangerous or harmful loads are to be conveyed, they shall be so enclosed as to prevent escape to atmosphere. The housing shall be properly sealed and, where necessary, provided with a vapour or dust evacuation device.

Hot or hygroscopic loads shall be given special attention.

5.6 Measures for protection against hazards caused by neglecting ergonomic principles

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 (see EN 614-1).

5.7 Measures for protection against hazards caused by failure of energy supply, breaking down of machine parts or other functional disorders

5.7.1 General

It shall be ensured that in the case of a power supply failure, all movements are stopped automatically. 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.

5.7.2 Infeed of conveyed loads

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

5.7.3 Unintended reverse movement

Conveyors which create hazards due to reverse movement shall be designed so that unintended reversing is prevented. Measures have to be taken in :

— swing tray conveyors, fixed tray conveyors ;

— belt, chain belt, and chain and slat conveyors with steep angles of incidence ;

— overhead conveyors with traction chains if the upwards and downwards moving strand have a total height difference of 4 m and a load of at least 25 kg/m and the chains are not self-blocking towards all levels after breakage.

Reverse movement can be prevented e.g. by :

— mechanical braking systems ; or

— anti run-back devices.

5.7.4 Inclined conveyed sections/unintended movement

Conveyors with conveying sections inclined in the conveying direction shall be set up so that they are held on failure of the drive, e.g. by a braked motor.

5.7.5 Overload of tow trolley systems

Main and auxiliary sections in tow trolley systems shall be equipped with load limiting devices (with or without motor cutoff) which are triggered when the permissible traction force is exceeded, i.e. independently of the overload protection of the electrical circuit.

If several drives work in a group, the entire group shall switch off when the load limiting device of one of the drives is triggered.

5.7.6 Overload protection system of vertical transfer devices

A vertical transfer device shall be equipped with an overload protection system if the rated capacity is more than 1000 kg and the mass of the load is not known prior to reaching the equipment.

Requirements are in particular :

— the overload protection shall be designed in accordance with EN 954-1 and shall meet at least category 1 ;

— 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 ;

— 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.

5.7.7 Controls and control systems

5.7.7.1 Controls and circuits for safety purposes

Controls and circuits for safety purposes shall be in accordance with EN 954-1 and shall meet at least category 1 requirements.

5.7.7.2 Control systems

The control systems and control equipment shall be designed using proven techniques and shall use proven components (see 9.4 of EN 60204-1:1997 for electrical and electronical systems, EN 982 for hydraulic control systems, EN 983 for pneumatic control systems). It shall be able to withstand the vibration, shock und bump levels normally occuring on mechanical handling equipment without failing to danger.

Safety related software and adjustable components shall not be assessible to unauthorized persons, e.g. use of access codes or special adjusting tools.

Switching over from automatic to manual or special mode and vice versa shall only be possible by using special lockable control devices which are located outside danger areas (e.g. keyswitch, password or other suitable means).

5.7.7.3 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 and/or visual warning signal shall be provided in accordance with EN 457, EN 842 and EN 61310-1, as appropriate. Such signals shall be provided e.g. :

— where open conveyors are out of sight of the operator ;

— 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 suitable 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.

5.7.7.4 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 stop (see 9.2.2 of EN 60204-1:1997). The category shall be chosen to bring the equipment to a stop condition within the shortest time compatible with the equipment.

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).

5.7.7.5 Emergency stopping

The emergency-stop function shall be in accordance with EN 418 and shall be either a category 0 or 1 stop. The category shall be chosen to bring the equipment to a stop condition within the shortest time compatible with the equipment.

Emergency stop devices shall be in accordance with EN 418 and shall be either :

— one or more emergency switches, which shall be installed in such a way that at least one may be reached within 10 m from any directly accessible (without using additional means) point of the equipment ; and/or

— one or more pull-cord operated switches arranged along the side of the installation ; or

— the conveyor power supply disconnecting device if the distance from any accessible point of the equipment 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 1,7 m.

Emergency stop devices shall be positioned at all control stations ; working positions and directly accessible (without using additional means) parts of the machinery, including manual loading/unloading points, walkways and transfer point (see 3.7.8 of EN 292-2:1991). Where more than one emergency stop device is provided, means shall be incorporated to show which device has been actuated. The emergency stop function shall be designed to avoid creating hazardous conditions (e.g. dangerous discharge of conveyed material)

NOTE The provision of an emergency stop device is not alternative to the installation of suitable guarding (see EN 418:1992, 4.1.3).

5.7.7.6 Pull-cord operated emergency-stop switches

The arrangement of pull-cord operated emergency stop switches shall be such that their associated switching device(s) operate(s) if either the operating cord is pulled in any direction or the cord breaks. Pull-cord switches shall also be designed so that the failure of any one single spring will cause its associated switching device(s) to operate (i.e. not cause a failure to danger).

The system shall be actuated by a cord movement of less than 300 mm and by the application of a force less than 125 N. This force is horizontal and perpendicular to the cord. It is applied mid-way between two support rings. The cord movement is the distance covered between the rest position and the actuation position of the cord point located mid-way between two support rings.

As the movement of the operating cord and the force to operate the system could be affected by the design of the cord supports and the distance between them, it shall be ensured that the cord is always free to move through the supports, particularly at changes of direction, without becoming disengaged from them.

Only cords which are free form "kinks" and of a type unlikely to "kink" in service shall be selected for use. The maximum length and other details shall be in accordance with the switch supplier's recommendations (e.g. protection of support rings and pulleys, prevention of freezing, changes in length due to temperature changes, etc.).

5.7.7.7 Operator controlled transfer cars

Controls for operator controlled power driven transfer cars shall be hold to run devices.

5.7.8 Hydraulic and pneumatic systems and equipment

Hydraulic and pneumatic systems and equipment shall be provided in accordance with all applicable clauses of EN 982 and EN 983, together with the particular requirements below.

NOTE Hydraulic equipment includes materials, fittings, components,devices, appliances, fixtures, apparatus and the like, used as part of, or in connection with, the hydraulic installation of the continuous handling equipment (e.g. hydraulic fluid reservoirs, hydraulic fluid, pumps, hydraulic motors, cylinders, valves, accumulators and all hydraulic piping on and between the continuous handling equipment and the hydraulic fluid reservoir).

Pneumatic equipment includes materials, fittings, components, devices, appliances, fixtures, apparatus and the like, used as part of, or in connection with, the pneumatic installation of the continuous handling equipment (e.g.pneumatic motors, cylinders, actuators, valves, lubricating fluid, the means of disconnection from the air supply and all piping on and from the continuous handling equipment to the means of disconnection from the main air supply, but not including air receivers and compressors).

5.7.8.1 Hydraulic and pneumatic systems

Systems shall be provided with means to regulate the working pressure, which shall be tamper-resistant if accessible to any person, e.g. shall only be adjustable using tools, or lockable.

NOTE See EN 982:1996, 5.3.5.1 and EN 983:1996, 5.3.5.1.

Systems shall be provided with means to provide protection against over-pressure, which shall be tamper-resistant if accessible to any person, e.g. shall only be adjustable using tools, or lockable.

NOTE See EN 982:1996 clause 5.3.5.1 and EN 983:1996 clause 5.3.5.1.

Over-pressure protection shall act at a pressure not exceeding 1,1 x the pressure during intended load movements. The preferred means of over-pressure protection is a pressure relief valve, which shall be fitted in an appropriate part of the system.

NOTE See EN 982:1996 and EN 983:1996, 5.1.2.

Systems shall be provided with suitable means of checking the working pressure at appropriate points in the system, e.g. the provision of suitable quick action coupling points. These coupling points shall be tamper-resistant, e.g. lockable if accessible to any person.

Systems shall have a means of disconnection, to prevent unexpected start-up when maintenance work or adjustments are being carried out on the hydraulic or pneumatic equipment (see EN 1037). This provision shall be either electrical disconnection of the pump or air compressor drive motor or disconnection by means of a valve or a plug/socket coupling. The disconnecting device shall be easily accessible to authorised personnel, shall be marked with purpose and type of operation and shall be capable of being locked in the "disconnected" position or capable of being secured in another manner.

NOTE See EN 1037:1995 clause 5.2 and EN 982:1996 clause 5.1.6 and EN 983:1996 clause 5.1.6.

If a system supplies power to more than one machine, it shall be possible for each individual machine to be disconnected from the supply to allow work to be carried out safely.

Where parts of a system remain pressurised after disconnection (e.g. due to inter-connections, or due to an energy source in that part of the circuit) each individual energy source shall be capable of disconnection and/or dissipation to allow work to be carried out safely. Such parts of the system shall be appropriately marked/identified/ protected.

NOTE See EN 982:1996 clause 5.3.4.5.1 and EN 983:1996 clause 5.1.6.

Systems shall incorporate filters which shall be positioned in the main supply line and also immediately before each safety related locking valve where contamination can cause a hazard.

NOTE See EN 982:1996 clauses 5.3.4.1.3 and 5.3.7 and EN 983:1996 clause 5.3.4.1.1.

Systems shall be designed and constructed to prevent or minimise surges in working pressure, minimise pressure losses and back pressure, particularly in safety related pneumatic systems.

NOTE See EN 983:1996 clause 5.3.3.1.4.

Hydraulic systems which incorporate gas loaded accumulators shall meet the requirements of EN 982 clause 5.3.4.5. Where accumulators provide hydraulic fluid for safety critical functions they shall incorporate a minimum fluid level detection device. If the minimum fluid level is reached, the device shall automatically give an stop command.

5.7.8.2 Hydraulic and pneumatic equipment

The supplier shall select and install hydraulic and pneumatic equipment which shall be suitable for the intended working environment.

Hydraulic systems for continuous handling equipment shall not use toxic and/or hazardous hydraulic fluid. Where special hydraulic fluid is used (e.g. where fire resistance is required), the fluid supplier's safety instructions shall be followed. Pneumatic systems shall only use compressed air or neutral gas.

Hydraulic fluid reservoirs shall meet the requirements of EN 982:1996, clause 5.3.4.4 and have a capacity of at least 10 % more than that required for the system in normal use.

All flexible piping, flexible hoses and also any pipework or connections used as transmission elements for safety purposes, shall be designed to withstand at least 3 x maximum working pressure (set pressure of the pressure relief valve) without failure or permanent deformation. Other hydraulic and pneumatic equipment, e.g. actuators, accumulators, valves, pipework and their connections, shall be designed to withstand at least 2 x maximum working pressure without failure or permanent deformation.

If ends of hydraulic or pneumatic cylinders are used to stop movement, they shall be able to withstand a static force corresponding to at least 3 x maximum working pressure without failure or permanent deformation. If end stops are incorporated in cylinders to stop movement, they shall be able to withstand a static force corresponding to at least 3 x maximum working pressure without failure or permanent deformation. Cylinders without end stops shall be suitably cushioned. If hydraulic or pneumatic cylinders are safety related, the ends shall be able to withstand a static force corresponding to at least 4 x maximum working pressure without failure or permanent deformation.

5.7.8.3 Piping practices

Piping of hydraulic systems, including any work carried out on site, shall meet the requirements of EN 982:1996, clauses 5.3.4.2 and 5.3.4.3 and shall be suitably designed and installed to prevent the entrapment of air. Piping of pneumatic systems, including any work carried out on site, shall meet the requirements of EN 983:1996, clauses 5.3.4.2 and 5.3.4.3 and shall be suitably designed and installed to prevent water formation. Labelling, colour coding or the use of incompatible couplings shall, where practicable be used to prevent or deter incorrect connection or reconnection which could result in risk of injury (e.g. reversal of a direction of movement or adversely affecting a safety function).

5.8 Devices and equipment for setting up and repair

5.8.1 Control devices

Systems which are difficult to view as a whole shall have one or more local control stations with hold to run control devices by means of which set up and repair can be safely achieved in manual mode. The following provisions shall be taken into account, e.g. :

— direct view of the locations, movements and loads ;

— cable length of portable control devices, long enough to allow a direct view of the movements being controlled ;

— safe stopping distance, e.g. by reduced speed ;

Cableless control devices shall meet the requirements of prEN 13557:1999, annex A.

5.8.2 Maintenance vehicles for self-propelled overhead conveyors

Maintenance vehicles for use with self-propelled overhead conveyors shall meet the following requirements :

— manual controls according to clause 5.8.1 ;

— an escape device , such as a descender device (see EN 341) ;

— guards against falling (see 7.1 of EN ISO 14122-3:2001) ;

— guards against crushing hazards, e.g. two-hand-control, cage ;

— measures against derailing according to clause 5.1.5.1.4 ;

— minimum dimensions to permit ergonomically good working conditions.

5.8.3 Standing on or travelling on the carrying element of vertical transfer devices

Where maintenance persons occupy the carrying element of a vertical transfer device, it shall be designed that :

— the carrying element cannot drop and ;

— the carrying element has safe flooring and persons are safeguarded against crushing hazards.

This can be ensured by the following measures :

— if standing on the carrying element is only intended when stationary positive locking safety devices, e.g. safety bolts, self-tightening wedges or holding ropes, have to be provided which can be fixed from outside ;

— if travelling on the carrying element is intended, measures according to annex E are required against crushing hazards and, in the case of a lifting height of more than 1,5 m, against unintended dropping of the carrying element.

Safe flooring shall be provided on the carrying element e.g. by panelling of the area to be stood on or by filling plates between rollers (see 5.1.7.3) or plates between the chains of chain conveyors. This flooring shall be designed to support a pressure of 1800 N/m² and a mass of 100 kg distributed over an area of 0,2 x 0,2 m at any part of the surface.

