
BUdfUj Y]b`g]ghYa]nU_cbh]bi]fb]`fUbgdcfh!`BUdfUj Y`nU\ fUb`Yb`Y`g]d_Y[U
a UHyf]Uj j `Vi b_Yf` žg]cg] žnUc[c j b_]`]b`]U_] `!`DcgYVbY`j UfbcghbY`nU hYj Y
nUbU ftcj Ub`Yž]nXY`Uj cža cbhYc`]b`gYfj]g]fUb`Y

Continuous handling equipment and systems - Safety and EMC requirements for the equipment for the storage of bulk materials in silos, bunkers, bins and hoppers

Stetigförderer und Systeme - Sicherheits- und EMV-Anforderungen an Einrichtungen für die Lagerung von Schüttgütern in Silos, Bunkern, Vorratsbehältern und Trichtern

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Equipements et systemes de manutention continue - Prescriptions de sécurité et de CEM pour les équipements de stockage des produits en vrac en silos, soutes, réservoirs et trémies

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ICS 33.100.01; 53.040.10

English version

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Trichtern

This European Standard was approved by CEN on 4 June 2001.

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

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

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EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

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 SIST EN 617:2002

Foreword

This European Standard has been prepared by Technical Committee CEN/TC 148 "Continuous handling equipment and systems - Safety", the secretariat of which is held by AFNOR.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by January 2002, and conflicting national standards shall be withdrawn at the latest by January 2002.

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 EU Directive(s).

For relationship with EU Directive(s), see informative annexes ZA and ZB, which are integral parts of this standard.

Within the framework of its programme of work, CEN/TC 148 requested the working group 4 "Safety requirements for the storage of bulk materials in silos, bunkers, bins and hoppers" to prepare the following standard :

- 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.*

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.*
- prEN 618, *Continuous handling equipment and systems - Safety and EMC requirements for equipment for mechanical handling of bulk materials except fixed belt conveyors.*
- prEN 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.*

Annex A is normative, the annexes B, C, D, ZA and ZB are informative.

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

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 system ;
- components without specific requirements are :
 - a) designed in accordance with the usual engineering practice and calculation codes, including all failure modes (see also Bibliography and annex B) ;
 - 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 required characteristics remain despite wear ;
- by design of the load bearing elements, a safe operation of the system is assured for loading ranging from zero to 100 % of the rated possibilities and during the tests ;
- to ensure the correct function of the equipment the ambient temperature is maintained between -5 °C to + 50 °C;
- negotiation occurred between the manufacturer¹⁾ and the user concerning particular conditions for the use and places of use for the machinery related to health and safety ;
- the place of installation allows a safe use of the machine.

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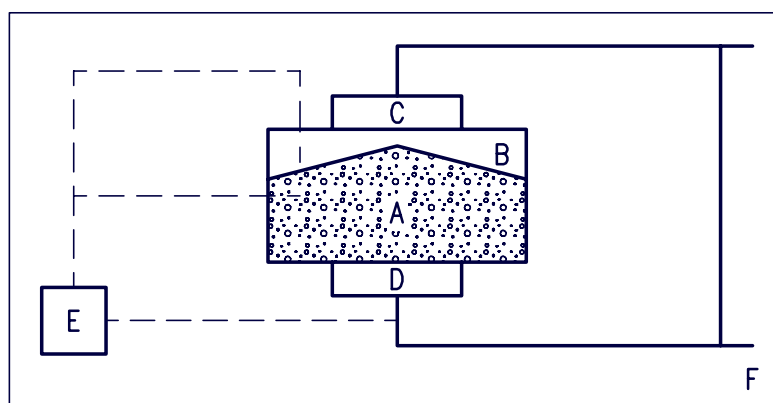
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1) “manufacturer” within the European Union is to be understood as intended in the Machinery Directive.

1 Scope

This European Standard deals with the technical requirements to minimise the hazards listed in clause 4 and annex A. These hazards can arise during the operation and maintenance of equipment to store bulk materials in silos, bunkers, bins and hoppers and their built-in inlet and outlet devices 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.

The following parts are dealt with in this standard (see Figure 1) :



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Key

- [SIST EN 617:2002](https://standards.iteh.ai/catalog/standards/sist/4824535b-0570-47e7-ba14-3997840c83/sist-en-617-2002)
- A Bulk material to be stored <https://standards.iteh.ai/catalog/standards/sist/4824535b-0570-47e7-ba14-3997840c83/sist-en-617-2002>
- B Storage space limited by the silo structure [3997840c83/sist-en-617-2002](https://standards.iteh.ai/catalog/standards/sist/4824535b-0570-47e7-ba14-3997840c83/sist-en-617-2002)
- C Charging
- D Discharging
- E Associated and additional equipment (e.g. flow aid devices, instrumentation, local control systems)
- F Working and traffic area

Figure 1 – Parts of a storage equipment

NOTE Silos are made of different materials e.g. concrete, steel, aluminium, spun rayon, wood.

