SLOVENSKI STANDARD
SIST EN 710:2000+A1:2010

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Varnost strojev - Varnostne zahteve za livarske stroje, stroje za izdelavo jeder in pripadajočo opremo

Safety of machinery - Safety requirements for foundry moulding and coremaking machinery and plant and associated equipment

Sicherheit von Maschinen - Sicherheitsanforderungen an Gießereimaschinen und -anlagen der Form- und Kernherstellung und dazugehörige Einrichtungen

Sécurité des machines - Prescriptions de sécurité applicables aux machines et chantiers de moulage et de noyautage en fonderie et à leurs équipements annexes

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

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Contents

Page

Tables

Foreword

This document (EN 710:1997+A1:2010) has been prepared by Technical Committee CEN/TC 202 “Foundry machinery”, 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of an identical text or by endorsement, at the latest by October 2010, and conflicting national standards shall be withdrawn at the latest by October 2010.

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This document includes Amendment 1, approved by CEN on 2010-03-18.

This document supersedes EN 710:1997.

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

A1 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 document. A1

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, Croatia, 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

〈A1〉 This European Standard is a type C standard as stated in EN ISO 12100.

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

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.

Where for clarity an example of a preventive measure is given in this European Standard, this should not been considered as the only possible solution. Any other solution leading to the same risk reduction is permissible if an equivalent level of safety is achieved. 〈A1〉

1 Scope

This standard specifies safety requirements to be met by the manufacturer for machines and plant used in foundries for the production of castings in disposable models. It takes into account the foreseeable significant hazards due to design, construction and installation that may occur during commissioning, operation, maintenance and decommissioning. It specifies preventative measures and verification means for the elimination or reduction of these hazards. It specifies requirements for information to be provided by the manufacturer to the user on safe operation and maintenance.

This standard applies to the following equipment:

— Machinery and plant constructed to condition and/or reclaim foundry sands;

— Moulding machinery and plants;

— Coremaking machinery and plants;

— Knock-out equipment;

— Other directly associated equipment.

The foreseeable significant hazards covered are listed in clause 5 and include:

— Mechanical hazards, movement of machinery and workpieces, ejection of material, of liquids and gases, inadequacy of the mechanical strength;

— Explosion, fire, exothermic reactions;

— Contact with hot parts, gases and flames;

— Noise and vibration;

— Thermal heat radiation and conduction;

— Harmful by-products, poisoning, pollution of operators' breathing air.

This standard applies to equipment covered by this standard which is placed on the market after the date of issue of this standard.

This standard does not cover the safety requirements for wax- and lost foam pattern production and wax removal equipment and drying ovens.

This standard does not apply to crane installations, winches, continuous conveyors or handling systems which could be an integral part of the above equipment.

The standard does not cover dust reduction equipment.

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⟩ EN 349, *Safety of machinery — Minimum gaps to avoid crushing of parts of the human body*

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

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

EN 614-2, *Safety of machinery — Ergonomic design principles — Part 2: Interactions between the design of machinery and work tasks*

EN 746-2, *Industrial thermoprocessing equipment — Part 2: Safety requirements for combustion and fuel handling systems*

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

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

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

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

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

EN 981, *Safety of machinery — System of auditory and visual danger and information signals*

EN 999, *Safety of machinery — The positioning of protective equipment in respect of approach speeds of parts of the human body*

EN 1005-2, *Safety of machinery — Human physical performance — Part 2: Manual handling of machinery and component parts of machinery*

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

EN 1093-1, *Safety of machinery — Evaluation of the emission of airborne hazardous substances — Part 1: Selection of test methods*

EN 1265, *Noise test code for foundry machines and equipment*

EN 1299, *Mechanical vibration and shock — Vibration isolation of machines — Information for the application of source isolation*

EN 1539, *Dryers and ovens, in which flammable substances are released — Safety requirements*

EN 13861, *Safety of machinery — Guidance for the application of ergonomics standards in the design of machinery*

EN 14253, *Mechanical vibration — Measurement and calculation of occupational exposure to whole-body vibration with reference to health — Practical guidance*

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

EN 61310-1, *Safety of machinery — Indication, marking and actuation — Part 1: Requirements for visual, acoustic and tactile signals (IEC 61310-1:2007)*

EN 61310-2, *Safety of machinery — Indication, marking and actuation — Part 2: Requirements for marking (IEC 61310- 2:2007)*

EN 60447, *Basic and safety principles for man-machine interface — Marking and identification — Actuating principles (IEC 60447:2004)*

EN 61496-1, *Safety of machinery — Electro-sensitive protective equipment — Part 1: General requirements and tests (IEC 61496-1:2004, modified)*

EN ISO 7731, *Ergonomics — Danger signals for public and work areas — Auditory danger signals (ISO 7731:2003)*