With a falling height of 1 m, safeguards against falling from the carrying element shall be provided, e.g. by guard rails according to 7.1 of EN ISO 14122-3:2001 or by installation of an anchor device according 4.3 of EN 795:1996 for using personal protective device.

6 Verification of the safety requirements and/or measures

As continuous handling equipment or systems are generally assembled at their place of use, verification shall be made both at the design and manufacturing stages and at the assembling and commissioning stages. Before commissioning, verification shall be made that all relevant safety requirements and measures of this standard have been applied.

For the verification of clause 5 see annex H (normative). For general considerations see items below.

6.1 At the design/manufacturing stages

The verification shall confirm :

— that the design calculation book is complete and in line with the technical specification of this standard relative to the equipment and/or system capacity related to safety ;

— that the manufacturing drawings include all the protective devices and the access necessary to operate, inspect and maintain the machine ;

— that the draft instruction handbook is complete enough for the installation and commissioning to be carried out in safety ;

— that the information concerning transportation of the equipment is complete and available when the equipment is supplied unassembled.

6.2 At the place of assembly before energization

The verification shall confirm that the equipment meets all requirements of the standard:

— that the reference documents, e.g. instruction handbook, electrical, hydraulic, pneumatic diagrams, engineering drawings or testing equipment etc., are available ;

— that all the safeguards have been properly installed and there are no unprotected hazard points in the accessible areas ;

— that all the access facilities have been installed and it is possible to reach control, setting and maintenance points without danger and the clearances for the personnel are in accordance with the appropriate clauses of this standard.

6.3 Commissioning

6.3.1 Off-load tests

The verification shall confirm that the following are in accordance with the appropriate clauses of this standard :

— that power disconnection/connection and normal stopping and starting functions operate ;

— that e.g. audible and visual warning devices and phonic connections operate as intended ;

— that speeds and ranges of movement of all moving parts comply with specifications of the standard and that all limit switches and emergency-stop devices are operating as intended by actuation ;

— that safety distances for people are as prescribed and that interlocking devices and trip devices operate as intended ;

— that clearances between parts of the machine in relation to other parts and in relation to fixed/moving obstacles outside the machine are as prescribed in the standard or that protection devices function ;

6.3.2 On load tests

The verification shall confirm :

— that the loads are carried correctly under intended conditions, i.e. without unintended accumulation or without overloading ;

— that hydraulic and pneumatic systems shall be tested for integrity and checked for leaks at a static pressure of at least 20 % above the normal setting of the over-pressure protection, to minimise the risk of direct or indirect injury from leakage.

6.3.3 Load limiting system

The verification shall include confirmation that load limiting devices function as required.

6.3.4 Tests for vertical transfer devices

During commissioning a load which is 1,1 times the rated load bearing capacity, shall be applied to the carrying element of vertical transfer devices. With this load a full cycle up and down shall be made to show that the carrying element stops correctly at all intended stop-positions and load transfer from and to the interfacing conveyors is performed without failure.

6.3.5 EMC-tests

6.3.5.1 Tests in relation to the EMC Directive

Compliance with the EMC requirements of 5.3 above shall be checked in accordance with the standards mentioned. If testing of the completed continuous handling equipment is not reasonably practicable due to the size of the machinery, the manufacturer shall verify that all appropriate equipment sub-assemblies comply with 5.3 above. The manufacturer shall also verify that these sub-assemblies are suitably installed and wired to minimise disturbances and/or their effects in accordance with any recommendation of the supplier(s) of the sub-assemblies.

6.3.5.2 Tests in relation to the Machinery-Directive

Compliance with the EMC requirements of 5.3 above shall be checked by carrying out preliminary testing and function testing. If testing of the completed continuous handling equipment is not reasonably practicable due to the size of the machinery, the manufacturer shall verify that all appropriate equipment sub-assemblies comply with 5.3 above. The manufacturer shall also verify that these sub-assemblies are suitably installed and wired to minimise the effects of disturbances on the equipment and in accordance with any recommendation of the supplier(s) of the sub-assemblies.

7 Information for use

7.1 Instruction handbook

7.1.1 General

The instruction handbook shall be in accordance with clause 5.5 of EN 292-2:1991 and shall include the information mentioned in EN 292-2:1991, annex A, 1.7.5. This information shall include the conditions under which the equipment is intended to be used, in particular with regard to :

— the materials to be handled : indication of the maximum permissible characteristics, e.g. dimension ;

— operating conditions : indication of the operating mode(s), e.g. automatic/manual operation ;

— range of intended environmental conditions according to the restrictions in the scope, e.g. wind, temperature, relative humidity.

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

The instruction handbook shall also contain information on prohibited applications such as :

— handling of unit loads different from those specified and hazardous unit loads ;

— man-riding.

Where a programmable logic system is provided, the instruction handbook shall contain all the instructions necessary for modifications of programmes considered allowable by the manufacturer .

7.1.2 Instructions for the installation of the equipment

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

— the maximum weights, dimensions and lifting points of the separate components supplied ;

— the assembly phases and technical requirements ;

— the handling method required ;

— the floor loadings for individual pieces of equipment ; In particular the floor beneath vertical transfer devices shall be designed with the load bearing capacity to support falling load holding devices and rated loads ;

— requirements for anchoring and fixing points.

7.1.3 Instructions for the use of the equipment

The instruction handbook shall include, in addition to 5.5.1 of EN 292-2:1991 the following information :

— instructions that only authorized personnel shall start, operate or interfere with the normal working of the system ;

— stopping modes and means ;in particular, normal and emergency stopping devices shall be made known to all appropriate personnel. Information concerning that the areas giving access to them shall be kept clear of obstacles. Their proper working shall be periodically checked.

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

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

— determining the cause of the emergency or accidental stoppage ;

— repairing the fault.

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

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

— the user shall be careful to ensure a regular feed, avoiding over-loading ;

— the user shall not modify the design or configuration of the equipment without consulting the manufacturer or his authorized representative ;

— after modification of the design or configuration of the equipment, recommissioning shall be carried out in accordance with 6.3 ;

— all loading and working stations and passageways shall be kept clear.

7.1.4 Instructions for maintenance

The instruction handbook shall specify in particular (see 5.5.1e of EN 292-2:1991) :

a) the technical knowledge and skills of the maintenance staff specially for particular operations which need specific competence, and that all adjustments, whether mechanical or electrical, shall be carried out by persons authorized to do so in accordance with a safe system of work ;

b) the conditions under which maintenance works and rectification of faults on continuous handling equipment or systems can be performed e.g. by requiring that the equipment is isolated, protected against unexpected start-up and measures are taken against unexpected movements ;

c) a list of wearing parts, as well as the approximate frequency and conditions for their replacement ;

d) a list of parts to be checked periodically ;

e) the conditions for examination and discard of wire ropes (see ISO 4309) and chains ;

f) that access to maintenance and inspection points shall be kept clear of obstacles.

The instruction handbook shall give the information concerning noise as required in EN 292-2:1991, annex A, 1.7.4f.

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

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

g) continuous handling equipment shall be kept in proper working condition and maintained in accordance with the manufacturer's instructions ;

h) inspection, adjustment, maintenance and cleaning of moving parts shall be carried out regularly in a safe manner according to the manufacturer's instructions ;

i) inspection and adjustment of continuous mechanical handling equipment, in motion or in use, shall only be carried out with guards in position ;

j) displacing or removal of a guard and/or neutralisation of a safety device shall be carried out in accordance with 4.2.2 of EN 292-2:1991 ;

k) repairs and removal of protective enclosures or panels shall only be carried out after stopping the equipment and starting devices have been rendered inoperative by persons authorized to do so in accordance with a safe system of work ;

l) entering the space below the carrying element of vertical transfer devices is only permissible if the safety devices are in place.

7.1.5 Training

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

7.1.6 Conveying of persons

Attention shall be drawn by a notice that no one travels on or in a conveyor that is not designed to convey persons while it is in motion.

7.1.7 Remaining underneath loads

Attention shall be drawn by a notice that no one may remain underneath loads, see ISO/DIS 3864-1:1999.

7.1.8 Marking of drag chain conveyors

If pushers or chains of drag chain conveyors run above the floor level, the tracks shall be marked in a conspicuous colour.

Transport routes of drag chain conveyors shall be marked according to the width of the loaded tow carts profile gauge by yellow lines painted on the floor.

7.1.9 Instruction handbook for vertical transfer devices

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

— entering the space beneath the lift is permissible only if the safety devices are present and effective ;

— working on lifting devices or on the lifting drive may be started only if the lift is prevented from unintentional movement or falling ;

— test runs of vertical transfer devices with access to dangerous moving parts or with opened panelling are permissible only if they are performed by a competent person making use of hold to run control devices ; no other control devices may have any effect.

7.1.10 Hazards generated by conveyed loads

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

7.1.11 Errors of fitting - Poor assembly

Various types of risks can arise from poor assembly of the different components of handling equipment or the system during all the erection phases and when commissioning. The person who erects and puts into operation the equipment shall observe carefully the requirements for the installation of the equipment in 7.1.2 and shall verify the proper installation of safety requirements in 6.2 and annex H.

7.2 Marking

7.2.1 Rating plate

The equipment shall be marked at least with the following :

a) name and address of the manufacturer ;

b) year of manufacturing ;

c) legal marking;

d) designation of series or type ;

e) serial number ;

f) the words "For information on the safe use of the machine, see the instruction handbook".

7.2.2 Load bearing capacity

In addition, the load bearing capacity shall be indicated in kilogram (kg) or ton (t) legibly and indelibly at loading points, in so far as the loading of the equipment is not automatically limited by the type of load suspension device or loading method.

7.2.3 Sign at vertical transfer devices

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

"Shut down the unit, lock the main switch.

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

7.2.4 Marking of hydraulic fluid reservoirs

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

7.2.5 Marking of couplings in hydraulic or pneumatic systems

Where incorrect connection or reconnection of couplings in hydraulic or pneumatic systems is not prevented by incompatible couplings, labelling or colour coding shall be used (see also 5.7.8.3).

7.2.6 Sign at load entry/exit points

If load entry/exit points are designed according to the requirements of annex F they shall be equipped with the following sign :

Figure 1 - "Access for unauthorized persons prohibited"

8 Electromagnetic compatibility requirements (EMC)

NOTE Clause 8 is related to the EMC Directive, 5.3 to the Machinery Directive.

The electromagnetic disturbances generated by the continuous handling equipment shall not exceed the levels specified in generic emission standard 50081-1. The continuous handling equipment shall also have sufficient immunity to electromagnetic disturbances to enable it to operate as intended when exposed to the levels and types of disturbance as specified in EN 61000-6-2. 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 unintended operation.

In particular, the following loss of performance or degradation of performance shall not occur:

— any sequencing, timing or counting error

— speed variation in excess of +/- 20 %

— inhibition of the operation of interlocking devices

— increase/ decrease of starting operation duration with more than 10 %

— reduction in non safety-related fault detection capability

Information on measures to reduce generated disturbances and measures to reduce the effects of disturbances on the continuous handling equipment is given in EN 60204-1:1997, 4.4.2. For those tests specified in EN 61000-6-2, any degradation of performances or loss of function allowed with regard to performance criteria “A” and”B” shall be declared by the manufacturer. Any temporary loss of function allowed with regard to performance criteria “C” shall be declared by the manufacturer.

Annex A
(normative)

