

Conveying, spraying and placing machines for concrete and mortar — Safety requirements

ICS 91.220

National foreword

This British Standard is the UK implementation of EN 12001:2003+A1:2009. It supersedes BS EN 12001:2003, which is withdrawn.

The start and finish of text introduced or altered by amendment is indicated in the text by tags. Tags indicating changes to CEN text carry the number of the CEN amendment. For example, text altered by CEN amendment A1 is indicated by **A1** **A1**.

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A list of organizations represented on this subcommittee can be obtained on request to its secretary.

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Machines pour le transport, la projection et la distribution
de béton et mortier - Prescriptions de sécurité

Förder-, Spritz- und Verteilmaschinen für Beton und Mörtel
- Sicherheitsanforderungen

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Foreword

This document (EN 12001:2003+A1:2009) has been prepared by Technical Committee CEN/TC 151 “Construction equipment and building material machines — Safety”, the secretariat of which is held by DIN.

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of an identical text or by endorsement, at the latest by May 2010, and conflicting national standards shall be withdrawn at the latest by May 2010.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN [and/or CENELEC] shall not be held responsible for identifying any or all such patent rights.

This document includes Amendment 1, approved by CEN on 2009-10-17.

This European Standard supersedes EN 12001:2003.

The start and finish of text introduced or altered by amendment is indicated in the text by tags **A1** **A1**.

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).

A1 For relationship with EU Directive(s), see informative Annexes ZA and ZB, which are integral parts of this document. **A1**

This document includes a bibliography.

Annex A is informative, annex B is normative.

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

Introduction

This document is a type C standard as stated in A1 EN ISO 12100-1:2003 A1.

A1 *deleted text* A1

When compiling this standard it was assumed that a negotiation took place between the user and the manufacturer in relation with the specific health and safety requirements for the needed use. It was also assumed that the design and calculation is based on European usual calculation rules.

NOTE 1 DIN 15018-1:1984, DIN 15019-2:1979 and A1 DIN 24117:2007 A1 are good examples of rules used in European usual calculation rules.

When provisions of this type C standard are different from those which are stated in type A or B standards, the provisions of this type C standard take precedence over the provisions of the other standards, for machines that have been designed and built according to the provisions of this type C standard.

NOTE 2 Some machines covered by this standard present risks which are very similar to mobile cranes.

A1 The machinery concerned and the extent to which hazards, hazardous situations and hazardous events are covered are indicated in the scope of this document. A1

1 Scope

1.1 This standard specifies the safety requirements for:

- conveying machines;
- spraying machines;
- placing machines for concrete and mortar or their components.

The machinery can be stationary or mobile.

This standard covers the machines described in 3.3 to A1 3.7 A1.

This standard does not cover:

- machines that are mobile during conveying, spraying and placing;
- cabins for any machines covered by this standard.

A1 *deleted text* A1

This standard does not concern the undercarriage of the truck and the engine(s) of the machines that are not driven by the main engine during conveying, spraying and placing. One other possibility is the combination with a truck mixer (see 3.3). A1 *deleted text* A1

This standard does not establish the additional requirements for operation subject to special rules (e. g. potentially explosive atmosphere, A1 *deleted text* A1 supply by electrical networks where voltage, frequency and tolerance differ from those of the public supply, if relevant due to e. g. electronic components, earthquake, lightning, using on public roads, hazards occurring during construction, transportation, commissioning, decommissioning, cableless remote controls other than radio controls, compressors and pressure vessels).

1.2 This standard deals with all significant hazards, hazardous situations and events relevant to conveying, spraying and placing machines when they are used as intended and under the conditions foreseen by the manufacturer (see clause 4). This standard specifies the appropriate technical measures to eliminate or reduce risks arising from the significant hazards.

1.3 This document is not applicable to machines which are manufactured before the date of publication of this document by CEN.