Safety requirements and/or measures in this standard apply to equipment used in all environments. However, additional risk assessment and safety measures need to be considered in severe conditions, e.g. low or high temperatures out of the range covered by EN 60204-1, corrosive environments, strong magnetic fields, radioactive conditions and bulk materials to be stored included their flow the nature of which could lead to a dangerous situation.

This standard does not cover requirements for :

- movable, non permanent storage equipment such as road vehicles, rail wagons, containers for bulk materials, ships and barges ;
- blow tanks and pressure vessels as used in pneumatic conveying systems ;
- stockpiles and flat storage ;
- storage equipment for non bulk materials (liquid, gas, slurries, sludge, silage) ;
- dismantling and transport of storage equipments;

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- procedure for entering the silo and behaviour of persons inside the silo;
- storage equipments for underground mining.

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

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 131, *Ladders - Terms, types, functional sizes.*

EN 292-1, *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 349:1993, *Safety of machinery - Minimum gaps to avoid crushing of the parts of the human body.*

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

EN 547-1:1996, *Safety of machinery - Human body measurements – Part 1: Principles for determining the dimensions required for openings for whole body access into machinery.*

EN 547-3, *Safety of machinery - Human body measurements – Part 3: Anthropometric data.*

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

EN 574, *Safety of machinery - Two- hand control devices - Functional aspects - Principles for design.*

prEN 618, *Continuous handling equipment and systems - Safety and EMC requirements for equipment for mechanical handling of bulk material except fixed belt conveyors.*

EN 620, *Continuous handling equipment and systems - Safety and EMC requirements for fixed belt conveyors for bulk material.*

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 741, *Continuous handling equipment and systems - Safety requirements for systems and their components for pneumatic handling of bulk material.*

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

EN 811:1996, *Safety of machinery - Safety distances to prevent danger zone being reached by the lower limbs.*

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 954-1:1996, *Safety of machinery - Safety related parts of control systems – Part 1: General principles for design.*

EN 1037:1995, *Safety of machinery - Prevention of unexpected start-up.*

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

EN 1127-1, *Explosive atmospheres – Explosion prevention and protection – Part 1: Basic concepts and methodology.*

prEN ISO 14122-1, *Safety of machinery - Permanent means of access to machines and industrial plants – Part 1: Choice of a fixed means of access between two levels (ISO/FDIS 14122-1:1999).*

prEN ISO 14122-2, *Safety of machinery - Permanent means of access to machines and industrial plants – Part 2: Working platforms and walkways (ISO/FDIS 14122-2:1999).*

prEN ISO 14122-3, *Safety of machinery - Permanent means of access to machines and industrial plants – Part 3: Stairways, stepladders and guard-rails (ISO/FDIS 14122-3:1999).*

prEN 12464, *Lighting applications – Lighting of work places.*

prEN 13202:1998, *Ergonomics of thermal environment - Temperatures of touchable hot surfaces - Guidance for establishing surface temperature limit values in production standards with the aid of EN 563.*

EN 26184-1, *Explosion protection systems - Part 1: Determination of explosion indices of combustible dust in air (ISO 6184-1: 1985).*

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

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

prEN 60204-11:1998, *Safety of machinery - Electrical equipment of machines - Part 11: General requirements for voltage above 1 000 V a.c. or 1 500 V d.c. and not exceeding 36 kV.*

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

EN 60825-1, *Safety of laser products – Part 1: Equipment classification, requirements and user's guide (IEC 60825-1:1993).*

EN 60947-5-1:1997, *Low voltage switchgear and controlgear - Part 5: Control circuit devices and switching elements - Section 1: Electromechanical control circuit devices (IEC 60947-5-1:1997).*

IEC 60364-7-706, *Electrical installations of buildings- Part 7: Requirements for special installations or locations. Section 706 – Restrictive conducting locations.*

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

IEC 61241-1-2, *Electrical apparatus for use in the presence of combustible dust - Part 1: Electrical apparatus protected by enclosures – Section 2: Selection, installation and maintenance of apparatus.*

ISO 3435, *Continuous mechanical handling equipment - Classification and symbolisation of bulk materials.*

ISO 3864, *Safety colours and safety signs.*

3 Terms and definitions

For the purposes of this standard the terms and definitions in EN 292-1 and the following terms and definitions apply :

3.1 silo
that part of a continuous handling system used to contain intended kind(s) of bulk material(s) during a certain period of time. The silo is usually charged from the top and discharged from one or more outlets at the bottom or side

With regard to this document "silo" is a generic term for bunker, bin, and hopper.