Examples of continuous handling equipment

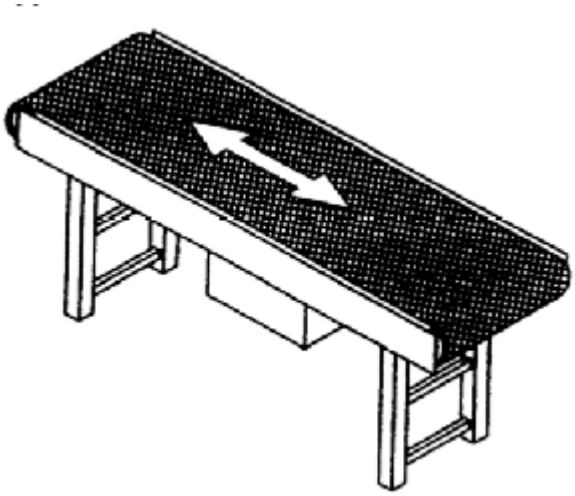


Figure A.1 - Belt conveyor

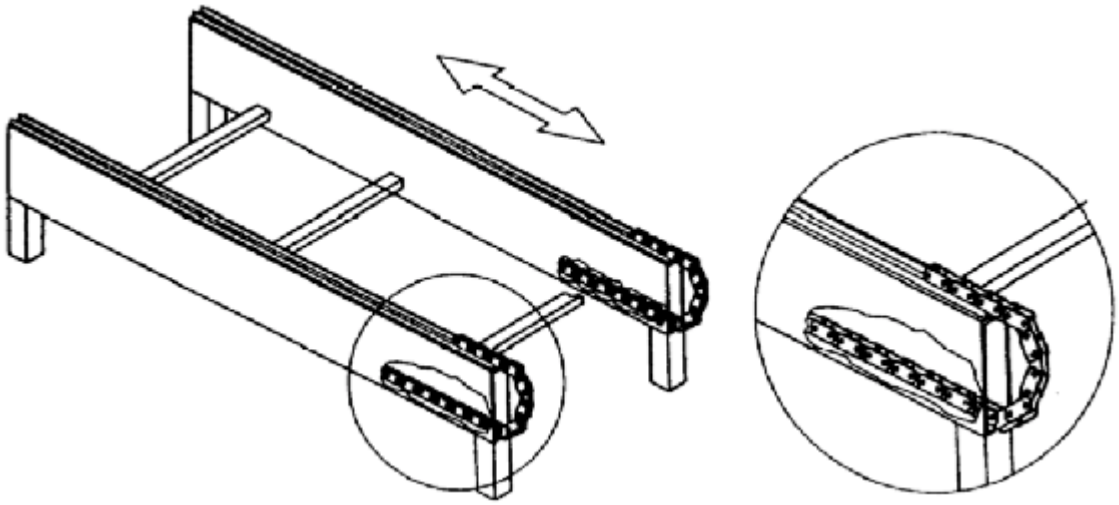


Figure A.2 - Drag chain conveyor

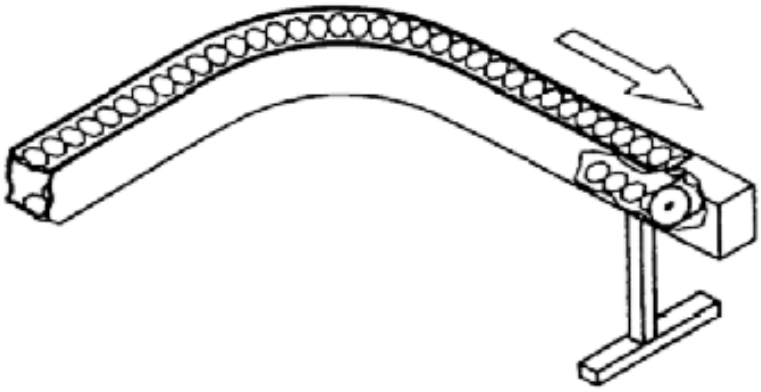


Figure A.3 - Plate conveyor

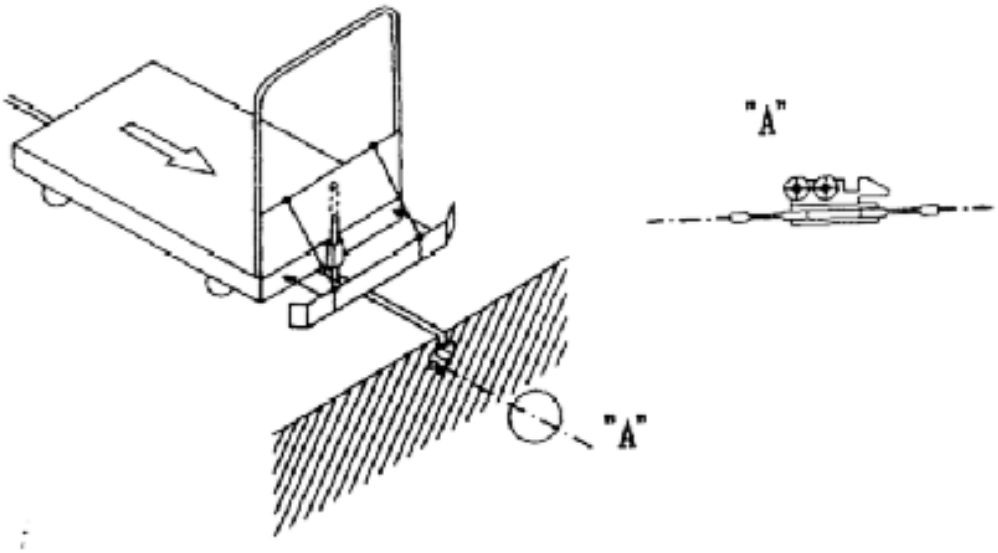


Figure A.4 - Single strand drag chain conveyor

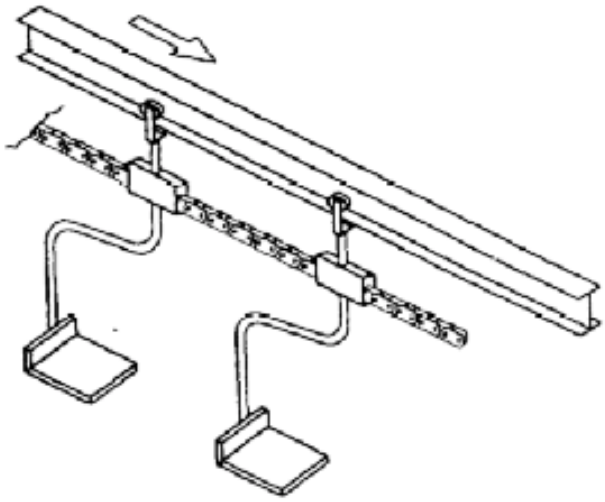


Figure A.5 - Overhead conveyor

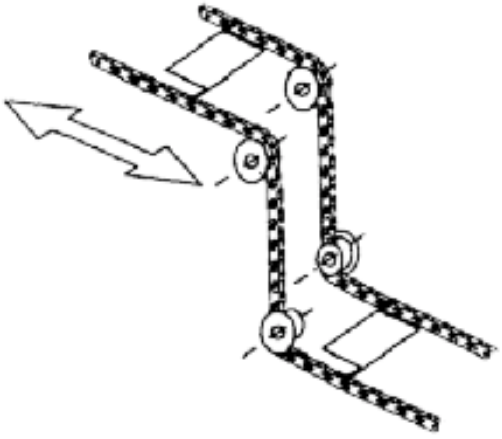


Figure A.6 - Swing tray conveyor

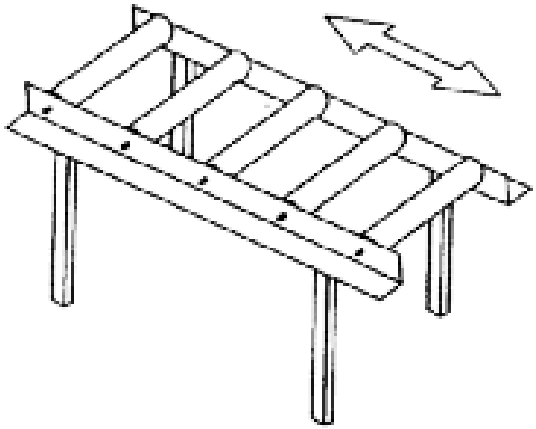


Figure A.7 - Gravity roller conveyor

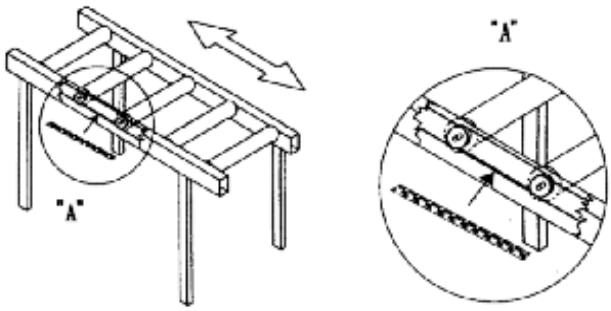


Figure A.8 - Driven live roller conveyor

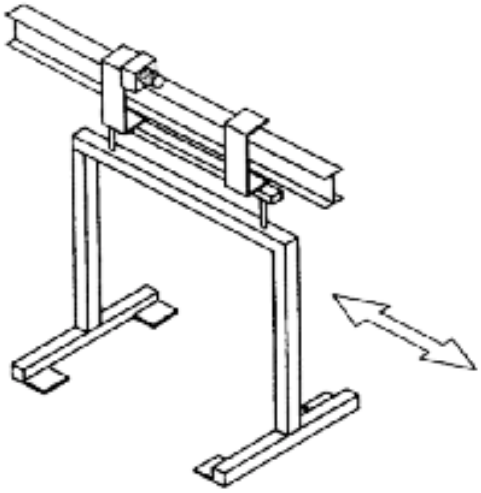


Figure A.9 - Overhead monorail conveyor

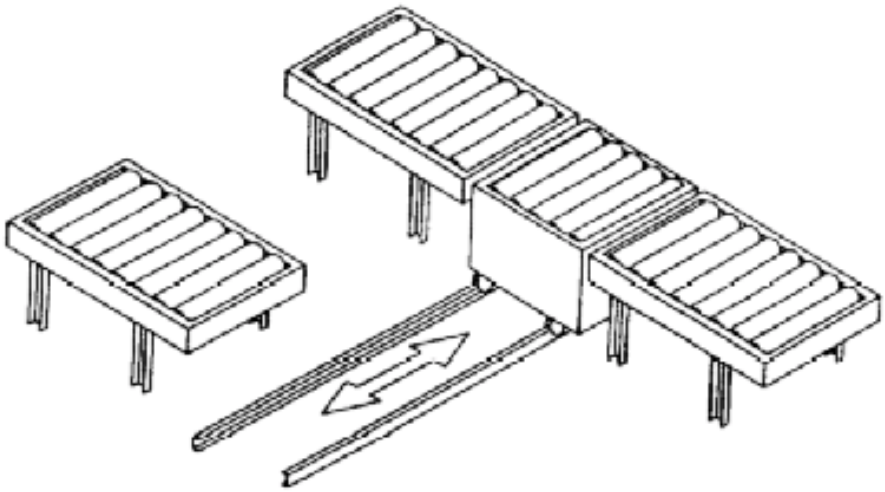


Figure A.10 - Transfer car

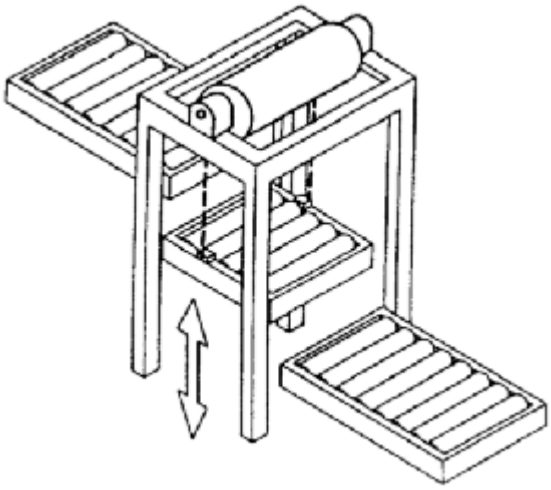


Figure A.11 - Vertical transfer device

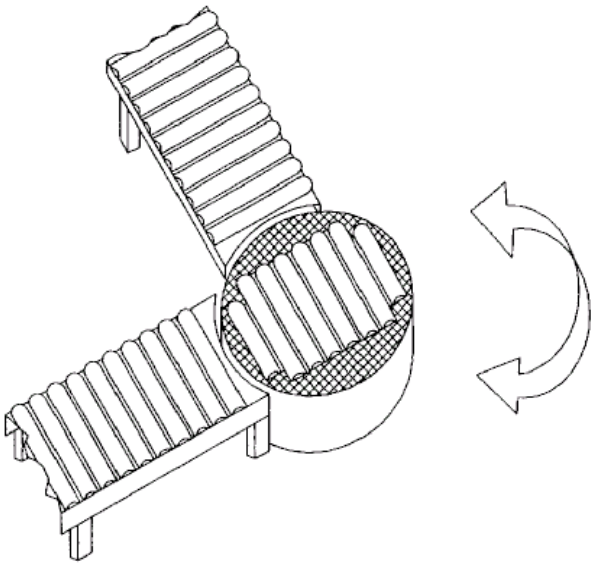


Figure A.12 - Horizontal transfer device (turntable)

Annex B
(normative)

List of hazards

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

	Hazards	Significant hazards dealt with	Hazard Location	Requirements Subclauses
1	**Mechanical hazards.**			
1.1	Crushing hazard	yes	General	5.1.1.1
			Enclosed units	5.1.1.2
			Lateral safety distances for conveyors	5.1.1.3
			Lateral safety distances for all overhead conveyors	5.1.1.4
1.2	Shearing hazard	yes	Specific lateral safety distances for self-propelled overhead conveyors	5.1.1.5
			Safety distances under self-propelled overhead conveyors	5.1.1.6
			Safety distances between mobil units of self-propelled overhead conveyors	5.1.1.7
			Prevention of access beneath vertical transfer devices	5.1.1.8
			Safety clearances in vertical transfer devices	5.1.1.9
1.3	Cutting or severing hazard	no		
1.4	Entanglement hazard	yes	Measures for protection against entanglement hazards	5.1.2
1.5	Drawing-in or trapping hazard	yes	Danger zones at transmission parts	5.1.3.1
			Drawing-in points at traction and carrying elements or pushing elements	5.1.3.2
			Diverting points of traction elements	5.1.3.3
			Danger zones between drag chain conveyors and conveyed unit loads	5.1.3.4
			Wheels or rollers of tow carts	5.1.3.5
			Rollers of overhead conveyors	5.1.3.6
			Contact points on driven roller conveyors	5.1.3.7
			Drawing-in points on driven roller conveyors	5.1.3.8
			Danger zones between roller conveyors and conveyed unit loads	5.1.3.9
			Drawing-in points at supporting rollers	5.1.3.10
				"continued"

(continued)

