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# International Standard



# 8456

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## Storage equipment for loose bulk materials — Safety code

*Équipements de stockage de produits en vrac — Code de sécurité*

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## Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work.

Draft International Standards adopted by the technical committees are circulated to the member bodies for approval before their acceptance as International Standards by the ISO Council. They are approved in accordance with ISO procedures requiring at least 75 % approval by the member bodies voting.

International Standard ISO 8456 was prepared by Technical Committee ISO/TC 101, *Continuous mechanical handling equipment*. It is based on the work carried out by "Section II — Continuous handling" of the European Mechanical Handling Confederation (FEM).

Users should note that all International Standards undergo revision from time to time and that any reference made herein to any other International Standard implies its latest edition, unless otherwise stated.

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# Storage equipment for loose bulk materials — Safety code

## 1 Scope

This International Standard gives, as an adjunct to the general safety rules laid down in ISO 1819, special safety rules for storage equipment for loose bulk materials, such as hoppers, silos, storage bins and bunkers, and bin gates.

## 2 Field of application

The safety rules laid down in this International Standard apply regardless of the use for which the equipment is intended.

These safety rules limit the supplier's responsibility to continuous mechanical handling equipment proper, excluding the structures to which such equipment is affixed, unless these are built into the storage equipment.

## 3 References

ISO 1819, *Continuous mechanical handling equipment — Safety code — General rules.*

ISO 7149, *Continuous handling equipment — Safety code — Special rules.*

## 4 General rules

The construction and operation of storage equipment for loose bulk materials, such as hoppers, silos, storage bins and bunkers, and bin gates, shall meet

- a) the legal and local requirements concerning safety in general;
- b) the general safety rules laid down in ISO 1819;
- c) the special safety rules laid down in ISO 7149;
- d) the rules for the manufacture of pressure or vacuum vessels not submitted to the action of a flame<sup>1)</sup>;
- e) the special rules laid down in clause 5.

## 5 Special safety rules

### 5.1 At the construction stage (design and manufacture)

#### 5.1.1 Hoppers and silos

##### 5.1.1.1 General

5.1.1.1.1 Components shall be determined so as to be able to withstand the loads (dead weights, materials stored, additional superstructures and supported machinery, and occasional operating overloads) expected under normal operating conditions, the climatic and geological conditions having been agreed upon between the contracting parties. Static and dynamic criteria shall be considered.

Stability shall be ensured under all load conditions defined in the contract.

5.1.1.1.2 If the stored materials are transported away by vehicles, the minimum distances between the substructures and the vehicles shall be the following :

- a) 500 mm for fixed, isolated obstacles (posts, pillars columns, corners of building, etc.) of less than 300 mm measured in the operating direction of the appliance;
- b) 700 mm for continuous, fixed obstacles (walls, warehouses, quays, buildings, etc.) and posts and pillars of 300 mm or more.

These minimum distances are not obligatory in the case of zones which are not working or movement zones.

5.1.1.1.3 Depending on the type of material, the design of hoppers and silos, and in particular sloping walls, and the position and dimensions of discharge openings shall allow satisfactory flow of the material due to gravity, with or without the help of auxiliary equipment.

Interior struts, interior ladders and other interior fittings likely to slow down the flow of material shall be avoided as far as possible.

1) Refer to the corresponding national regulations.

**5.1.1.1.4** As far as fire resistance is concerned, hoppers, silos, bins and bunkers shall comply with the national and local regulations in force.

**5.1.1.1.5** If materials likely to heat up dangerously are stored in the silos, a system for temperature detection shall be specified.

**5.1.1.1.6** Abrasion and corrosion effects shall be taken into account.

### **5.1.1.2** Closed hoppers, silos, bins and bunkers

**5.1.1.2.1** Inspection doors and detachable parts of closed hoppers, silos, bins and bunkers shall be fitted with a device so that they can be locked with a key.

**5.1.1.2.2** Whenever the nature of the material or the feeding or discharge method is liable to alter the pressure in hoppers, silos, bins and bunkers, a pressure-equilibrium device shall be provided.

**5.1.1.2.3** If necessary, hoppers, silos, bins and bunkers shall be fitted with a filter system to prevent atmospheric pollution exceeding the value fixed by national or local regulations.

**5.1.1.2.4** If explosive materials, or materials likely to create an explosive mixture, are stored, the hoppers, silos, bins and bunkers shall be equipped with an explosion device which allows controlled venting.

This requirement does not apply to installations fitted with an effective flame-proofing system (inerting, etc.).

### **5.1.1.3** Open hoppers, silos, bins and bunkers

**5.1.1.3.1** Where there is permanently an access to the upper opening of open hoppers, silos, bins and bunkers, this opening shall be fitted with a guard to prevent anyone falling in.