EN ISO 11064-1, *Ergonomic design of control centres — Part 1: Principles for the design of control centres (ISO 11064-1:2000)*

EN ISO 11688-1, *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 13849-1, *Safety of machinery — Safety-related parts of control systems — Part 1: General principles for design (ISO 13849-1:2006)*

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

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

ISO 6184-1, *Explosion protection systems — Part 1: Determination of explosion indices of combustible dusts in air*

ISO 3864-1, *Graphical symbols — Safety colours and safety signs — Part 1: Design principles for safety signs in workplaces and public areas*

ISO 7000, *Graphical symbols for use on equipment — Index and synopsis* A1

3 A1 Terms and definitions

For the purposes of this document, the terms and definitions given in EN ISO 12100-1:2003, EN ISO 12100-2:2003 and the following apply.

NOTE Definitions used in EN and ISO standards referred to in this European Standard are also valid for this European Standard.

3.1
moulding machinery
machines used to make sand moulds. There are various machinery types which compact granular moulding materials including:

— jolt moulding machines (compaction by jolting the moulding machine deck),

— squeeze moulding machines (compaction by squeezing the pattern equipment and the moulding sand together),

— jolt and squeeze moulding machines,

— shoot-/blow- and squeeze moulding machines,

— impulse moulding machines (the moulding sand is compacted by a compression wave which acts on the top of the sand fill),

— air-flow-squeeze moulding machines (similar to impulse-moulding machines, except that the compressed air escapes through nozzles in the pattern plate),

— dynamic squeeze moulding machines (compensating pressure squeeze pistons act on the top of the sand fill),

— suction and squeeze moulding machines (the pressure differential between the moulding box and the pattern draws in the moulding sand),

— vacuum-moulding machines (unbonded sand is compacted by vacuum),

— sand slingers (the moulding sand is flung into the moulding box by the centrifugal force of a rotating wheel).

3.2
moulding plant
equipment used to make ready-to-pour sand moulds. A moulding plant consists of moulding stations (automatic moulding machines for complete moulds) or several moulding machines (moulding group) that produce the moulding parts separately. It may also include lines for core setting, mould closing, weighting or clamping, pouring, cooling, knocking-out of the mould parts and emptying of the boxes as well as integral transfer systems linking the various stations and lines

3.3
disposable mould
mould that is destroyed to remove the casting

3.4
core making machinery
machines used to make solid and/or hollow cores and they are classified into core shooters and core blowers. The principle of core shooting is to rapidly expand compressed air via the sand reservoir into the sand. The

sand is then fluidized by the airstream and the sand–air-mix is transported into the core box. The principle of core blowing is to transport the sand by means of compressed air into the core box (direct working). The sand is conveyed along in front of the compressed air

3.5
coremaking plant
equipment used to make ready-to-use cores (single cores and/or core assemblies). A plant may consist of a sand preparation plant, core making machine, equipment for handling, deflashing, assembling, coating and drying of cores

3.6
conditioning equipment
equipment and plant used to prepare ready-to-use bonded sands, including equipment for its conveyance and storage

3.7
sand mixers and mills
machines for batch mixing (blending, coating, kneading) of moulding or core sand with bonding agents, water and complementary mould material additions. The machines are provided with rotating paddles and/or milling rollers and fast rotating paddles for the aeration of the material. Typically, machines consist of a circular container in which are mounted rotating ploughs and/or mill wheels (mullers).

3.8
machines for continuous mixing
machines in which the contents are continuously mixed and conveyed to the discharge gate

3.9
sand aerators
machines used to aerate the mixed sand such as belt aerators (conveyor belt with impact bars) or wheel aerators (drum with impact bars)

3.10
spike disintegrators
disintegrators with a horizontal or a vertical rotating axis. Used and lump sand is conveyed axially to the disintegrator wheels. The disintegrator wheels are normally provided with projections and rotate in opposite directions

3.11
installations for the storage and pneumatic conveyance of coal dust or coal dust substitutes and their mixtures with bonding agents
silos and pipework that are filled pneumatically with such material and by which the material is supplied pneumatically to the next operation (e. g. sand mixers)

3.12
sand dryers and heaters
plant consisting of a heating system and/or subsequent cooling equipment

3.13
reclamation equipment
equipment and plant including storage and conveying facilities used for the reclamation of used sands by mechanical and/or thermal processing means

3.14
sand lump crushers
machines used to break down lumps of used sand by mechanical means

3.15
thermal reclamation ovens
machines used to destroy the binder by thermal means

3.16
mechanical reclamation machines
machines used to destroy the binder by mechanical means

3.17
magnet separators
machines used to separate ferro-magnetic material from the used sand

3.18
screening installations
machines used to classify used sands (this may be achieved by vibration, rotation or other means)