2 Normative references

[A1] The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies. **[A1]**

[A1] *deleted text* **[A1]**

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

EN 894-1:1997, *Safety of machinery — Ergonomic requirements for the design of displays and control actuators — Part 1: General principles for human interactions with displays and control actuators*

EN 894-2:1997, *Safety of machinery — Ergonomic requirements for the design of displays and control actuators — Part 2: Displays*

EN 894-3:2000, *Safety of machinery — Ergonomic requirements for the design of displays and control actuators — Part 3: Control actuators*

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

[A1] *deleted text* **[A1]**

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

[A1] *deleted text* **[A1]**

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

[A1] *deleted text* **[A1]**

EN 13309:2000, *Construction machinery — Electromagnetic compatibility of machines with internal electrical power supply*

[A1] EN 60204-1:2006, *Safety of machinery — Electrical equipment of machines — Part 1: General requirements (IEC 60204-1:2005, modified)* **[A1]**

[A1] EN ISO 3744:2009, *Acoustics — Determination of sound power levels of noise sources using sound pressure — Engineering method in an essentially free field over a reflecting plane (ISO 3744:1994)*

EN ISO 11201:2009, *Acoustics — Noise emitted by machinery and equipment — Measurement of emission sound pressure levels at a work station and at other specified positions — Engineering method in an essentially free field over a reflecting plane (ISO 11201:1995, including Cor 1:1997)*

EN ISO 11204:2009, *Acoustics — Noise emitted by machinery and equipment — Measurement of emission sound pressure levels at a work station and at other specified positions — Method requiring environmental corrections (ISO 11204:1995, including Cor 1:1997)*

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

EN ISO 12100-1:2003, *Safety of machinery — Basic concepts, general principles for design — Part 1: Basic terminology, methodology (ISO 12100-1:2003)*

EN ISO 12100-2:2003, *Safety of machinery — Basic concepts, general principles for design — Part 2: Technical principles (ISO 12100-2:2003)*

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

EN ISO 13849-1:2008, *Safety of machinery — Safety-related parts of control systems — Part 1: General principles for design (ISO 13849-1:2006)*

EN ISO 13850:2008, *Safety of machinery — Emergency stop — Principles for design (ISO 13850:2006)*

EN ISO 13857:2008, *Safety of machinery — Safety distances to prevent danger zones being reached by upper and lower limbs (ISO 13857:2008)* 

3 Terms and definitions – Symbols and abbreviated terms

For the purposes of this document, the definitions given in  EN ISO 12100-1:2003  and the following apply.

3.1

concrete and mortar

homogeneous mix comprising the components cement, graded aggregate and water plus additives

3.2

additives

material added to concrete or mortar to change the properties of the mix

3.3

Conveying, spraying and placing machines for concrete

3.3.1

concrete pumps

concrete pumps are working machines with hopper for pumping of concrete, see example figure A.1.1. Concrete pumps are piston pumps or rotor pumps. The concrete hopper can be fitted out as an agitator. The concrete pumps can be towed or not but can be used only in the stationary position. The pumping is realised by mechanical transport through delivery lines. The concrete pumps can be self-propelled integrated into concrete placing booms and shotcreting machines, see A.1, A.1.2 and A.1.3

NOTE One other possibility is the combination with a truck mixer. This case is not dealt with in this standard.

3.3.2

shotcreting machines

shotcreting machines are machines with hopper for spraying of concrete.

The hopper can be fitted out as a mixer. The spraying is realised by mechanical or pneumatic transport through delivery lines. Pneumatic concrete spraying compressors can be used with or without air chambers. The shotcreting machines can be self propelled, towed or not but can be used only in the stationary position. See example figure A.1.3

3.4

mortar conveying and spraying machines

mortar conveying and spraying machines are working machines for conveying and/or spraying of mortar. The conveying is realised by mechanical (see example figure A.2.1, A.3 and A.4) or pneumatic (see example figure A.2.2) transport through delivery lines. In case of only pneumatic function the hopper is an air chamber, see example figure A.2.2. For mechanical drive the pumping is realised by screw pumps. A mixer can be integrated, see example figure A.2.1. The conveying and spraying machines can be towed or not but can be used only in the stationary position. See example figures A.2, A.3 and A.4

3.5

concrete placing booms

concrete placing booms are power-driven, slewable devices consisting of one or more extending or fold-out parts for guiding the delivery line.