3.2 bulk material
a bulk material is a mixture consisting of a minimum of two phases, solid and gas. Normally liquid is also present in a bulk material and is referred to as moisture content. The solid in a bulk material consists of fine or coarse particles or of larger pieces or mixtures of these. In practice bulk materials are known as dusts, powders, meals, grains, granules, lumps, and pellets

NOTE For further information relating to description and classification of bulk materials see FEM 2.381 and FEM 2.581/2.582 (see Bibliography) and ISO 3435 (clause 2).

3.3 charging
devices to facilitate silo filling

3.4 discharging
devices to facilitate silo emptying. The minimum function of this equipment is :

- withdrawal of bulk material through the designed outlet ;
- converging of bulk material from the silo to downstream equipment (e.g. airlocks, gates) ;
- provision of the intended discharge rate(s).

3.5 working area
an area as intended by the manufacturer where persons operate equipment under normal conditions (inspection, maintenance and cleaning are excluded)

NOTE For manufacturers information relating to intended use see Introduction, negotiation.

3.6 traffic area
an area as intended by the manufacturer which is accessible or reachable by all persons without opening a guard, activating a trip device or using additional means. This area includes permanent means of access

NOTE For manufacturers information relating to intended use see Introduction, negotiation.

3.7 flow aid devices
additional equipment to assist the flow of bulk materials from silos. These can be static or dynamic. Static aids include all types of wall linings and non-moving inserts. Dynamic aids include all moving inserts and also fixed or moving equipment that may incorporate all forms of energy input into the bulk material e.g. via air, vibration (including sound), mechanical agitation etc.

3.8

flow channel

a route through a bulk material stored in a silo through which flow can occur

Flow channels are usually wider at the top than at the silo outlets and have quite steep walls. When flow channels are present the full capacity of the silo may not be realisable.

3.9

flow behaviour

the characteristic or pattern of bulk materials flow during the discharge period in a silo, known as mass flow, core flow (funnel flow), rat-holing, etc.

3.9.1

mass flow

flow behaviour of bulk material in a silo during the discharge period. All particles of bulk material are in motion towards the outlet during this period of time. No dead or stagnant zones occur

NOTE Mass flow silos empty completely.

3.9.2

core flow

flow behaviour of bulk material in a silo during the discharge period. At the beginning of the discharge period only a core zone of bulk material is in motion towards the outlet. Bulk material adjacent to this core zone remains stationary. The movement of bulk material starts above the outlet, forming a flow channel or funnel (funnel flow) which either extends up vertically to the top surface of bulk material or inclined to the silo walls. The geometry of this flow channel can be variable. As discharge operation proceeds, bulk material surrounding the flow channel either gradually slides down into the channel on certain slip lines or remains stationary forming a stable hole which is referred to as rat-holing or piping

NOTE Core flow is also referred to as funnel flow.

3.9.3 rat-holing

flow behaviour of bulk material in core flow (see core flow) forming a stable hole shaped like a pipe or a rat-hole

NOTE Rat-holing is also referred to as piping.

3.9.4

flooding

flow behaviour of aerated or fluidised bulk material, caused by increase of the contained air or voidage. These bulk materials show properties similar to a liquid, resulting in flooding dischargers, feeders or flushing through small gaps between flanges, gates etc.

NOTE Flooding is also referred to as flushing.

3.9.5

arching

the formation of a blockage of bulk material in a silo which obstructs flow. It can occur at any position in the silo but is usually to be found in any converging section. The arch can be caused by particles held in position by mechanical friction or by all forms of cohesion e.g. surface tension, van der Waals forces, electrostatic charges, icing up, crystallisation

NOTE Arching is also referred to as bridging, or doming.

4 Hazards

This clause 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.

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Risks in systems for the storage of bulk materials in silos are very different from those risks resulting from the hazards for typical machines listed in EN 292-1 and EN 292-2. Therefore in annex A, the types of hazards are marked with respect to systems for the storage of bulk materials.

The following hazards in equipment for the storage of bulk materials in silos are of major importance :

- **hazards arising from bulk materials**, which can cause risk of fire, explosion, noxious vapours, burns, uncontrolled increasing or lowering of the temperature ;
- **hazards arising from the problems associated with the flow of bulk materials** and/or initiated by associated equipment (mass flow, core flow, arching, flooding, overfilling, overloading, etc.) ;
- **hazards in connection with entry of persons into silos.**

5 Safety and EMC 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.

Charging and discharging equipment covered by prEN 618, EN 620 and/or EN 741 shall comply with the requirements of these standards.