	Hazards	Significant hazards dealt with	Hazard Location	Requirements Subclauses
1.6	Impact hazard	yes	Cross over passageways Prevention of access to danger zones Crossings of fixed track conveyors and other means of transportation Path of mobile conveyors or tow carts Crossings of self-propelled overhead conveyors and traffic areas Transport area of transfer cars	5.1.4.1 5.1.4.2 5.1.4.3 5.1.4.4 5.1.4.5 5.1.4.6
1.7	Stabbing or puncture hazard	no		
1.8	Friction or/abrasion hazard	no		
1.9	High pressure fluid or gas ejection hazard	yes	hydraulic/pneumatic equipment	5.7.8
1.10	Falling or ejection of parts (of machinery and processed material/workpieces)	yes	Falling of load holding devices or counterweights Parts which can be hinged End stops of conveyors Dropping and/or derailing of railguided conveyors Loosening of trolleys Interruptions of tracks of overhead conveyors Transfer devices of overhead conveyors Switching off for vertical transfer devices Lowering speed for vertical transfer devices Falling loads (general) Inclined conveying routes Conveying rate of linked systems Removable carrying elements for overhead conveyors or self propelled overhead conveyors Component failure on inclined chain conveyors	5.1.5.1.1 5.1.5.1.2 5.1.5.1.3 5.1.5.1.4 5.1.5.1.5 5.1.5.1.6 5.1.5.1.7 5.1.5.1.8 5.1.5.1.9 5.1.5.2.1 5.1.5.2.2 5.1.5.2.3 5.1.5.2.4 5.1.6
1.11	Loss of stability (of machinery and machine parts)	no		
1.12	Slip, trip and fall hazards in relationship with machinery (because of their mechanical nature)	yes	Shafts, pits or passages through the ceiling Underfloor chains Crossings on roller conveyors Conveyors on which persons may travel Walkways, working platforms and passageways	5.1.7.1 5.1.7.2 5.1.7.3 5.1.7.4 5.1.7.5
				"continued"

(continued)

	Hazards	Significant hazards dealt with	Hazard Location	Requirements Subclauses
2	**Electrical hazards**			
2.1	Electrical contact direct or indirect	yes	Electrical and electronic equipment	5.2
2.2	Electrostatic phenomena	yes	Electrostatic charges	5.2.2
2.3	Thermal radiation or other phenomena such as projection of molten particles, and chemical effects from short circuits, overloads, etc.	yes	Environment Wiring practices	5.2.1.2 5.2.1.3
2.4	External influences on electrical equipment	yes	EMC	5.3
3	**Thermal hazards** **for example resulting in :**			
3.1	burns and scalds, by a possible contact of persons, by flames or explosions and also by the radiator of heat sources	yes	hot materials or machine parts	5.4
3.2	health-damaging effects by hot or cold work environment	no		
4	**Hazards generated by noise, resulting for example in**			
4.1	hearing losses (deafness), other physiological disorders (e.g. loss of balance, loss of awareness, etc.)	no		
4.2	interference with speech communication, acoustic signals etc.	no		
5	**Hazards generated by vibration (resulting in a variety of neurological and vascular disorders)**	**no**		
6	**Hazards generated by radiation especially by**			
6.1	electrical arcs	no		
6.2	lasers	no		
6.3	ionizing radiation sources	no		
6.4	machines making use of high frequency electromagnetic fields	no		
7	**Hazards generated by materials and substances processed, used or exhausted by machinery for example**			
7.1	hazards resulting from contact with or inhalation of harmful fluids, gases, mists, fumes and dusts	yes	Hazards resulting from contact with or inhalation of harmful fluids, gases, mists, fumes and dusts	5.5
7.2	fire or explosion hazard	no		
7.3	biological and micro-biological (viral or bacterial) hazards	no		
8	**Hazards generated by neglecting ergonomic principles in machine design (mismatch of machinery with human characteristics and abilities) caused e.g. by**			
8.1	unhealthy postures or excessive efforts	yes	Protection against hazards caused by neglecting ergonomic principles	5.6
				"continued"

(continued)

	Hazards	Significant hazards dealt with	Hazard Location	Requirements Subclauses
8.2	inadequate consideration of human hand-arm or foot-leg anatomy	no		
8.3	neglected use of personal protection equipment	no		
8.4	inadequate area lighting	no		
8.5	mental overload or underload, stress, etc.	no		
8.6	human error	no		
9	**Hazard combinations**	**no**		
10	**Hazards caused by failure of energy supply, breaking down of machinery parts and other functional disorders, for example**			
10.1	failure of energy supply (of energy and/or control circuits)	yes	Unpowered movement Infeed of conveyed material	5.7.1 5.7.2
10.2	unexpected ejection of machine parts or fluids	yes	Unintended reverse movement Inclined conveyed sections/unintended movement Overload of tow trolley systems Overload protection of vertical transfer devices	5.7.3 5.7.4 5.7.5 5.7.6
10.3	failure, malfunction of control system (unexpected start up, unexpected overrun)	yes	Controls and safety circuits Control systems Start and restart function Stop functions and stop devices Emergency stopping Pull-cord operated emergency stop switches Operator controlled transfer cars	5.7.7.1 5.7.7.2 5.7.7.3 5.7.7.4 5.7.7.5 5.7.7.6 5.7.7.7
10.4	errors of fitting	yes	Poor assembly	7.1.11
10.5	overturn, unexpected loss of machine stability	no		
11	**Hazards caused by (temporary) missing and/or incorrectly positioned safety related measures/means, for example**	**yes**	**Instructions for maintenance**	**7.1.4**
11.1	all kinds of guard	yes	Protection against hazards caused by (temporary) missing and/or positioned safety related measures/ means	5.8
11.2	all safety related (protection) devices	yes		
11.3	starting and stopping devices	yes	Control systems Start and restart function Stop functions and stop devices Operator controlled transfer cars Controls for setting up and repair	5.7.7.2 5.7.7.3 5.7.7.4 5.7.7.7 5.8
				"continued"

(concluded)

	Hazards	Significant hazards dealt with	Hazard Location	Requirements Subclauses
11.4	safety signs and signals	yes	Conveying of persons	7.1.6
			Remaining underneath loads	7.1.7
			Marking of drag chain conveyors	7.1.8
			Sign at vertical transfer devices	7.2.3
11.5	all kinds of information or warning devices	yes	Starting	5.7.7.3
			Rating plate	7.2.1,7.2.4
			Load bearing capacity	7.2.2
			identification of couplings	7.2.5
11.6	energy supply disconnecting devices	yes	Electrical hazards	5.2.1
			Disconnection of the energy supply	5.2.1.1
			Disconnection of subdivided conveyor systems	5.2.1.1
11.7	emergency devices	yes	Emergency stopping	5.7.7.5
			Pull-cord operated emergency-stop switches	5.7.7.6
11.8	feeding/removal means of workpieces	no		
11.9	essential equipment and accessories for safe adjusting and/or maintaining	yes	Maintenance vehicles for self-propelled overhead conveyors	5.8.2
			Standing on or travelling on the carrying element of vertical transfer devices	5.8.3
11.10	equipment evacuating gases, etc.	yes	General	5.5

Annex C
(normative)