These concrete placing booms may be mounted on trucks, trailers or special-purpose vehicles (e. g. for terrain, tunnel or rail application). The concrete placing booms can be self propelled, towed or not but can be used only in the stationary position. See figures A.1.2 and A.5

3.6

delivery line systems

delivery line systems are pipes, hoses, couplings, valves and end hoses through which the concrete, mortar or their components are to be transported

3.7

control station/panel

the control station is that place where the control devices for machine operation are located direct on the machine.

A distinction is made between

- control station on/at the machine;
- remote control panel.

For machines with remote control, the control station on/at the machine is an emergency control station.

3.8

normal operation

operation of the machine with all systems functioning

NOTE Exceptions: repair and maintenance, emergency operation 

4 List of significant hazards

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

Table 1 — List of significant hazards

	Hazards	Locations/circumstances/consequences	See clause/annex:
A1 4.1	Mechanical hazards (according to EN ISO 12100-1:2003, 4.2)		A1
4.1.1	Crushing	Accessibility to zones between fixed and moving parts	5.3.1.1, 5.3.1.2, 5.3.1.6, 5.3.1.7, 5.3.2.1, 5.3.2.2, 5.3.2.3, 5.3.2.6, 5.3.2.7, 5.3.3.2, 5.3.3.3
4.1.2	Shearing	Access to areas between fixed and moving parts outside and inside conveying and spraying machines Access to fixed and moving parts inside the hopper, either from the inlet or from another point	5.3.2.2
4.1.3	Entanglement	Access to unprotected shafts	5.3.1.4, 5.3.2.3
4.1.4	Entrapment	Access to moving parts inside the hopper Access to the moving parts of the mixer Access to feed points of V-belt or chain sprocket drives	5.3.1.4, 5.3.2.3
4.1.5	Impact	Access to moving parts of stabilisers and concrete placing boom	5.3.3.4, A.5
4.1.6	High-pressure fluid ejection	Access to the hydraulic system Access to the delivery line system	5.3.4.1
4.1.7	Ejection of parts or material	Access to outlet and wear of piping	5.3.1.5, 5.3.2.4, 5.3.4.1
4.1.8	Strength	loss of strength	5.3.1.5, 5.3.3.1
4.1.9	Stability	Loss of stability	5.3.1.5, 5.3.2.4, 5.3.2.5, 5.3.3.1
4.1.10	Slipping	Access to areas where slipping is possible	5.1.2, 5.3.1.5, 5.3.2.5, 5.3.3.1
A1 4.2	Electrical hazards (according to EN ISO 12100-1:2003, 4.3)	Electrocution, electric shocks or burns	5.1.3
4.3	Thermal hazards (according to EN ISO 12100-1:2003, 4.4)	Access to hot machine parts	5.1.5
4.4	Hazardous noise (according to EN ISO 12100-1:2003, 4.5)	Hearing loss and other physiological damage, impaired oral communication and perception of warning signals	5.6, 7.1.13, Annex C
4.5	Hazards from materials and consumables used (according to EN ISO 12100-1:2003, 4.8)	Contact with or inhalation of harmful fluids, gases, dust or aerosols	5.1.1, 5.1.5, 5.3.4, 7
4.6	Ergonomics (according to EN ISO 12100-1:2003, 4.9)	Injury due to poor design of control stations/panels Inadequate lighting Unsuitable operator's position for fuelling Inadequate access and departure facilities	5.1.6 5 5 5
4.7	Hazards resulting from system failures (according to EN ISO 12100-1:2003, 4.3)	Failure of power supply Failure of control systems	5.1.1, 5.1.4, 5.3.1.3, 5.3.1.4, 5.3.1.5, 5.3.2.4, 5.3.3.2
4.8	Electromagnetic compatibility (EMC)	Unforeseeable functions of the machine and/or disturb of external devices	5.7 A1

5 Safety requirements and/or protective measures

Machinery shall comply with the safety requirements and/or protective measures of this clause.

In addition, the machine shall be designed according to the principles of **EN ISO 12100-1** for hazards relevant but not significant which are not dealt with by this document (e. g. sharp edges).

For applications of a B level standard such as EN 614-1:2006, EN 894-1:1997, EN 894-2:1997, EN 894-3:2000, EN 982:1996, EN 1088:1995, EN 60204-1:2006, EN ISO 13850:2008, EN ISO 13857:2008, 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.

