



# SLOVENSKI STANDARD

## SIST EN 12001:2004

01-september-2004

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### Stroji za transport, brizganje in polaganje betona in malte - Varnostne zahteve

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

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

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

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Ta slovenski standard je istoveten z: <sup>SIST EN 12001:2004</sup> EN 12001:2003

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#### ICS:

91.220

Gradbena oprema

Construction equipment

**SIST EN 12001:2004**

**en**

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ICS 91.220

English version

## Conveying, spraying and placing machines for concrete and mortar - Safety requirements

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

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## Foreword

This document (EN 12001:2003) 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of an identical text or by endorsement, at the latest by June 2004, and conflicting national standards shall be withdrawn at the latest by June 2004.

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 annex ZA, which is an integral part of this document.

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, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Luxembourg, Malta, Netherlands, Norway, Portugal, Slovakia, Spain, Sweden, Switzerland and the United Kingdom.

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## Introduction

This document is a type C standard as stated in EN 1070:1998.

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

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 DIN 24117:1987 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.

## 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 3.9.

This standard does not cover:

- machines that are mobile during conveying, spraying and placing;
- cabins for any machines covered by this standard;
- noise. It is a significant hazard;
- vibration;
- EMC is not covered by EN 12001:2003. [SIST EN 12001:2004](#)

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). For truck mixer see prEN 12609:1996.

This standard does not establish the additional requirements for operation subject to special rules (e. g. potentially explosive atmosphere, electromagnetic compatibility (immunity), 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.

## EN 12001:2003 (E)

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

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

EN 518:1995, *Structural timber — Grading — Requirements for visual strength grading standards.*

EN 563:1994, *Safety of machinery — Temperatures of touchable surfaces — Ergonomics data to establish temperature limit values for hot surfaces.*

EN 614-1:1995, *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.*

EN 954-1:1996, *Safety of machinery — Safety-relevant 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 1070:1998, *Safety of machinery — Terminology.*  
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EN 1088:1995, *Safety of machinery — Interlocking devices associated with guards — Principles for design and selection.*

prEN 12609:1996, *Truck mixers — Safety requirements.*

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

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



### 3 Terms and definitions – Symbols and abbreviated terms

For the purposes of this document, the definitions given in EN 1070:1998 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

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## EN 12001:2003 (E)

- 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

### 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.

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Table 1 — List of significant hazards

	Hazards	Locations/circumstances/consequences	See clause/annex:
4.1	Mechanical hazards (according to EN 292-1:1991, clause 4.2)		
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
4.2	Electrical hazards (according to EN 292-1:1991, clause 4.3)	Electrocution, electric shocks or burns	5.1.3
4.3	Thermal hazards (according to EN 292-1:1991, clause 4.4)	Access to hot machine parts	5.1.5
4.4	Hazardous noise (according to EN 292-1:1991, clause 4.5)	Hearing loss and other physiological damage. Impaired oral communication and perception of warning signals.	It is not dealt with in this standard
4.5	Hazards from materials and consumables used (according to EN 292-1:1991, clause 4.8)	Contact with or inhalation of harmful fluids, gases, dust or aerosols	7
4.6	Ergonomics (according to EN 292-1:1991, clause 4.9)	Injury due to poor design of control stations/panels Inadequate lighting Unsuitable operator position for fuelling Inadequate access and departure facilities	5.1.6
4.7	Hazards resulting from system failures (according to EN 292-1:1991, clause 4.3)	Power supply failure, Control systems failure	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

## 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 292 for hazards relevant but not significant which are not dealt with by this document (e. g. sharp edges).

EN 294:1992, EN 418:1992, EN 518:1995, EN 614-1:1995, EN 894-1:1997, EN 894-2:1997, EN 894-3:2000, EN 982:1996, EN 1088:1995 and EN 60204-1:1997 shall be used: When the application of a B level standard is required, 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 60204-1:1997

#### 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 418:1992.

### 5.1.5 Thermal protection and exhaust fumes

The maximum temperature of touchable surfaces shall comply with EN 563:1994 taking a contact time of 10 sec 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 614-1:1995, 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. If this is not the case, either manual or automatic priority switching from one station/panel to another shall be possible.

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

The immunity of the internal electrical system shall comply with EN 13309:2000.

## 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 (see prEN 12609:1996);
- mortar conveying and spraying machines, see 5.3.2 (see prEN 12151:1995);
- mobile and stationary concrete placing booms, see 5.3.3;
- delivery line systems, see 5.3.4.

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5.3 Machinery groups

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

Component	Hazard group	Hazard	According to EN 292-1:1991	Safety measures																				
5.3.1.1 Hopper	Mechanical	Crushing between agitator, valve, hopper wall and grille cover	4.2.1	<p>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.</p> <p>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).</p> <p>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:</p> <table border="1"> <thead> <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> </thead> <tbody> <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> </tbody> </table> <p><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</p> <p>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).</p>	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																					

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## Mobile and stationary concrete pumps and shotcreting machines

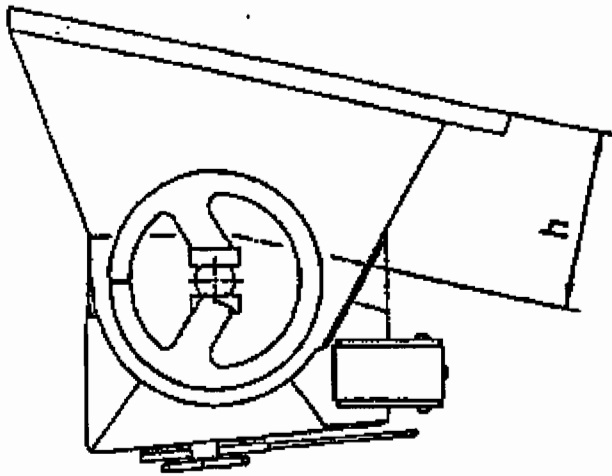


Figure 1 — Grille – crushing point clearance

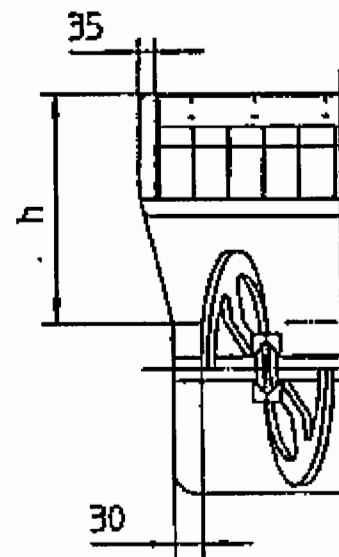


Figure 2 — Hopper wall – grille clearance

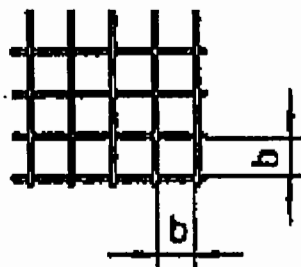


Figure 3 — Mesh width – grille



Figure 4 — Clearance – bars

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