Examples of mechanical hazards

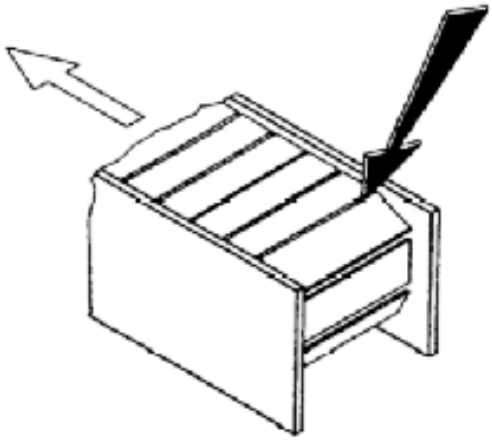


Figure C.1 - Crushing hazard

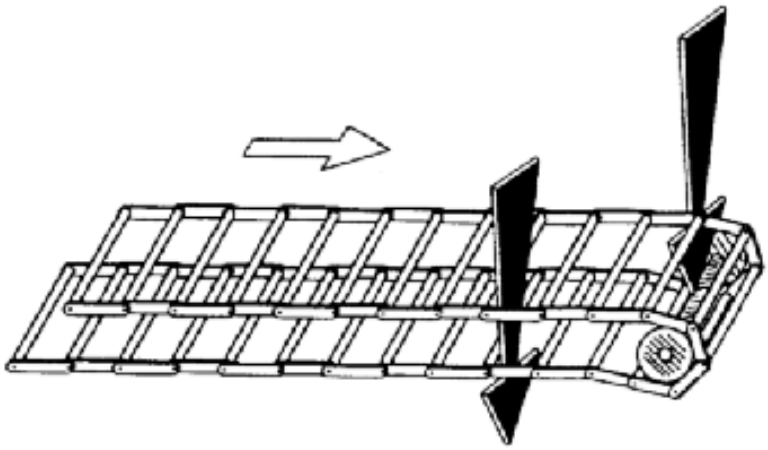


Figure C.2a) - Shearing hazard

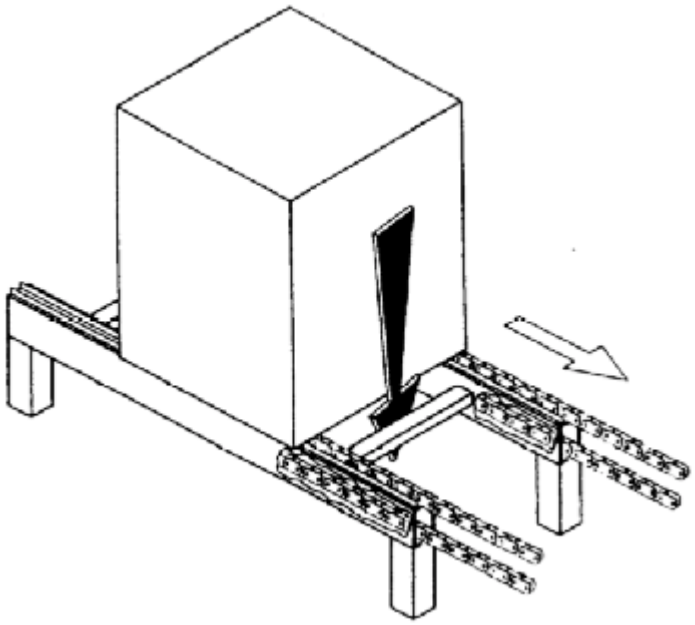


Figure C.2b) - Shearing hazard

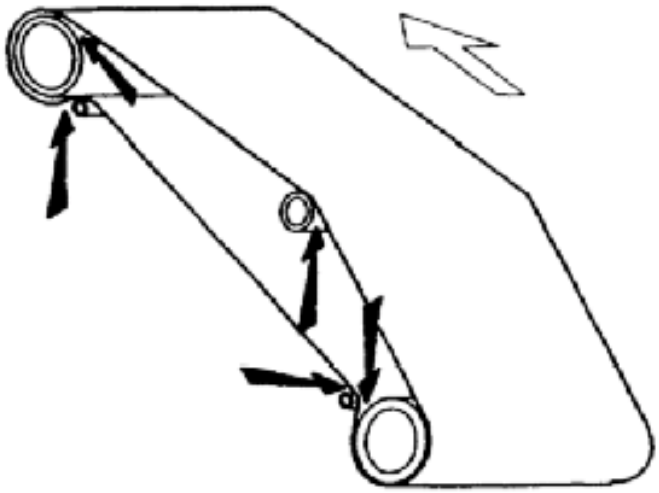


Figure C.3a) - Drawing-in hazard

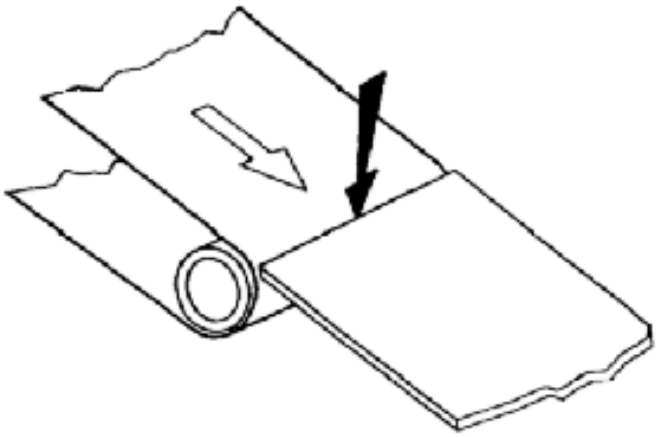


Figure C.3b) - Drawing-in hazard

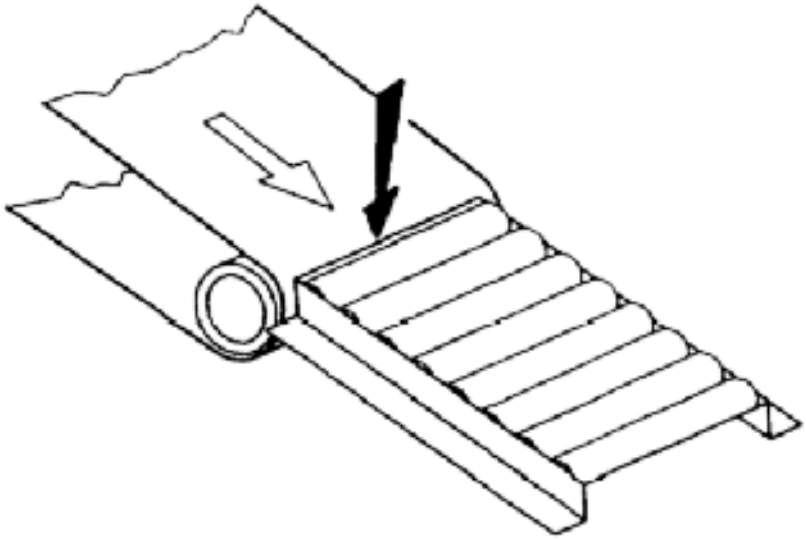


Figure C.3c) - Drawing-in hazard

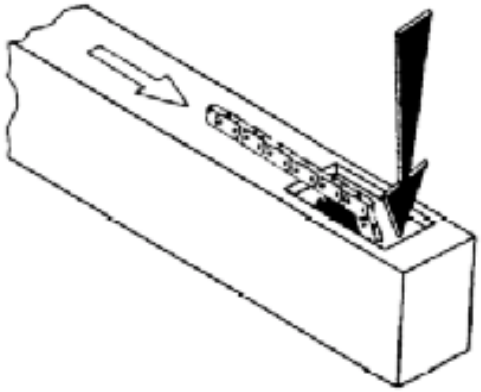


Figure C.4 - Drawing-in and crushing hazard

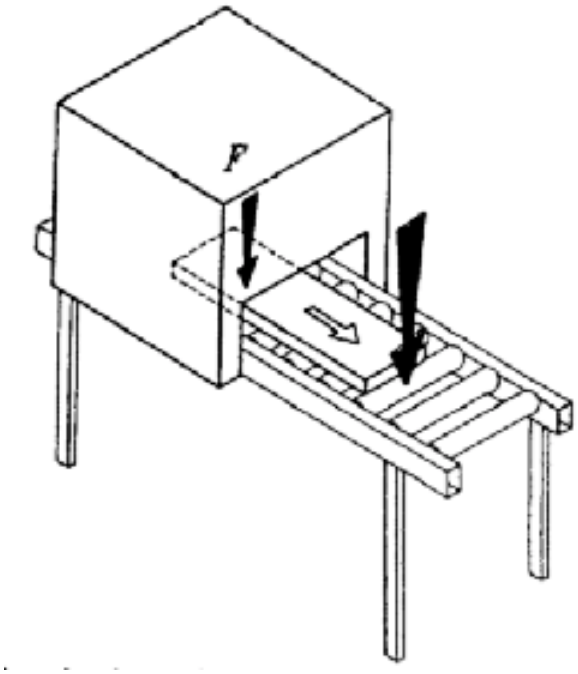


Figure C.5 - Drawing-in and shearing hazard

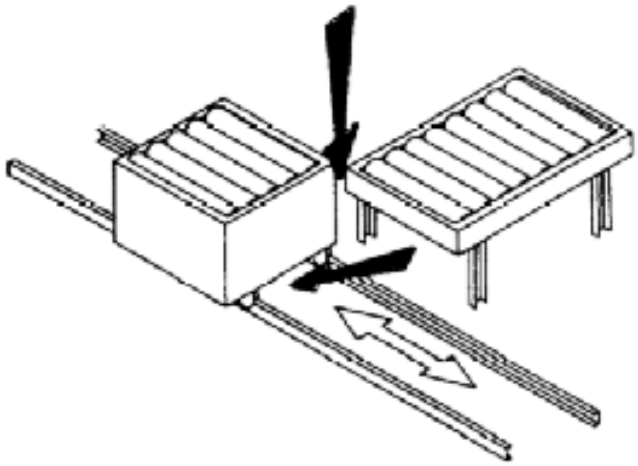


Figure C.6 - Shearing and impact hazard

Annex D
(normative)

Examples of safety requirements and/or measures

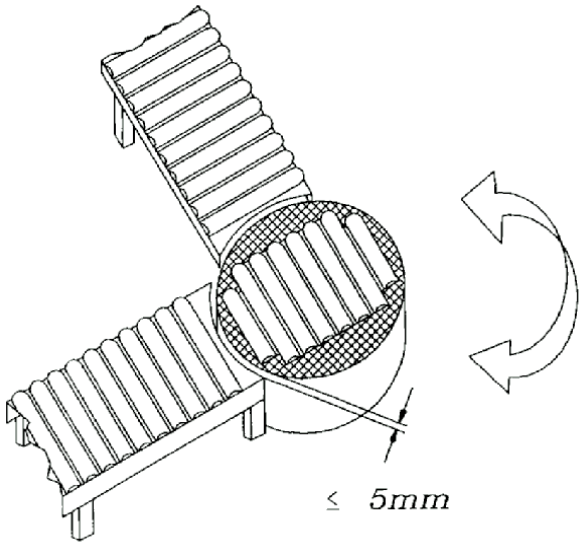


Figure D.1 - Turntable - continuous gap

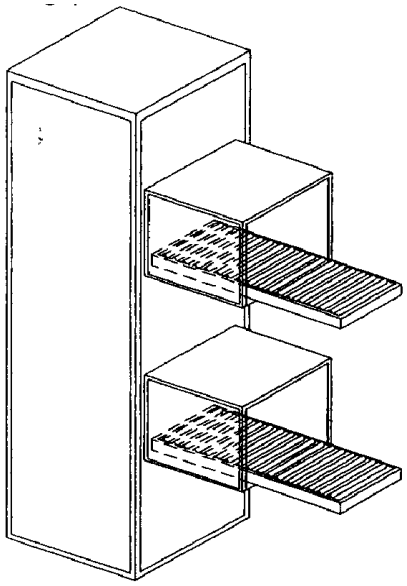


Figure D.2 - Guard for a vertical transfer device

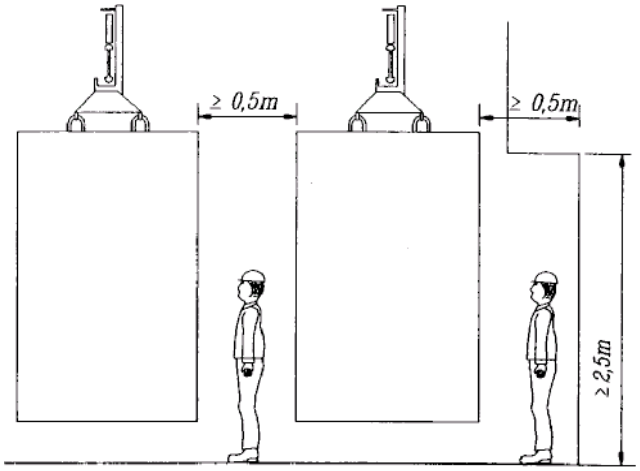


Figure D.3 - Lateral safety distances at vehicles of self-propelled overhead conveyors

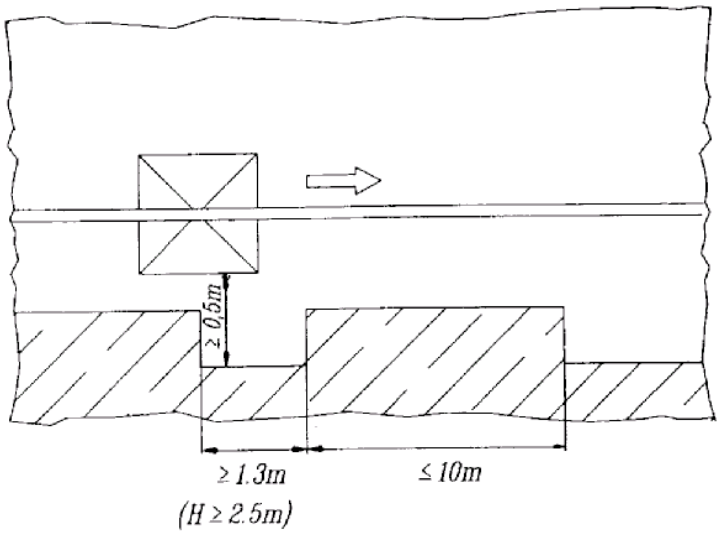


Figure D.4 - Fixed obstructions in the safety space

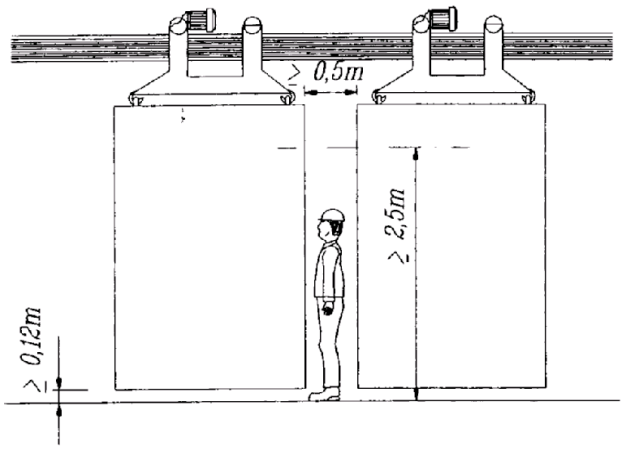


Figure D.5 - Safety distances under and between vehicles arranged one behind the other

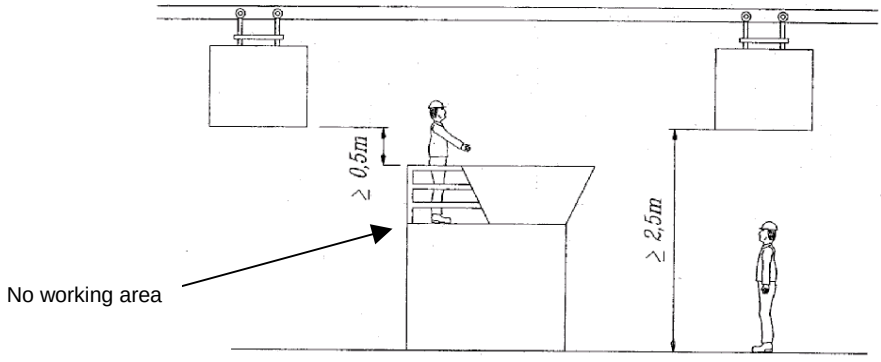


Figure D.6 - Safety distance above parts of structures or machines which can be walked on and other traffic areas and working stations

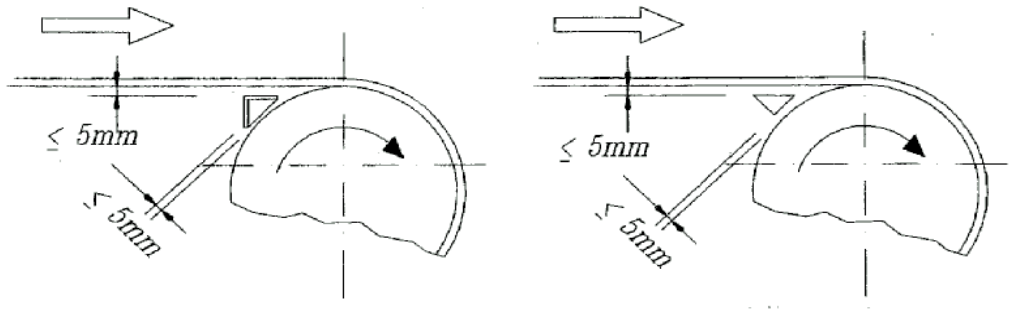


Figure D.7 - Nip guards at drawing in points of e.g. belts

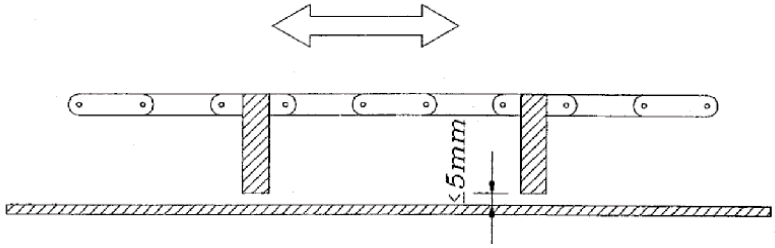
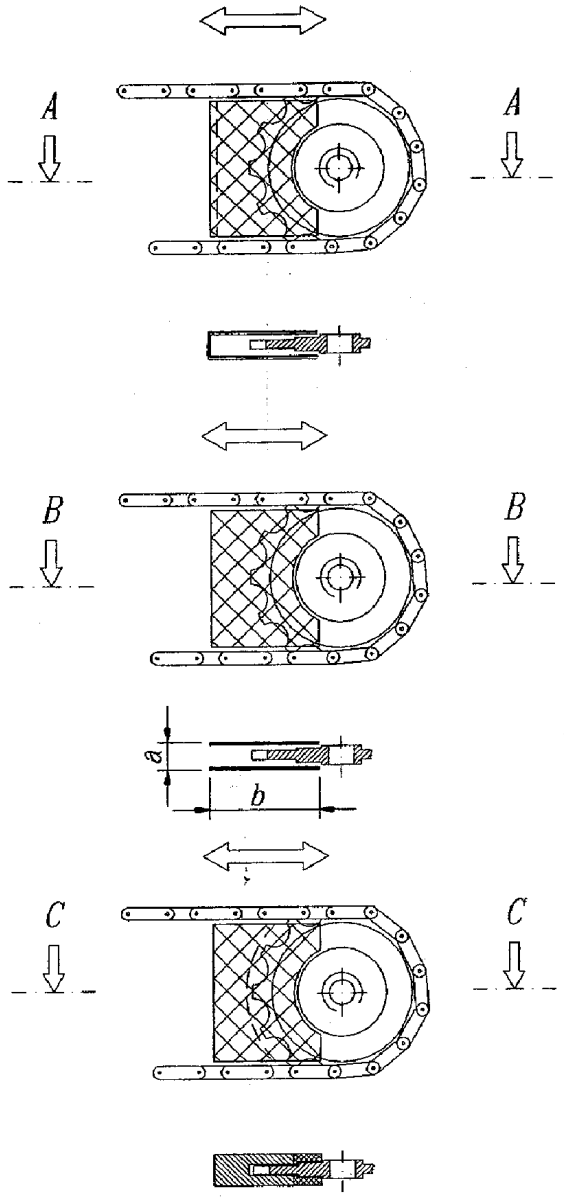