The general section (see 5.1) deals with hazards common to all conveying, spraying and placing machines. The specific section (see 5.2) covers the hazards specific to the individual type of machines.

5.1 Requirements common to all machines

5.1.1 Hazards resulting from the failure of hydraulic or pneumatic systems

The hydraulic system shall be designed in accordance with EN 982:1996. The following shall be especially taken into account:

- line breaks during operation (e. g. line-break safety facilities);
- maintenance and servicing work is to be carried out (provision of check/vent valves, mechanical locking devices, etc.).

With the exception of dual cylinder drive the check valves shall be connected with the pressure chamber of the cylinder without additional connecting lines.

For dual cylinder drive only one check valve shall be used. The connection piping between these check valves and both cylinders shall:

- have an safety factor increased by 25 % and
- be protected against mechanical damage.

5.1.2 Risk of slipping

Work stations, access walkways and gangways shall be of an anti slip type e. g. checker plates or gratings.

5.1.3 Electrical hazards

Electrical installations shall comply with **EN 60204-1:2006**.

5.1.4 Emergency stop system

Machines shall have an emergency stop device at the control station. Where more than one control station is foreseen each main control station (not the local control) on the machine shall be equipped with an emergency stop. Cable remote control stations are considered as being control stations on the machine. For cableless controls the emergency stop shall be at the control station on the machine. The remote control station shall be equipped with a stop function.

The emergency stop system:

- stops all machine functions in the shortest time compatible with the system;

- prevents the machine from starting up again automatically; a restart has to be initiated by the operator;
-  shall comply with EN ISO 13850:2008. 

5.1.5 Thermal protection and exhaust fumes

The maximum temperature of touchable surfaces shall comply with  EN ISO 13732-1:2008  taking a contact time of 10 s into account.

Where necessary, guards or thermal insulation material shall be used.

Exhaust fumes shall be conducted away from operator workstations (see instruction handbook).

5.1.6 Ergonomics

The general requirements of  EN 614-1:2006 , EN 894-1:1997, EN 894-2:1997 and EN 894-3:2000 shall be used for the ergonomic aspects.

5.1.7 Power supply, control systems failures

If there is more than one control station/panel, the respective function (e. g. start, close, open) shall be possible from one station/panel only.  The control system shall be in accordance with EN ISO 13849-1, Performance Level c. 

In the event of a system failure, it shall be possible to switch manually or automatically to another station/panel.

 The machine shall comply with the EMC requirements as defined in EN 13309. 



5.1.8 Fixed guards

Their fixing systems shall remain attached to the guards or to the machinery when the guards are removed. Fixed guards shall follow the design principle as defined in EN 953. 

5.2 Specific requirements for single machines

This part of the specification is divided according to machine types.

The following machine types are covered:

- Mobile and stationary concrete pumps and shotcreting machines, see 5.3.1  *deleted text* .
-  mortar-conveying and spraying machines, see 5.3.2

NOTE For combined machines with mixers see also EN 12151:2007; 

- mobile and stationary concrete placing booms, see 5.3.3;
- delivery line systems, see 5.3.4.

5.3 Machinery groups

5.3.1 Mobile and stationary concrete pumps and shotcreting machines (see annex A)

Component	Hazard group	Hazard	According to A1 EN ISO 12100-1:2003 A1	Safety measures																				
5.3.1.1 Hopper	Mechanical	Crushing between agitator, valve, hopper wall and grille cover	4.2.1	Grilles on openings of hoppers of concrete pumps and shotcreting machines, which are intended to be opened once a day or more often shall be interlocked with the drives of the agitators/valves in such a way that the drives are stopped as the covers are opened. Grilles on openings of hoppers of concrete pumps and shotcreting machines, which are not intended to be opened once a day or more often shall be secured with bolt(s) (see also 7, cleaning procedure). At concrete pumps and shotcreting machines, the filler openings of the hopper shall be secured by rod-type or grille-type guards in the following dimensions: <table><tr><th colspan="2">Rods</th><th colspan="2">Grilles</th></tr><tr><th><i>a</i></th><th><i>h</i></th><th><i>b</i></th><th><i>h</i></th></tr><tr><td>70 mm</td><td>200 mm</td><td>80 mm</td><td>180 mm</td></tr><tr><td>35 mm</td><td>100 mm</td><td>70 mm</td><td>150 mm</td></tr><tr><td></td><td></td><td>40 mm</td><td>90 mm</td></tr></table> <i>a</i> = maximum permissible clearance between rods in mm <i>b</i> = maximum permissible mesh width in mm <i>h</i> = minimum permissible clearance of covers from crushing point between agitator and mixing vessel/r hopper wall in mm NOTE These clearances between the rods or mesh widths are the best compromise between safety and performance to allow the bulk material „concrete“ to be filled (other clearances hamper the bulk material).	Rods		Grilles		<i>a</i>	<i>h</i>	<i>b</i>	<i>h</i>	70 mm	200 mm	80 mm	180 mm	35 mm	100 mm	70 mm	150 mm			40 mm	90 mm
Rods		Grilles																						
<i>a</i>	<i>h</i>	<i>b</i>	<i>h</i>																					
70 mm	200 mm	80 mm	180 mm																					
35 mm	100 mm	70 mm	150 mm																					
		40 mm	90 mm																					