If a horizontal grid of bars or a rigid wire screen is used, it shall cover the upper opening in its entirety and be designed so that it withstands the impact of someone falling from a height of 1 m.

The gap between the bars or the mesh dimensions of the rigid wire screen shall not exceed 200 mm.

If the guard consists of a fixed guard-rail, it shall be at least 1 m high in accordance with ISO 1819.

If the opening of the silo is at ground level and the feeding is carried out by a vehicle, the guard-rail may be discontinued at the vehicle feed point and a device preventing the vehicle falling into the silo shall be provided.

If, in the absence of the vehicle, there is a risk of someone falling into the silo, an additional protective device preventing this from happening shall be provided.

**5.1.1.3.2** Inspection doors, detachable parts and openings in the guard-rails, specified in 5.1.1.3.1, shall, as in the case of closed silos, be fitted with a device so that they can be locked with a key.

**5.1.1.3.3** The rules specified in 5.1.1.3.1 and 5.1.1.3.2 are also applicable to partially open hoppers, silos, bins or bunkers; for example, cases where feeding is carried out by mobile conveyors (shuttle conveyors) or by travelling tripper.

### **5.1.1.4** Pneumatically filled and/or pneumatically emptied hoppers, silos, bins and bunkers for loose bulk materials

**5.1.1.4.1** The components shall be designed so that they are capable of withstanding the maximum permitted pressure or vacuum.

**5.1.1.4.2** If filling is carried out by blowing, a pressure-relief device shall be fitted to prevent the system pressure exceeding the safe working pressure.

**5.1.1.4.3** If filling is carried out by suction, the system shall be equipped with a suitable safety device so as to prevent the vacuum exceeding the acceptable limit.

**5.1.1.4.4** If hoppers, silos, bins or bunkers incorporate a pneumatic transfer or fluidization system, any dynamic loads resulting from this should be taken into consideration.

## **5.1.2** Bin gates

### **5.1.2.1** General

**5.1.2.1.1** Depending on the nature of materials, bin gates shall be designed so that their operation ensures satisfactory interruption of the flow of materials. Opening the bin gates shall allow regular flow of materials once they have started to flow.

**5.1.2.1.2** Bin gates shall be designed so that they cannot open accidentally.

**5.1.2.1.3** Manual operation of bin gates shall not require a muscular force of more than 300 N per operator.

### **5.1.2.2** Bin gates for pneumatic systems

Bin gates for pneumatic systems shall be designed so as to ensure satisfactory tightness for the material concerned and for the maximum permitted pressure or vacuum.

## **5.1.3** Integrated mechanical handling equipment

See ISO 1819.

## 5.2 At the installation stage (design, manufacture and entry into service)

### 5.2.1 Hoppers, silos, bins and bunkers

#### 5.2.1.1 General

**5.2.1.1.1** If the filling of hoppers, silos, bins and bunkers is automatic, suitable automatic devices shall be provided to stop the feeding process when the hoppers, silos, bins and bunkers reach full capacity.

**5.2.1.1.2** If there is a health hazard from gas, dust or dangerous mixtures, all necessary safety precautions shall be taken, in particular :

- a) by using controlled operational methods (for example, a closed system);
- b) by preventing the escape of hazardous substances (for example, by suction);
- c) by preventing anyone from coming into contact with such substances;
- d) by providing protective clothing and breathing apparatus.

**5.2.1.1.3** If there is a danger of explosion through the presence of gas, dust or explosive mixtures, all necessary safety precautions shall be taken to avoid explosions or limit the consequences, in particular :

- a) by avoiding the build up of an explosive atmosphere;
- b) by avoiding sources of ignition;
- c) by using explosive-pressure-resistant systems;
- d) by making provisions for explosive-pressure-relief openings;
- e) by adopting explosion suppression measures.

**5.2.1.1.4** All precautions shall be taken in order to prevent anyone from falling into or being buried in these installations, and, in particular, in order to avoid anyone getting inside the hoppers, silos, bins and bunkers when there are no efficient protection arrangements, such as :

- a) a well-designed discharge arrangement;
- b) devices for loosening blockages;
- c) interlocked access (manholes, etc.);
- d) bunker winches.

**5.2.1.1.5** In order to ensure compliance with the rule specified in 5.1.1.1.2, the following provisions shall be made :

a) if the equipment moves along fixed paths (for example, fixed tracks), these tracks shall be laid in such a way as to provide the required minimum clearances;

b) where steerable vehicles are used, special devices, such as bollards, island plinths or continuous curbs, shall be provided to ensure these distances are maintained.