Figure D.8 - Plate guards below pushers



Key

a) Closed cover
b) Open cover, Measures a,b in accordance with EN 294
c) Nip guards

Figure D.9 - Guards and nip guards on sprockets

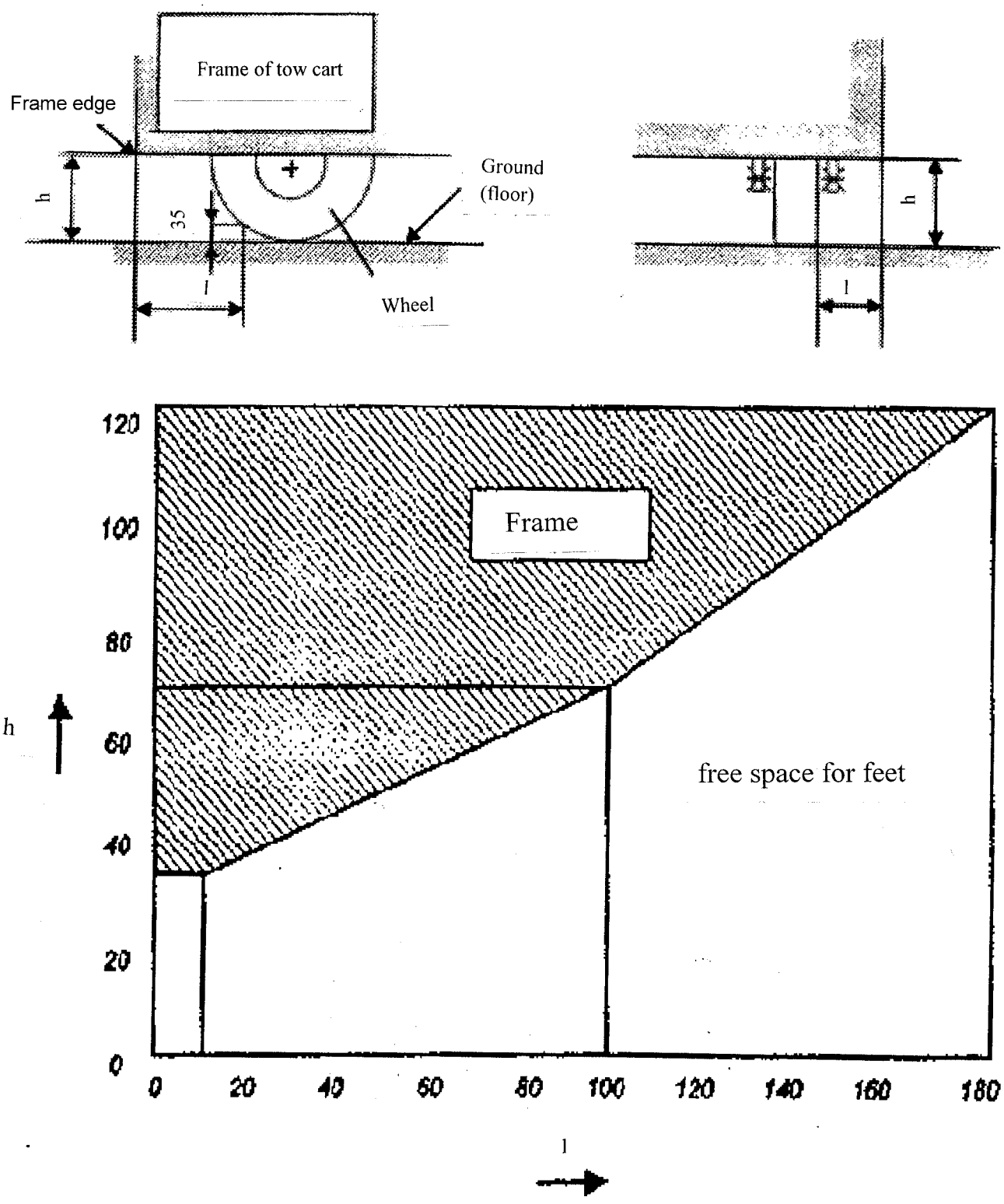


Figure D.10 - Safety distances for rollers of tow carts

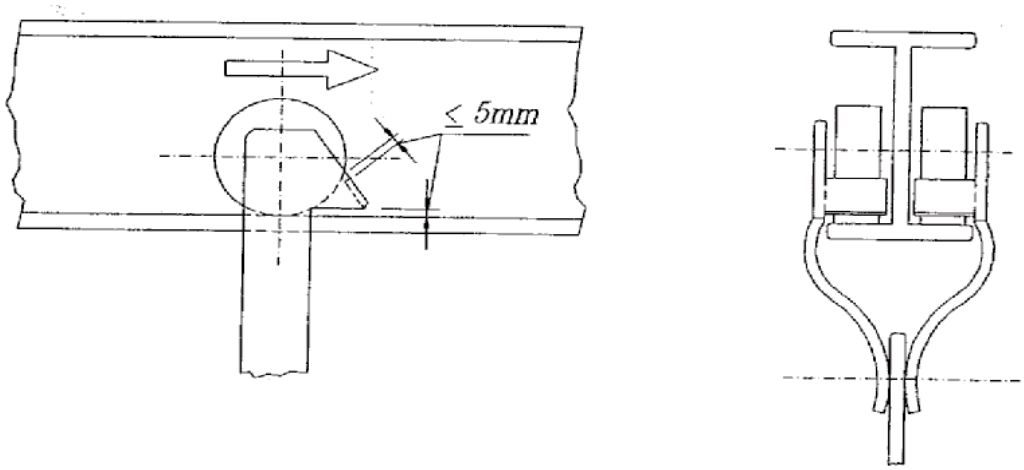


Figure D.11 - Protection on rollers of overhead conveyors

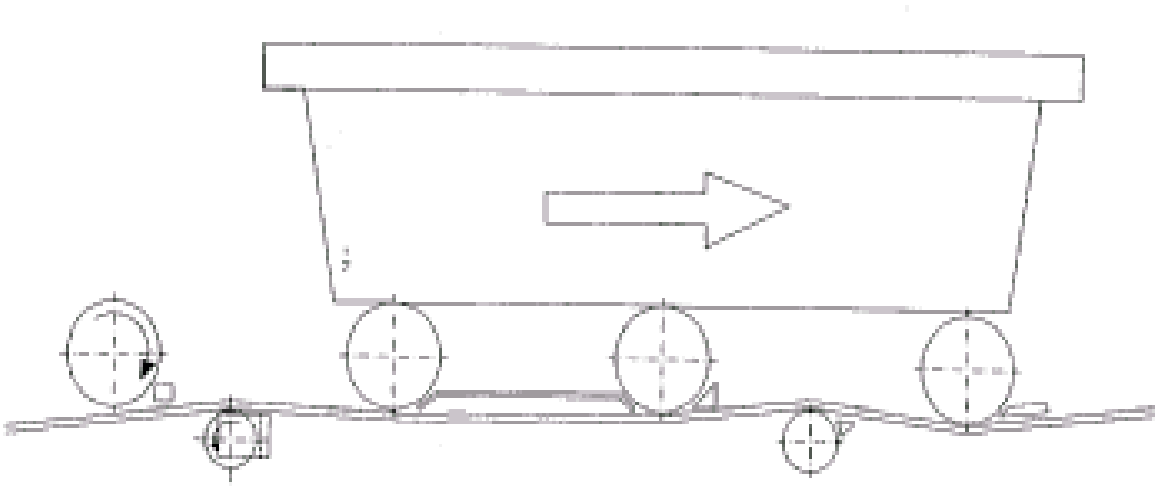


Figure D.12 - Protection of contact points on belt driven roller conveyors

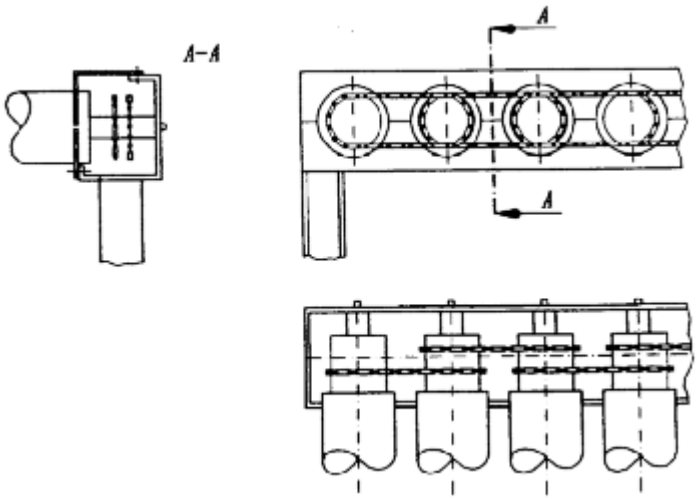


Figure D.13 - Protection on chain driven roller conveyors

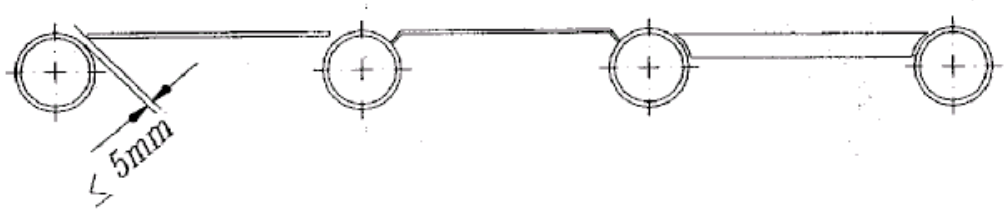
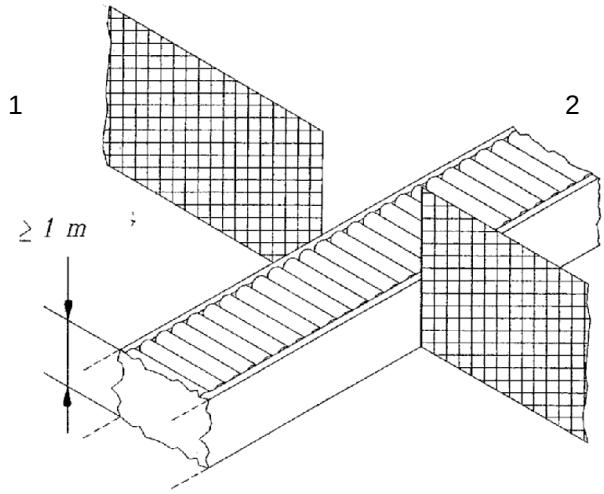


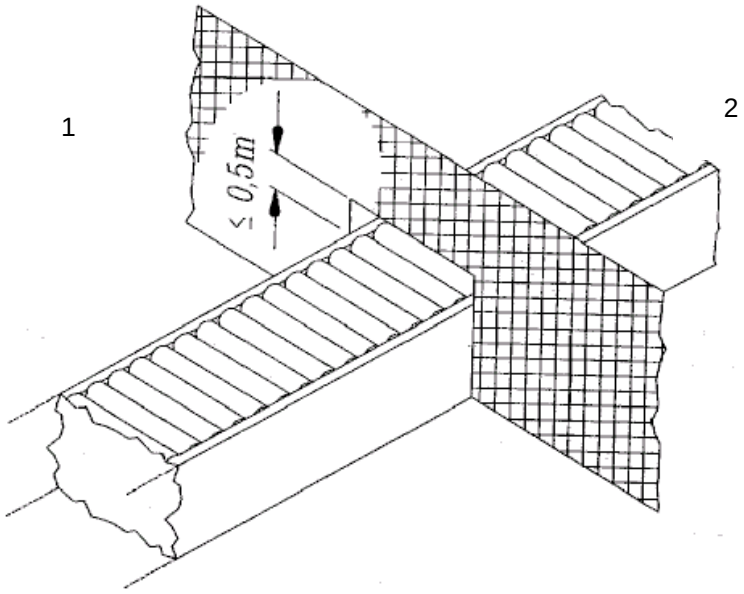
Figure D.14 - Protection between roller conveyors and conveyed unit loads



Key

1. Working and traffic area
2. Danger zone

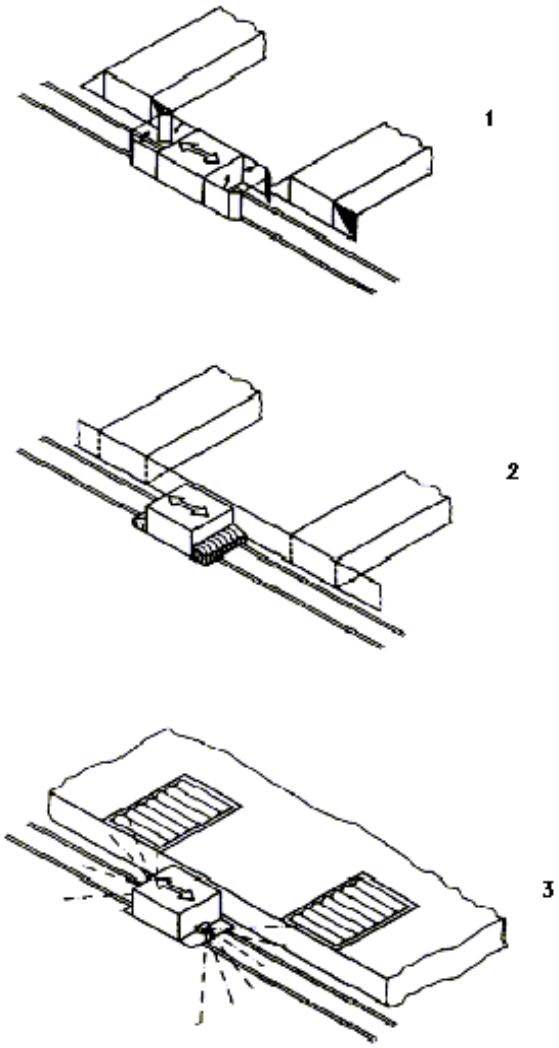
Figure D.15 - Prevention of access to danger areas (1)



Key

1. Working and traffic area
2. Danger zone

Figure D.16 - Prevention of access to danger areas (2)



Key

1. Extended sensors and deterring device
2. Bumper and continuous frontal guard
3. Laser detector and covering of intermediate space

Figure D.17 - Protection on transfer cars and interfaceing conveyors

Annex E
(normative)

Measures against crushing hazards and dropping of the carrying element of vertical transfer devices

E.1 Equipment with rope, chain or belt suspension of the carrying element

E.1.1 Safety gear with overspeed governor

A safety gear with overspeed governor is necessary where the carrying element of a vertical transfer device is designed to carry persons.