Mobile and stationary concrete pumps and shotcreting machines

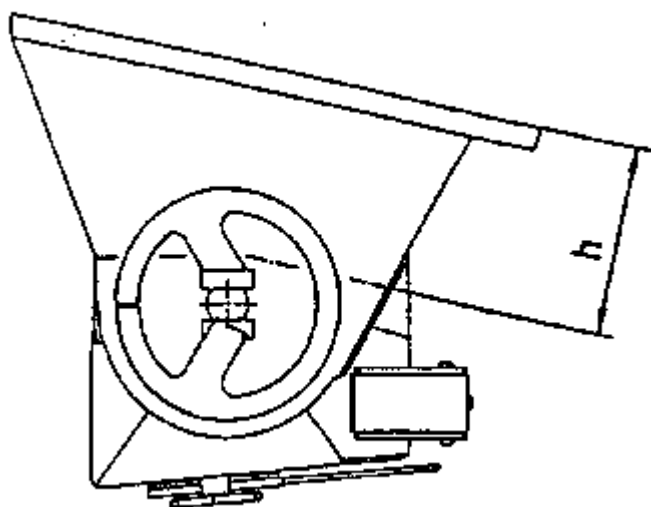


Figure 1 — Grille – crushing point clearance

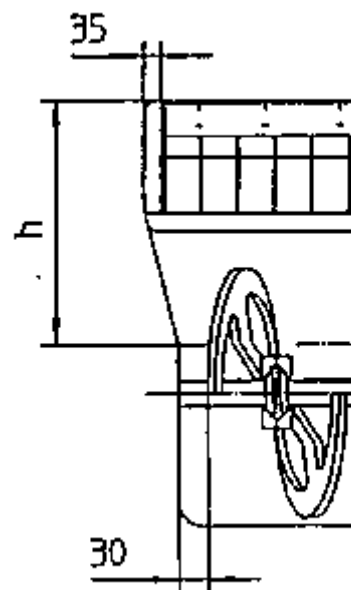


Figure 2 — Hopper wall – grille clearance

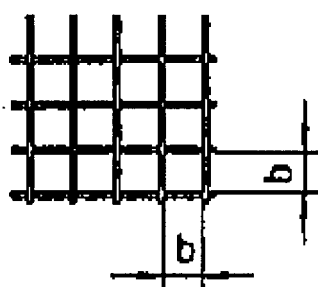


Figure 3 — Mesh width – grille

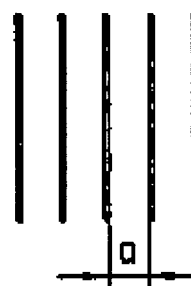


Figure 4 — Clearance – bars

Component	Hazard group	Hazard	According to A1 EN ISO 12100- 1:2003 A1	Safety measures
5.3.1.2 Hopper	Mechanical	<u>Crushing</u> between fixed and movable parts	4.2.1	Hinged covers or hinged hoppers shall be lockable in their ultimate upper position. The control device(s) for power-operated covers or hoppers, shall be of hold to run type. The distance from the control device(s) to the crushing points shall be large enough to ensure that, when the control device(s) is(are) released, the hazard points are accessible only when the hazardous movement is ended.
A1 5.3.1.3 Pump		Crushing between fixed and movable parts	4.2.1	Screwed covering with distances according to EN ISO 13857:2008 or if the covering is movable, a fixed guard shall be provided as per EN 953:1997. Screwed coverings shall only be able to be opened with tools.
5.3.1.4 Drive area		Crushing between hinged covers and machine parts	4.2.1	Hinged covers shall be lockable in opened position.
		Entanglement by free-running shafts	4.2.1	Screwed covering with distances according to EN ISO 13857:2008. Screwed coverings shall only be able to be opened with tools.
		Entrapment between V-belt and driving pulleys	4.2.1	Screwed covering with distances according to EN ISO 13857:2008. Screwed coverings shall only be able to be opened with tools.
		Unexpected machine movements		If starting the engine, an unintentional and unexpected hazardous movement shall be avoided. A1
5.3.1.5 Entire machine	Mechanical	<u>strength</u>	4.2.2	The design of the machine shall be carried out corresponding to the state of the art. The intended use of the machine shall be considered (see Introduction).
		<u>Stability</u> due to faulty support on the subsoil	4.2.2	The maximum support forces occurring shall be marked on the outriggers.
		Loss of stability by the machine or parts thereof while being moved by lifting gear on the construction site	4.2.2	Machines or their individual components which are moved or lifted with lifting gear for assembly purposes on construction sites shall be equipped with attachment points.

Component	Hazard group	Hazard	According to A1 EN ISO 12100- 1:2003 A1	Safety measures
		<u>Slipping</u> in connection with the machine	A1 4.10 A1	For maintenance, assembly and dis- mantling work and for inspections which cannot be carried out from ground level, working stands or plat- forms shall be available. These shall be safely accessible and shall permit working to be done from them without any risk to those involved (see 5.1.2).