**5.2.1.1.6** If the manufacturer is not aware of the special characteristics of the installation, which is generally the case for standard bins and bunkers sold as produced, the contractor in charge of putting up the installation shall be responsible for the provision of the safety devices covered by the rule specified in 5.1.1.3.1.

**5.2.1.1.7** Safety openings which are located below the maximum level of the product shall open inwards.

**5.2.1.1.8** Manholes and other access openings shall conform to national standards.

**5.2.1.2** Pneumatically filled and/or pneumatically emptied hoppers, silos, bins and bunkers for loose bulk materials

**5.2.1.2.1** If a pneumatic installation operates with a conveying gas which is harmful or which conveys harmful materials, the point at which the gas is discharged shall be situated in a safe place.

**5.2.1.2.2** Specific dangers due to static electricity caused by the displacement or the movement of materials shall be taken into account (see 5.2.1.1.2 to 5.2.1.1.4).

### 5.2.2 Bin gates

The means of operating bin gates, whether manual or mechanical, shall be readily accessible. In the case of direct loading of vehicles under the bin gate, the gate control shall be placed so as to permit supervision of the flow, without any danger to the operator.

### 5.2.3 Marking of equipment

All powered appliances or complete installations shall carry the following indications permanently and legibly marked in a clearly visible place :

- a) the name and address of manufacturer or supplier and his mark;
- b) the year of manufacture and serial number.

### 5.2.4 Access ways, stairways and control rooms

See ISO 1819.

Safety devices shall be installed and checked before any test.

### 5.3 During the utilization stage (operation and maintenance)

#### 5.3.1 General

**5.3.1.1** Hoppers, silos, bins and bunkers or storage equipment shall never be used or modified for a purpose or materials other than that for which they have been designed nor under conditions other than those stipulated in the sales contract and in the operating and maintenance instructions, without the user ensuring that it is safe to do so.

**5.3.1.2** The user shall have adequate feed control so that he can prevent the appliance from becoming overloaded.

Clear working instructions concerning loading of appliances shall be prominently displayed near the places of work.

**5.3.1.3** The user shall not alter feed points, especially their position, or increase the flow-rate, without ensuring that it is safe to do so.

**5.3.1.4** In addition to the relevant rule specified in ISO 1819, it is strictly forbidden to transport people on mechanical conveyors which feed directly into silos or hoppers.

**5.3.1.5** Only the staff responsible for doing so shall operate the installation or intervene during normal operation of the installation; in particular, the installation shall only be put into service by a qualified and competent representative.

**5.3.1.6** The staff shall be acquainted with normal and emergency stopping devices and these devices shall be readily accessible; access areas shall be kept free of obstacles. Periodic checks shall be made to ensure that these devices are operating correctly.

**5.3.1.7** Before restarting an appliance after an emergency or untimely stop, an investigation should be carried out to

- a) determine and rectify the cause of the stoppage;
- b) repair any fault in the appliance;
- c) check that every safety device which may have been affected by the stoppage is examined and made fully operational;
- d) check that staff are not at risk.

**5.3.1.8** The automatic devices, mentioned in 5.2.1.1.1 for stopping the feeding of hoppers, silos, bins and bunkers which have reached their maximum level, shall undergo routine testing to check their effectiveness.

**5.3.1.9** Access to the inside of hoppers, silos, bins and bunkers is prohibited and notice of this prohibition shall be prominently displayed.

If it is necessary to go inside hoppers, silos, bins and bunkers, a specific authorization shall be given by the person responsible for the installation.

Anyone who is given this authorization shall be made aware of the risks involved. The person shall be advised of any special precautions that have to be taken. These special precautions may involve the use of

- a safety harness;
- a winch;
- breathing apparatus or protective masks;
- anti-static clothing;
- special anti-static and anti-spark shoes;
- helmets.

The person(s) entering the hoppers and silos shall be constantly supervised by a specially appointed, competent person. Filling devices shall have been locked beforehand in the off position.

In all cases where keys are provided (see the rules specified in 5.1.1.2.1 and 5.1.1.3.2), they shall be held by the person in charge.

**5.3.1.10** The user shall ensure periodically that devices for the prevention of explosions and limitation of their consequences are available and fully operational.

#### 5.3.2 Pneumatically filled and/or pneumatically emptied hoppers, silos, bins and bunkers for loose bulk materials

**5.3.2.1** The working order of the safety devices controlling the pressure and vacuum (safety valves, bursting discs, etc.) shall be checked regularly.

**5.3.2.2** If filling is carried out by blowing and there is a filter on the air exhaust, the air filter shall be checked regularly.