For the application of EN 547-1, EN 547-3, EN 842, EN 953:1997, 5.3 of EN 954-1:1996, the manufacturer shall carry out an adequate risk assessment for the requirements thereof where choice is necessary.

NOTE This specific risk assessment is part of the general risk assessment relating to the hazards not covered by this C-standard.

5.1 Mechanical hazards

Mechanical hazards shall be safeguarded by guards.

Appropriate safety distances in accordance with EN 349:1993, Table 1 or EN 294:1992, Table 1 or Tables 2, 3, 6 and EN 811:1996 and/or hinged or slidable guards, fixed enclosing guards, fixed distance guards or interlocking guards shall be provided to protect operators from crushing and shearing hazards.

5.1.1 Guard construction

Guards shall be in accordance with EN 953 and may be perforated or imperforate sheet construction. If of perforated construction, the safety distances to prevent danger areas being reached shall comply with EN 294:1992 (see 5.1 above).

Where it is intended to step on covers or guards, they shall be able to withstand a force of 1 500 N evenly distributed over an area of 0,2 m × 0,2 m, with a deformation less 1 % of any reference dimension and no contact with moving parts. After loading it shall be possible to replace the guard.

The other guards shall be able to withstand a force of 150 N evenly distributed on a area of 0,2 m × 0,2 m with a deformation less 1 % of any reference dimension and with no contact with moving parts. After loading it shall be possible to reuse the guard.

NOTE The design of guards should enable spillage to be cleared without removal of guards.

5.1.1.1 Fixed enclosing guards

Fixed enclosing guards shall be in accordance with 3.2.1 of EN 953:1997. They shall be securely fixed in position using captive type fastenings and shall only be capable of being fixed and fastened with the aid of a tool. If they are removable, they shall be capable of being removed and replaced without dismantling any other part. Guards shall be designed so that they cannot remain in the closed position unless they are fastened.

Openings in fixed enclosing guards shall conform with EN 294:1992, Tables 3, 4 or 6 and EN 811:1996, Table 1.

5.1.1.2 Fixed distance guards

Fixed distance guards shall be in accordance with 3.2.2 of EN 953:1997. They shall be securely fixed in position using captive type fastenings and shall only be capable of being fixed and fastened with the aid of a tool. The safety distance provided by fixed distance guards shall conform to EN 294: 1992, Table 2.

5.1.1.3 Hinged or slidable guards

For hinged guards (e.g. doors) on totally enclosed parts, the type of attachment and the type and direction of opening shall be in accordance with the requirements of EN 953. Where the opening and compartment are large enough for any person to enter, the panel shall be capable of being opened from inside without a key or tool. Openings shall conform with EN 294:1992, Tables 3, 4 or 6 and EN 811:1996, Table 1.

5.1.1.4 Interlocking guards

Interlocking guards shall be in accordance with 3.5 of EN 953:1997, shall be securely fixed in position and shall use interlocking devices in accordance with EN 1088: 1995, 4.2.1.

5.1.2 Choice of guards

5.1.2.1 Inspection guards during operation

If a guard is intended to be opened during operation to allow viewing of a danger zone:

- 1) safety distance of EN 294:1992, Tables 2, 3, 4, 6 and EN 811:1996, Table 1 shall be met ; or
- 2) an additional fixed guard shall be provided which prevents danger points from being reached, e.g. made from perforated plate or wire mesh and complying with the safety distances of EN 294:1992, Table 4 and EN 811:1996, Table 1.

Hinged or slidable guards shall be self closing and self locking.

5.1.2.2 Access guards for maintenance or repair out of operation

If access guards for maintenance or repair out of operation are intended to be opened more frequently than once every eight hours they shall be interlocked with guards.

If access guards for maintenance or repair out of operation are intended to be opened less frequently than once every eight hours they shall be opened with a tool or a key.

If there are hinged or slidable guards they shall be retained open by a positive engagement device.

5.1.2.3 Access guards for maintenance or repair in special operating modes

Access guards for maintenance and repair in special operating modes as defined in 5.10.1.2 shall be fixed, hinged or slidable guards. They shall be retained open or shut by a positive engagement device. They shall be able to be opened from inside without a tool or a key.

5.1.3 Crushing

The lowering and raising system of chutes and telescoping pipes shall be fitted with a safety device to prevent the accidental lowering, or lifting, of the articulated part, and to prevent kickback of any manually operated crank.

The device for lowering and raising the movable part shall be so located that there is no necessity for the operator to be under the equipment. The range of movement in any direction shall be limited by safety devices, so as to ensure a minimum gap according to EN 349:1993, Table 1 (body and head).