		<u>Ejection of parts or material</u>	A1 4.2.1 A1	The machines shall be constructed in such a way that blockages in the de- livery lines shall be removed without any risk. This can be achieved with a reverse-pumping device.
		<u>Inadvertent, uncon- trolled movements of machine parts</u> due to reciprocal controlling facilities at more than one control panel	A1 4.11 A1	Operation shall be only possible from the one pre selected control panel (positive switchover essential). Actuating elements shall be secur- able against unauthorized operation and shall be positioned, designed and marked in such a way as to pre- vent mistaken identity.
5.3.1.6 Stabilisers	Mechanical	<u>Crushing</u> between movable supports and fixed machine parts or de- vices not belonging to the machine	4.2.1	See 5.3.3.2
5.3.1.7 Concrete placing boom	Mechanical	<u>Crushing</u> between movable concrete placing boom parts and fixed machine parts, be- tween moving ma- chine parts and de- vices not belonging to the machine	4.2.1	See 5.3.3.3

5.3.2 Mortar conveying and spraying machines (see annex A)

Component	Hazard group	Hazard	According to A1 EN ISO 12100- 1:2003 A1	Safety measures
5.3.2.1 Hopper	Mechanical	Crushing between agitator, hopper wall and grille cover	4.2.1	Hoppers containing agitators or worm conveyors shall be equipped with a grille cover. Distances with dimensions according to A1 EN ISO 13857:2008 A1.. If the grille-bar clearance specified in A1 EN ISO 13857:2008 A1 is too narrow for the material concerned, e.g. due to wet or coarse-grained material, the grille-bar clearance can be increased. The mesh width may be at a maximum of 60 mm and the distance between grille bar and crushing point shall be at least 120 mm. In contrast, grille covers of mortar-conveyance machinery using compressors whose air chamber has to be pressure-sealed with a cover prior to conveyance after each filling and mixing operation may have a maximum mesh width of 70 mm. The grille cover shall have a minimum clearance of 120 mm from the crushing point between agitator or worm conveyor and hopper wall. In the case of grille covers which are either not screwed down or opened once a day or more often, it shall be ensured that the agitator or the worm conveyor is positively stopped and is secured against restarting when the grille cover is opened. The cut out mechanism shall not be circumventable by simple means. Hinged grille covers shall be positioned and equipped in such a way that they cannot close inadvertently from opened position. Outlet openings shall be secured by a hopper or a guard, at the base of which a grille complying with the following specifications is mounted: Max. permissible mesh width of grille 70 mm and min. clearance between covers and crushing points 150 mm. or max. permissible mesh width of grille 40 mm and min. clearance between covers and crushing points 120 mm. Interpolations are possible