3.19
gassing equipment
equipment used to produce and/or condition reactive gasses and supply them to the gassing station or into the sand mixture. Typical processes are:

binder system	reactive gas
silicate …….....	CO_2
urethane (coldbox) ……..	amine
furane resin/peroxide or epoxy resin/peroxide …..	SO_2
alkaline resin ……	methyl-formate
inorganic binders ……..	hot air (as dehydration assistance)

3.20
knock-out equipment
equipment used to separate castings from the moulding box and/or the mould and/or cores from castings

3.21
punch-out equipment
equipment used to separate the mould and castings from the moulding box by vertical or horizontal movement of a punch-out piston

3.22
rotary knock-out and/or cooling drum
rotating or reciprocating cooling drum through which sand and castings are conveyed and separated. The rolling movement of the castings breaks up the lumps of sand as the drum rotates

3.23
knock-out grid
a grid provided with a vibrating facility for the separation of moulding sand from the moulding box and/or from the casting

3.24
knock-out tray
oscillating conveyor for the separation of casting and moulding material

3.25
modes of operation
moulding/core making machinery and equipment (single machines or groups of interconnected parts) can function under different modes of operation

a) setting
all the steps within a process can be initiated separately and manually in any sequence, e. g., mould changing or pattern changing

b) manual
all the steps within a process can be initiated separately in the sequence of, or out of the sequence of, the programme, e. g., termination of a moulding cycle or continuation of a moulding cycle for testing or fault detection

c) step
each part of a cycle is initiated manually and then proceeds to completion in the pre-determined sequence

d) semi-automatic
after a start-initiation a complete manufacturing cycles is completed in the pre-determined sequence

e) automatic
each cycle is initiated by the previous cycle, e. g., continuous operation A1

A1

4 Significant hazards

The significant hazards, hazardous situations and events, as far as they are dealt with in this document, identified by risk assessment as significant for these types of machinery and which require action to eliminate or reduce the risk, are listed in Clause 5, Table 1, together with the appropriate safety measures. A1

A1

5 Safety requirements and/or protective measures

5.1 General

5.1.1 Machinery shall comply with the safety requirements and/or protective measures formulated in Table 1 in relation with the different significant hazards. In addition, the machine shall be designed according to the principles of EN ISO 12100-2 for relevant but not significant hazards which are not dealt with by this document.

5.1.2 Fixed guards

These guards shall be designed in accordance with EN ISO 12100-2, EN ISO 13857 and EN 953.

These guards shall also be designed to contain processed materials, fluids or parts that can foreseeable be ejected or to contain emissions of substances or noise if applicable.

Where practical, these guards shall be fixed to the machine structure.

If floor mounted, these guards shall be securely fixed and have a minimum height of 1,4 m and be positioned at a sufficient distance from the danger zone in accordance with Table 1 of EN ISO 13857:2008.

The installation of fixed covers is sufficient for safeguarding danger zones when there is no need to reach in or walk in during normal operation.

5.1.3 Movable guards

5.1.3.1 Detection and monitoring

Movable guards in danger zones with fixed cycle intervention or access (e. g. during loading and unloading of parts), set-up activities, periodical manual cleaning or spraying or troubleshooting is required, shall incorporate guard interlocking according to EN 1088.

When the guard is open, the drive power supply for the relevant hazardous movements shall be positively disconnected.

5.1.3.2 Interlocking guard with guard locking

An interlocking guard with guard locking effective within the hazardous period shall be used when the stopping time of the hazardous movement is greater than the access time of a person in reaching the danger zone.

5.1.3.3 Closing the guards

Closing the guards shall not initiate operation of hazardous movements. If movement was interrupted by opening of an interlocked danger zone guard, the restart shall be performed by actuation from outside the guard.

5.1.3.4 Power operated guards

Power operated guards shall not create a trap. Either the power provided shall be insufficient to cause injury in the event of trapping, or the guard shall be provided with a safety trip device to prevent injury.

Actuation of the safety trip device shall stop or reverse the direction of movement of the movable guard.

5.1.4 Electro-sensitive protective devices (ESPD)

If electro-sensitive protective devices (see EN 61496-1) are used then the following requirements shall be met:

a) the control system of the machine shall be able to interrupt the hazardous movement in time when it receives the output signal from such a protective device;

b) they shall switch on if the control system of the machine is connected,

c) they shall be tested at each machine cycle;

d) they shall not act as control devices;

e) they shall not be adjustable neither in the vertical nor in the horizontal direction;

f) they shall be interlocked with the hazardous movements of the machine;

g) the output-signals of such devices shall be independent of the electronic control system of the machine or shall be connected to failsafe PLC;

h) the protective field of such devices shall cover the access area;

i) they shall be positioned so that persons cannot remain between the protective field of the device and the danger zone and initiate a machine cycle;

j) their position, in relation to the danger zone, shall take into account the machine stopping time, the approach speed of the operator and the initiation time of the device (see EN 999).