E.1.1.1 The safety gear shall operate by means of an overspeed governor at a speed no higher than 0,7 m/s or 1,4 times the rated speed, whichever is the greater.

Operation of the safety gear at a tripping speed of more than 1 m/s shall not result in a mean design retardation of more than 3 g taking into account the mass of the relevant machine parts, the rated load and the operator(s). In no case shall the safety of the operator be endangered by the operation of the safety gear.

The tensile force in the overspeed governor rope produced by the governor, when tripped, shall be at least the greater of the following two values :

a) either 300 N ; or

b) twice that necessary to engage the safety gear.

The breaking load of the rope shall be at least 8 times the tensile force produced in the rope of the overspeed governor when tripped.

E.1.1.2 When there is more than one safety gear, their actuators shall be connected (e.g. by mechanical means) to ensure they operate simultaneously.

E.1.1.3 Operation of the safety gear shall stop the hoist unit.

E.1.1.4 Breakage of or slackness in the overspeed governor rope or chain shall stop the hoist unit.

E.1.2 Lifting elements

E.1.2.1 Ropes or chains of hoist units shall be dimensioned in accordance with recognised codes of practice for load spectrum and operating time class. The ratio between the minimum breaking load and the maximum static force for all types of suspension equipment shall be at least 5. When carrying a person the factor will be 10.

E.1.2.2 All lifting elements of one lifting unit shall be of the same size, strength and construction.

E.1.2.3 Steel suspension ropes shall be made of at least 114 wires. The tensile strength of the wires in the rope shall not be less than 1570 N/mm^2.

E.1.2.4 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 carrying element is in its lowest position.

E.1.2.5 The ratio of the diameter of pulleys and drums measured at the centreline of the rope and the nominal diameter of a rope shall be in accordance with recognised codes of practice for load spectrum and operating time class, but in no case less than 22 : 1.

E.1.2.6 Means shall be provided to equalise the tension of the lifting elements where more than one element is fixed to one point, and their position shall be monitored.

E.1.2.7 Chains used as lifting elements shall be leaf or roller type only.

E.1.2.8 Rope pulleys, chain wheels or sprocket wheels shall be provided with guards to prevent the ropes or chains from leaving the grooves or teeth.

E.1.2.9 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 used for rope terminations for load carrying ropes.

E.2 Equipment with hydraulic drives

E.2.1 Cylinders, pipes, valves and fittings shall withstand twice the maximum working pressure without permanent distortion or failure in accordance with EN 982.

E.2.2 Hoses shall be able to withstand at least 3 times their maximum working pressure.

E.2.3 Means shall be provided for venting entrapped air from hydraulic circuits.

E.2.4 A pressure relief valve shall be installed between the pump and the non-return valve and shall operate at no more than 10 % above the operating pressure.

E.2.5 Provisions shall be provided to prevent lowering of the operators position in case of pipe or hose failure e.g. by a valve connected directly to the lifting cylinder or by means of a clamping unit.

E.3 Equipment with leadscrew drive

E.3.1 The ratio of the ultimate tensile stress of the material used to the design stress of the threads for leadscrews and nuts shall not be less than 6. A lower safety factor, but not less than 3, may be used on a machine without an elevating operator´s position unless there is a danger to persons.

E.3.2 The leadscrew mechanism shall be designed to prevent its separation from the lifting device during normal use.

E.3.3 Each leadscrew shall have a load bearing nut and an unloaded safety nut of the same material and size. The safety nut shall only be loaded if the load bearing nut fails. It shall not be possible to raise the lifting device when the safety nut is under load. The leadscrew shall have higher wear resistance than the nuts.

E.3.4 It shall be possible to inspect the condition of the load bearing nut without major disassembly, for instance by measurement of the clearance between the load bearing nut and the safety nut.

E.3.5 Leadscrews shall be fitted with devices at both ends to prevent the load bearing and safety nuts from leaving the leadscrew.

E.4 Equipment with rack and pinion drive

E.4.1 The ratio of the ultimate tensile stress of the material used to the design stress of racks and pinions shall not be less than 6.

E.4.2 In addition to the normal mechanisms of the machines, positively acting devices shall also be provided which prevent the driving pinion and the pinion which operates the safety gear from becoming disengaged from the rack. These devices shall ensure that the axial movement of the pinion is limited so that at least 2/3 of the tooth width remains engaged. They shall also restrict the radial movement of the pinion out of its normal combing position to a maximum of 1/3 of the tooth height.

E.4.3 Visual examination of the pinions shall be possible without the removal of the pinions or major disassembly of structural components.

E.5 Control device on the carrying element

To protect persons against crushing hazards while travelling on the carrying element, hold-to-run control devices have to be provided which shall be secure against inadvertent operation. It shall be possible to prevent simultaneous control from outside by a mode selection switch which can be locked. The travelling speed shall be reduced to creep speed. An emergency control device shall be provided at the control position on the carrying element.

Annex F
(normative)

Typical examples for the design of conveyors to prevent or deter their misuse to gain access to danger areas

F.1 General requirements

a) Access along the side of conveyors shall be minimised using the measures in F.3.2 below.

b) Walking beneath conveyors shall be prevented by fixed guards.

NOTE The following subclauses show the mostly used safety measures to prevent or deter the misuse of conveyors to gain access to danger areas but do not exclude other measures.

F.1.1 If the load entry/exit height is 0,5 m maximum and complies with EN 294 for safety distances, no further safeguarding measures shall be required (example see Figure D.16).

NOTE If danger zones can be reached through the load entry/exit the requirements of clause 5.1 apply.

F.1.2 If the load entry/exit height is greater than 0,5 m access may be prevented by a deterring/impeding device at least 1 m high (see subclause a)) and arranged in accordance with EN 294:1992, Table 1. However, if foreseeable misuse e.g. incorrect behaviour resulting from normal carelessness or from following a line of least resistance (see sub clause b)) in gaining access to or reaching danger zones can occur, access to the load transfer area shall be safeguarded by other means given in F.2 below :

a) Deterring/impeding device

Where deterring/impending shall be given by the conveyor itself, the conveyor shall be fixed firmly in place and access to a danger zone from under or between the sides of the conveyor and the aperture shall be prevented. (example see Figure D.15)

b) Access

Authorised access via an interlocked door shall be made as convenient as possible to deter personnel seeking access by any other route.

F.1.3 If the conditions of F.1.1 or F.1.2 are not applicable measures according to F.2 shall be provided and the conveyor shall have a minimum length of 1,2 m in the conveying direction ; or a minimum length of 2 m if the conveyor height is less than 0,3 m.

F.2 Measures dependent on the type of conveyor

If the frame width is 40 mm and more the possibility of walking on the frame of the conveyor shall be minimized by the design of its surface (see Figure F.1).

F.2.1 Roller conveyors

F.2.1.1 Gravity roller conveyors

For a roller length of 0,85 m minimum (i.e. width of the conveyor) and gap between rollers of 0,1 m maximum the possibility of walking on the conveyor is deterred. Where roller tracks are used, entry between the tracks shall be deterred e.g. by the use of a deterring net or mat as described in clause F.2.4.

F.2.1.2 Live roller conveyors

The gap between the rollers and the roller diameter shall be selected to minimize the possibility of standing or walking on the rollers (e.g. 0,12 m minimum gap). Persons are to be deterred from stepping between the rollers at

conveying levels of 0,5 m or less e.g. by fixing a tightly tensioned net, capable of bearing a person, or a building reinforcing mat of about 0,15 m grating beneath the rollers at about 0,3 m height above the floor.

F.2.2 Twin chain conveyors

To deter persons from walking between the chains in the case of chain 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 one of the following means (see Figure F.2) :

— deterring net or mat as described in clause F.2.4 ;

— sloping plates marked in warning colours (black/yellow) ;

— pressure sensing floor marked in warning colours (black/yellow - not for use in case of a fall hazard).

For chain spacing distances of less than 0,85 m and/or a chain width of 40 mm or more, other means shall be considered (see F.2.3).

F.2.3 Other conveyors

In case of danger areas behind the safeguards in F.2.3.1 and F.2.3.2, safety distances in accordance with EN 294:1992, Table 1, shall be provided.

F.2.3.1 Safeguarding by mechanical guards

In case of crushing/shearing hazards caused by moving conveyor parts or the hazard of falling into the floor opening for vertical transfer devices mechanical guards shall be used, e.g. gates, swinging doors, lowering guards or doors (see Figure F.3). The control of the safeguard shall be designed in such a way, that the guard shall only be released or opened to allow the passage of conveyed material.

F.2.3.2 Safeguarding by trip devices

In case of crushing and/or shearing hazards caused by moving conveyor parts, but not the hazard of falling into the floor opening for vertical transfer devices, trip devices, e.g.photo-electric devices or pressure sensitive devices shall be used (see Figure F.4).

F.2.4 Deterring net or mat

Deterring persons from walking on the floor between parts of the conveyor or between the sides of the conveyor and the surroundings, e.g. fencing,can be made by :

— a tightly tensioned steel wire or fibre rope net ; or

— a building reinforcing mat of about 0,15 m grating.

This net or mat shall be capable of bearing a load of 70 kg applied on an area with a dimension of 0,1 x 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.

F.3 Measures for the area beside the conveyor

F.3.1 Measures against crushing/shearing hazards

If there is a distance of less than 0,5 m between conveyed material and fixed parts of the surroundings, e.g. fencing, danger zones shall be safeguarded e.g. by trip devices, such as trip wires or photo-electric devices.

F.3.2 Measures against access

The area between the conveyor and the fixed guard (fencing) shall be protected against access by e.g. sloping plates marked in warning colours (black/yellow - see Figure F.5). For distances of more than 0.5 m deterring nets or mats as described in clause F.2.4 shall be provided.

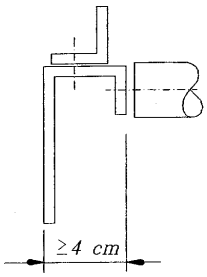
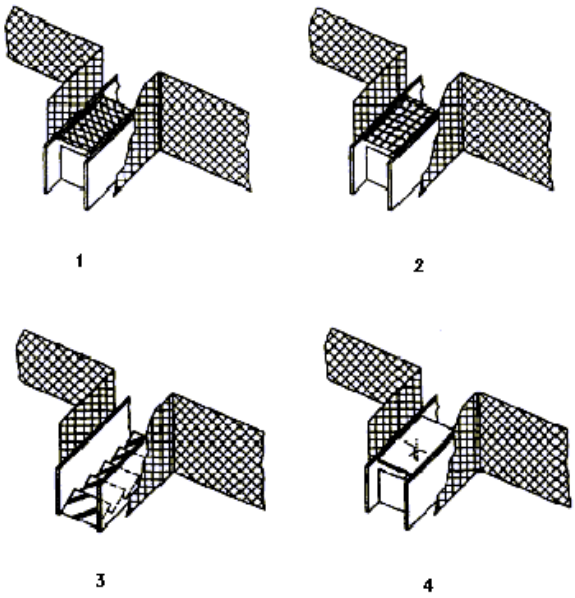


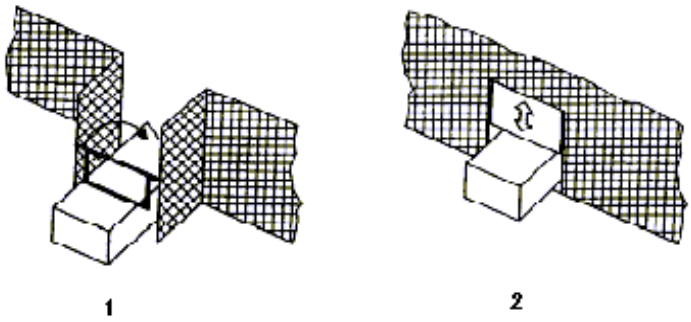
Figure F.1 - Design of frame surface



Key

1. Steel wire or fibre rope net
2. Building reinforcing mat
3. Sloping plates
4. Pressure sensing floor

Figure F.2 - Area between chains of twin chain conveyors



Key

1. Gate
2. Door

Figure F.3 - Mechanical guards

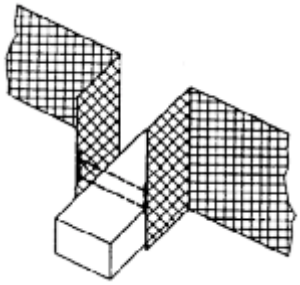


Figure F.4 - Trip devices

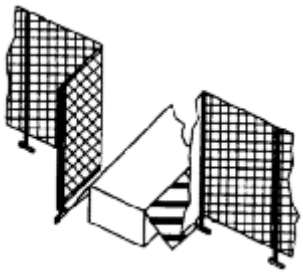


Figure F.5 - Sloping plates

Annex G
(informative)

Considerations for a risk assessment for continuous handling equipment for unit loads

G.1 Mechanical hazards

A distinction is made between :

— hazards due to the power transmission system (gear motor, pinions, pulleys, etc.) ; and

— hazards due to the conveying of the load.