Component	Hazard group	Hazard	According to A1 EN ISO 12100- 1:2003 A1	Safety measures
5.3.2.2 Hopper	Mechanical	<u>Crushing</u> between hinged hopper and fixed machine parts	4.2.1	Movable hoppers shall be lockable in their limit position to prevent any inadvertent movement. To control the closing movement of power-operated hoppers, a hold to run device using control device(s) shall be provided. The control device(s) shall have sufficient clearance from the crushing points shall be large enough to prevent contact with moving parts.
		<u>Shearing</u> between agitator and hopper	4.2.1	Feeder hoppers must be designed in such a way that inadvertent movement by the agitator is avoided when covers are opened. The cover of the opening for cleaning purposes can also be secured in such a way as to prevent access to crushing parts.
5.3.2.3 Driving area	Mechanical	<u>Crushing</u> between hinged covers and fixed machine parts	4.2.1	If hazardous movements are possible without the use of tools during work on the machine, it shall be ensured that access to hazardous points is prevented (e. g. covers with automatic cut-out). If this is done by automatic stopping of the drive, a safety facility shall be installed against inadvertent restarting. Hinged covers shall be located or equipped in such a way that they cannot close inadvertently when in opened position.
		<u>Entanglement</u> by free-running drive shafts	4.2.1	Screwed covering with distances according to A1 EN ISO 13857:2008 A1. Screwed coverings shall only be able to be opened with tools.
		<u>Entrapment</u> between V-belts and drive units	4.2.1	Screwed covering with distances according to A1 EN ISO 13857:2008 A1. Screwed coverings shall only be to open with tools.
5.3.2.4 Entire machine	Mechanical	<u>Loss of stability</u> by the machine or parts thereof while being moved by lifting gear on the construction site	4.2.2	Conveying and spraying machines or their individual components which are moved or lifted with lifting gear for assembly purposes on construction sites shall be equipped with attachment points.
		<u>Inadvertent, uncontrolled movements of machine parts</u> due to reciprocal controlling facilities at more than one control console	A1 4.11 A1	Operation possible from one pre selected control console only (positive switchover essential).

Component	Hazard group	Hazard	According to A1 EN ISO 12100- 1:2003 A1	Safety measures
		Inadvertent initiation of hazardous movements	A1 4.11 A1	Actuating elements initiating hazardous movements shall be equipped with control device(s) using hold to run control device(s). Actuating elements shall be securable against unauthorized operation and shall be positioned, designed and marked in such a way as to prevent mistaken identity.
	Mechanical	<u>Ejection of parts or material</u> when the lock of the conveying vessel lid is being opened	A1 4.2.1 A1	The lock of the conveying vessel lid shall be equipped in such a way that it can be opened only when the system is depressurized.
		While removing blockages	A1 4.2.1 A1	The machines shall be designed in such a way that persons are not endangered by ejection of returning material. Blockages in the delivery lines shall be removed without any risk. This can be achieved, for example, through appropriate designing of the return nozzle or by ejection-proof attachment of the return hose to the return nozzle and the mortar hopper or with a reverse-pumping mechanism.
5.3.2.5 Entire machine	Mechanical	<u>Slipping</u> on the way to workplaces for maintenance work	A1 4.10 A1	For maintenance, assembly and dismantling work and for inspections which cannot be carried out from ground level, working stands or platforms shall be available. These shall be safely accessible and shall permit working to be done from them without any risk to those involved (see 5.1.2).
		<u>Loss of stability</u> through faulty design	4.2.2	Accessible covers including grilles shall be designed for an individual load of 1,5 kN.
5.3.2.6 Stabilizers	Mechanical	<u>Crushing</u> between movable supports and fixed machine parts or devices not belonging to the machine	4.2.1	See 5.3.3.2
5.3.2.7 Concrete placing boom	Mechanical	<u>Crushing</u> between movable concrete placing boom and fixed machine parts or devices not belonging to the machine	4.2.1	See 5.3.3.3