5.1.5 Two-hand control devices

If two-hand control devices (see EN 574) are used, then the following requirements shall be met:

a) the control system of the machine shall be able to interrupt the hazardous movement in time if one actuator of this device is released;

b) they shall comply with type IIIB of EN 574;

c) they shall be interlocked with the hazardous movements of the machine;

d) their output-signals shall be independent of the electronic control system of the machine or shall be connected to failsafe PLC;

e) their position, in relation to the danger zone, shall take into account the machine stopping time, the approach speed of the operator and the initiation time of the device (see EN 999).

5.1.6 Several persons at the same time occupied at hazardous points

When machinery and plant require frequent intervention (i. e. for feeding and/or removing of parts) and if several persons are occupied at the same time at hazardous points of machinery and plant, each person shall be protected (e.g. by movable guards, two-hand control devices or electro-sensitive protective devices) so that they will not be mutually endangered during that intervention.

5.1.7 Control systems

Where access to the danger zone is required during normal operation (EN ISO 12100-2:2003, 5.2.3) the safety related control systems of the equipment, including the interlocking devices, shall be in accordance with performance level PL=e and category 4 as specified in EN ISO 13849-1.

Where access to the danger zone is required for maintenance and setting activities, troubleshooting or cleaning the electric/electronic components of the safety related control systems of the equipment including the interlocking devices, shall be in accordance with at least performance level PL=d and category 2 as specified in EN ISO 13849-1. The hydraulic and pneumatic equipment shall comply with at least performance level PL=c and category 1 as specified in EN ISO 13849-1.

If these tasks can only be performed whilst the protective device is switched off, lockable mode selection switches shall be provided for the disconnection of the protective device and the simultaneous transition to setting mode. Hazardous movements shall be interrupted immediately when the manual control actuator(s) is released. Unsecured movements of dangerous parts shall be prevented e.g. gravity fall. When reduced speed of such movements is used to permit maintenance and setting activities the control system in this mode shall comply with performance level PL=e and category 4 as specified in EN ISO 13849-1.

When there are electronic components within the machine control system, the interlocking of the safety functions (emergency stop, interlocking, electro-sensitive protective devices or two-hand control devices) shall be independent of the electronic control system of the machine or shall be connected to failsafe PLC. If the monitoring is achieved by an electronic system then the signals shall be connected to an electronic control system by separate input modules.

Limit switches within controls shall be arranged or installed so that no unintended start can be initiated.

The machine shall be so designed, that it will stop immediately at any point in its cycle when an emergency stop (see EN ISO 13850) is activated or a safety function or device (see EN 1088) has become inoperative.

5.1.8 Ergonomics

EN 13861 shall be used as a guideline for considering ergonomic aspects in the design of moulding and core making machinery and plant and associated equipment. Particular consideration shall be given to EN 614-1, EN 614-2, EN 894-1, EN 894-2, EN 894-3, EN 60447 and EN ISO 11064-1.

For the manual handling of loads (e. g. flasks, setting, removal of cores or patterns, maintenance) see EN ISO 12100-2, EN 614-1 and EN 1005-2.

5.1.9 Noise

Noise emitted by the plant is a significant hazard, and the manufacturer shall give consideration to means to reduce the hazard. Noise hazards and measures are considered in Table 1.

Noise measurement and declaration shall be made according to EN 1265.

5.1.10 Vibrations

Vibration hazards and measures are considered in Table 1.

Vibrations shall be considered at the design stage using the guidance given in EN 1299 as appropriate.

Moulding and core making machines are not expected to create harmful hand-arm vibration.

NOTE 1 Where the hands or arms of the worker(s) are subjected to a vibration emission having a weighted root mean square acceleration exceeding 2,5 m/s^2 the actual value should be stated. When experience has shown that the magnitude of hand-arm vibration is in general significantly below 2,5 m/s^2 it is sufficient to mention that the acceleration is below this limit.

Where the risk of whole-body vibration is given in Table 1, measurement according to EN 14253 shall be made.

NOTE 2 Where the body of the worker(s) is subjected to a whole body vibration emission exceeding 0,5 m/s^2, the single whole-body vibration value (weighted root mean square acceleration) should be stated.

5.1.11 Structure of Table 1

The following Table 1 is developed to allow the designer and manufacturer of the equipment to apply a logical approach for checking the design against the list of significant hazards with respect to the different types of machinery covered by the scope of this standard.

Table 1 is structured as follows:

— column 1 identifies the significant hazards;

— column 2 describes the hazardous situations;

— column 3 describes possible injuries;

— columns 4 and 5 are specifying preventative measures to avoid or minimize the hazards;

— column 6 identifies the verification methods to be used to demonstrate conformity. A1