Power transmission parts present a hazard which is certain and localized. They will be equipped with fixed guards.

The conveyed load may cause physical injuries by crushing, shearing. Injuries depend on :

— the loads itself : its masses, speeds, driving forces by the rollers, its shapes, the contact surfaces, its material hardnesses, etc. ;

— the type of stress applied : crushing, shearing, etc. ;

— the part of the human body which is affected : finger, hand, elbow, forearm, body, etc.

In view of this great number of parameters, it is not simple to determine the seriousness of a hazard. This is all the more difficult since there are only a few studies which have some connection with this subject, i.e. EN 953 for power-driven guards, the force necessary to close the doors of public transport vehicles and garage doors, car impact biomechanics. These studies cannot be directly used.

On the other hand, the technical standardization committee CEN/TC 122 has included a new item in its work programme "Maximum values of machines' active forces to avoid crushing of parts of the human body". Due to the necessary research work, there will not be any usable results for several years.

Before specifying safeguards, there is a need to assess the seriousness of hazards as well as the probability of their occurrence. These two aspects form part of the risk assessment.

G.2 Seriousness of the hazard

Seriousness is determined using an approximate method which takes into account four parameters :

— the speed ;

— the weight of the load ;

— the force applied to the load by the conveyor ;

— the material of which the load is made.

A "weighting" from 1 to 5 is applied to each of these four parameters depending on their value.

For a given moving load, the weightings corresponding to each parameter will be added to obtain a "seriousness index". So the "seriousness index" ranges from 4 (the four parameters have the lowest weightings) to 20 (the four parameters have the highest weightings).

For a number of different loads a list of "seriousness indices" will be obtained. These indices are grouped in a scale with 5 levels of seriousness.

G.3 Risk probability

Risk probability depends on how close persons are and how often they come by.

A distinction is made between areas with a high average, small and very low probability, dependent on the frequency, attendance time and distance of persons.

G.4 Safeguards to be fitted

The safeguard to be fitted depends on the seriousness of the hazard ("level of seriousness") and on the area ("risk probabilitiy"). The lowest level of safety measures will apply for low seriousness and low risk probability, the highest level for high seriousness and high risk probability.

NOTE See also EN 954-1 and EN 1050.

Annex H
(normative)

Verification of safety requirements and/or measures

Safety requirements and/or measures of the clauses 5 and 7 of this standard shall be verified according to the Table below. It includes the following types of verification :

1) visual inspection, the result of which only being to establish that something is present (e.g. a guard, a marking, a document) ;

2) measuring, the result of which being that the stated measurable parameters have been met (e.g. geometric dimensions) ;

3) functional tests, the result of which shows that the adequate signals intended to be forwarded to the main control system of the complete machine are available and comply with the requirements and with the technical documentation ;

4) special verification, the procedure being given under "remarks" or in the referred clause.

As continuous mechanical handling equipment or system is generally assembled at its place of use, verification shall made at the appropriate time preferably :

— at the design (D) ;

— manufacturing (M) ;

— assembling (A) ; and/or

— commissioning stage (C).

All safety measures and dimensions should be verified during design stage.

Subclause	Visual Inspection	Measuring	Functional Tests	Special verifi-cation	Remarks
5, 2nd paragraph	A		C		
5, 3rd paragraph				D	choice of stopping means
5.1.1.1, 1st paragraph		A			
5.1.1.1, 2nd paragraph	A	A			fence
5.1.1.1, 2nd paragraph	A		C		interlocking guards
5.1.1.1, 2nd paragraph	A		C		trip devices
5.1.1.2		A			fixed guards
5.1.1.2	A		C		interlocking guards
5.1.1.3		A			gaps
5.1.1.3	A		C		trip devices
5.1.1.4		A	C		
5.1.1.5		A			
5.1.1.6		A			
					"continued"

(continued)

Subclause	Visual inspection	Measuring	Functional Tests	Special verifi-cation	Remarks
5.1.1.7		A (C)			Safety distances
5.1.1.7	A				guarding
5.1.1.8	A				fixed guard
5.1.1.8			C		interlocking devices
5.1.1.9		A			
5.1.2	A				
5.1.3.1		A			fixed guard
5.1.3.1	A		C		interlocking guard
5.1.3.2		A			gaps
5.1.3.2	A		C		trip device
5.1.3.3	A				
5.1.3.4	A				
5.1.3.5		A			
5.1.3.6	A				
5.1.3.7	A				guards
5.1.3.7		M			gap
5.1.3.8	A				
5.1.3.9	A	A			
5.1.3.10, 1st paragraph			A		possibility of deviation
5.1.3.10, 2nd paragraph	A				
5.1.4.1	A				fixed devices
5.1.4.1			C		trip devices, interl. guards, controls
5.1.4.2	A				See annex F.
5.1.4.3			C		
5.1.4.4			C		
5.1.4.5		A			
5.1.4.6, 1st paragraph	A				fixed guards
5.1.4.6, 1st paragraph			C		trip devices
5.1.4.6, 1st paragraph	(A)		(C)		load entry/exit – see annex F
5.1.4.6, 2nd paragraph			C		
5.1.4.6, 3rd paragraph	A				fixed devices
5.1.4.6, 3rd paragraph			C		trip devices
5.1.5.1.1	A				
5.1.5.1.2			A		mechanical parts
5.1.5.1.2			C		with loads
5.1.5.1.3				D	calculation of mechanical strength
					"continued"

(continued)

Subclause	Visual Ispection	Measuring	Functional Tests	Special verifi-cation	Remarks
5.1.5.1.4	M				
5.1.5.1.5	A				
5.1.5.1.6	A		A		mechanical parts
5.1.5.1.6			C		interlocking parts
5.1.5.1.7	A		A		mechanical parts
5.1.5.1.7			C		interlockings, controls
5.1.5.1.8			C		
5.1.5.1.9			M		type test for series construction or individual test for non series construction
5.1.5.1.9	M				individual test for series construction
5.1.5.2.1	A				
5.1.5.2.2	M				
5.1.5.2.3			C		
5.1.5.2.4				D	calculation
5.1.6	A				
5.1.7.1	A				
5.1.7.2	A	A			
5.1.7.3	A	A			
5.1.7.4		C			
5.1.7.5	A				
5.2.1, 2nd paragraph				D	choice of equipment
5.2.1.1, 1st paragraph	M (A*)				* If added during assembly.
5.2.1.1, 2nd paragraph	A				
5.2.1.1, 3rd paragraph	A				
5.2.1.2, 1st paragraph	M (A*)				* If added during assembly.
5.2.1.2, 2nd paragraph			C		
5.2.1.2, 3rd paragraph				D	choice of equipment
5.2.1.3	A				
5.2.2	A				
5.3		M			See also 6.3.5.
5.4		C			
5.5			C		
5.6				D	choice of means
5.7.1			C		
5.7.2			C		
5.7.3			C		
					"continued"

(continued)

Subclause	Visual Ispection	Measuring	Functional Tests	Special verifi-cation	Remarks
5.7.4			C		
5.7.5			C		
5.7.6			C		
5.7.7.1				D	circuit diagrams, choice of components
5.7.7.2			C		see also 6.3.4 for vertical transfer devices
5.7.7.3, 1st paragraph	A				
5.7.7.3, 2nd paragraph			C		
5.7.7.3, 3rd paragraph			C		
5.7.7.4, 1st paragraph				D	choice of stopping means
5.7.7.4, 1st paragraph				D	choice of stop category
5.7.7.4, 2nd paragraph			C		
5.7.7.4, 3rd paragraph			C		
5.7.7.5, 1st paragraph				D	choice of stopping means
5.7.7.5, 2nd paragraph	A				
5.7.7.5, 3rd paragraph		A			
5.7.7.5, 4th paragraph	A		C		
5.7.7.6, 1st paragraph			C		
5.7.7.6, 2nd paragraph			C		
5.7.7.6, 3rd paragraph	A		C		
5.7.7.6, 4th paragraph	M, A				
5.7.7.7			C		
5.7.8.1, 1st paragraph	A				
5.7.8.1, 2nd paragraph	A		C		
5.7.8.1, 3rd paragraph	A				
5.7.8.1, 4th paragraph	A				
5.7.8.1, 5th paragraph	A				
5.7.8.1, 6th paragraph	A				
5.7.8.1, 7th paragraph				C	pressure test with factor 1,1 above the maximum working pressure
5.7.8.1, 8th paragraph	A		C		
5.7.8.1, 9th paragraph				D	system design
5.7.8.1, 10th paragraph	A		C		
5.7.8.2, 1st paragraph				D	choice of equipment
5.7.8.2 ; 2nd paragraph				D	choice of fluid/gas
5.7.8.2, 3rd paragraph				D	capacity of fluids reservoir
5.7.8.2, 4th paragraph				D	choice of equipment
					"continued"

(continued)

Subclause	Visual Ispection	Measuring	Functional Tests	Special verifi-cation	Remarks
5.7.8.2, 5th paragraph				D	choice of equipment
5.7.8.3				D	system design
5.7.8.3	A				measures against incorrect connection
5.8.1	A		C		
5.8.2	A		C		
5.8.3	A				annex E
7.1.1				M	check
7.1.2				M	check
7.1.3				C	check
7.1.4				C	check
7.1.5				C	check
7.1.6	A				
7.1.7	A				
7.1.8	A				
7.1.9				C	check
7.1.10				C	Check
7.1.11				A	training
7.2.1	C				
7.2.2	C				
7.2.3	C				
7.2.4	C				
7.2.5	C				
E.1.1				D	choice of component
E.1.1.1, 1st paragraph		C			
E.1.1.1, 2nd paragraph				D	calculation
E.1.1.1, 3rd paragraph		A			
E.1.1.1, 4th paragraph				D	choice of components
E.1.1.2	A				
E.1.1.3			C		
E.1.1.4			C		
E.1.2.1				D	choice of components
E.1.2.2				D	choice of components
E.1.2.3				D	choice of components
E.1.2.4	C				
E.1.2.5				D	choice of components
E.1.2.6	A		C		
					"continued"

(concluded)

Subclause	Visual Ispection	Measuring	Functional Tests	Special verifi-cation	Remarks
E.1.2.7				D	choice of components
E.1.2.8	A				
E.1.2.9				D	choice of components
E.2.1				D	choice of components
E.2.2				D	choice of components
E.2.3			A		
E.2.4			C		
E.2.5			M		type test for series construction or individual test for non series construction.
E.2.5	M				individual test for series construction
E.3.1				D	choice of components
E.3.2	A				
E.3.3	A			D	choice of components
E.3.4	A				
E.3.5	A				
E.4.1				D	choice of components
E.4.2	A				
E.4.3	A				
E.5	A		C		
F.1	A				
F.1.1	A	A			
F.1.2	A	A			
F.1.2 a)	A				
F.1.2 b)	A		C		
F.1.3	A				
F.2	A				
F.2.1.1	A	A			
F.2.1.2	A	A			
F.2.2	A				
F.2.3		A			
F.2.3.1			C		
F.2.3.2			C		
F.2.4				D	see F.2.4 – type test with load
F.2.4			A		see F.2.4 – individual test: check of fixing/tension
F.3.1			C		
F.3.2	A				

Annex ZA (informative)

Relations of this document with EC Directives

This European Standard has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association and supports essential requirements of following EC Directives :

Machinery Directive 98/37/EC, amended by 98/79/EC

Compliance with this standard provides one means of conforming with the specific essential requirements of the Directive concerned and associated EFTA regulations.

WARNING: Other requirements and other EC Directives may be applicable to the products falling within the scope of this standard.

Annex ZB (informative)

Clauses of this European Standard which address Principal Protection Requirements of the EU Electro-magnetic compatibility Directive 89/336/EEC

This European Standard has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association and supports essential requirements of following EC Directives :

Machinery Directive 98/37/EC, amended by 98/79/EC

The following clauses of this standard are likely to support requirements of the EMC Directive 89/336/EC :

6.3.5.1 Tests in relation to the EMC Directive

8 Electromagnetic compatibility requirements

Compliance with these clauses of this standard provides one means of conforming with the specific essential requirements of the Directive concerned and associated EFTA regulations.

WARNING: Other requirements and other EU Directives may be applicable to the products falling within the scope of this standard.