

Footwear manufacturing machines — Footwear moulding machines — Safety requirements

ICS 61.060

National foreword

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The UK participation in its preparation was entrusted to Technical Committee MCE/3/12, Leather products machinery - Safety.

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Foreword

This document (EN 1845:2007) has been prepared by Technical Committee CEN/TC 201 “Leather and imitation leather goods and footwear manufacturing machinery - Safety”, the secretariat of which is held by UNI.

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of an identical text or by endorsement, at the latest by June 2008, and conflicting national standards shall be withdrawn at the latest by December 2008.

This document supersedes EN 1845:1998.

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 and ZB, which are an integral part of this document.

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 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 document.

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.

1 Scope

1.1 This European Standard applies to footwear moulding machines which are intended for use in the shoe industry for the production of footwear and footwear components.

These machines are:

- direct-on sole moulding machines (see Figures 1, 2 and 3);
- unit sole and footwear component moulding machines (see Figures 4 to 10);
- full shoe and boot moulding machines (see Figure 11).

This European Standard applies also to the mentioned machines when used for other products than footwear and footwear components, as far as these products require no other changes than a different mould.

1.2 This European Standard specifies safety requirements for construction, transport, installation, adjustment, setting, teaching or process change-over, operation, cleaning, maintenance, decommissioning, dismantling and, as far as safety is concerned, disposal for machines mentioned in 1.1.

It deals with all significant hazards, hazardous situations and events relevant to footwear moulding machines, when they are used as intended and under conditions of misuse which are reasonably foreseeable by the manufacturer (see Clause 4).

1.3 The following machines are excluded from the scope of this European Standard unless used for direct-on sole moulding or reaction moulding:

- moulding machines with static injection units and static mould stations (clamping units);
- moulding machines with static metering and mixing units and mobile stations with linear configuration (mould carriers).

1.4 The European Standard does not deal with hazards created by the mixing and metering unit.

NOTE For metering and mixing units, see EN 1612-1.

The use of machines within the scope of this European Standard in industries other than those specified in 1.1 may give rise to hazards not considered during its preparation.

NOTE For this application see also EN 201 and prEN 1612-2.

1.5 This European Standard also applies to the following additional equipment for material handling and operation which are an integral part of the machine:

- spraying devices, injection units, casting units, nozzle cleaners, sprue pullers, mould front edge cleaners, activating devices, robots and equipment for preparatory and subsequent treatment (see Figure M.1).

1.6 This European Standard assumes the machines:

- are operated by adequately trained persons;
- are used with adequate workplace lighting (see EN 12464-1).

1.7 This document is not applicable to footwear moulding machines which are manufactured before the date of publication of this European Standard by CEN.

2 Normative references

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.

EN 294:1992, *Safety of machinery — Safety distances to prevent danger zones being reached by the upper limbs*

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

EN 547-2:1996, *Safety of machinery — Human body measurements — Part 2: Principles for determining the dimensions required for access openings*

EN 574:1996, *Safety of machinery — Two-hand control devices — Functional aspects — Principles for design*

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

EN 626-1:1994, *Safety of machinery — Reduction of risks to health from hazardous substances emitted by machinery — Part 1: Principles and specifications for machinery manufacturers*

EN 626-2:1996, *Safety of machinery — Reduction of risk to health from hazardous substances emitted by machinery — Part 2: Methodology leading to verification procedures*

EN 811:1996, *Safety of machinery — Safety distances to prevent danger zones being reached by the lower limbs*

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

EN 894-3:2000, *Safety of machinery — Ergonomics 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 982:1996, *Safety of machinery — Safety requirements for fluid power systems and their components — Hydraulics*

EN 983:1996, *Safety of machinery — Safety requirements for fluid power systems and their components — Pneumatics*

EN 999:1998, *Safety of machinery — The positioning of protective equipment in respect of approach speeds of parts of the human body*

EN 1005-2:2003, *Safety of machinery — Human physical performance — Part 2: Manual handling of machinery and component parts of machinery*

EN 1005-3:2002, *Safety of machinery — Human physical performance — Part 3: Recommended force limits for machinery operation*

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

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

EN 1760-1:1997, *Safety of machinery — Pressure sensitive protective devices — Part 1: General principles for the design and testing of pressure sensitive mats and pressure sensitive floors*

EN 1760-2:2001, *Safety of machinery — Pressure sensitive protective devices — Part 2: General principles for the design and testing of pressure sensitive edges and pressure sensitive bars*

EN 1837:1999, *Safety of machinery — Integral lighting of machines*

EN 12545:2000, *Footwear, leather and imitation leather goods manufacturing machines — Noise test code — Common requirements*

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

EN 60947-5-1:2004, *Low-voltage switch gear and control gear — Part 5-1: Control circuit devices and switching elements — Electro-mechanical control circuit devices (IEC 60947-5-1:2003)*

EN 61310-1, *Safety of machinery — Indication, marking and actuation — Part 1: Requirements for visual, auditory and tactile signals*

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

CLC/TS 61496-2:2006, *Safety of machinery — Electro-sensitive protective equipment — Part 2: Particular requirements for systems using active opto-electronic protective devices (APODs)*

CLC/TS 61496-3:2003, *Safety of machinery — Electro-sensitive protective equipment — Part 3: Particular requirements for equipment using active opto-electronic responsive to diffuse reflection (AOPDDR)*

EN ISO 11688-1:1998, *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 13732-1:2006, *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 13849-1:2006, *Safety of machinery — Safety related parts of control systems — Part 1: General principles for design (ISO 13849-1:2006)*

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

EN ISO 14121-1:2007, *Safety of machinery — Risk assessment — Part 1: Principles (ISO 14121-1:2007)*

EN ISO 14122-1:2001, *Safety of machinery — Permanent means of access to machinery — Part 1: Choice of a fixed means of access between two levels (ISO 14122-1:2001)*

EN ISO 14122-2:2001, *Safety of machinery — Permanent means of access to machinery — Part 2: Working platforms and walkways (ISO 14122-2:2001)*

3 Terms and definitions

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

3.1

footwear moulding machines

either injection, pouring or direct-on vulcanising machines used in the footwear manufacturing industry only. The moulding stations of these machines may be either single or multiple, static or mobile and may have linear, rotary or conveyor configuration. The processed material may be either thermoplastic, thermosetting plastic, thermosetting elastomere, 2-component liquid polyurethane (PU) or rubber

3.2

direct-on sole moulding machines

machines used to mould the sole directly onto a lasted upper. One side of the hollow mould is formed by the prepared base of the lasted upper

3.3

unit sole and footwear component moulding machines

machines used to mould complete soles, inserts and shoe components independently of the uppers

3.4

full shoe and boot moulding machines

machines used to mould a complete article of footwear by the injection of material into the cavity of a mould containing a mould last

3.5

static station machines

mould stations are fixed in position. The moulds are filled with material either by their own individual nozzles, or by one or more nozzles which move from station to station

3.6

mobile station machines

one or more nozzles are fixed in position. The mould stations are indexed to the nozzle(s) for filling

3.7

rotary configuration

mould stations are arranged in a circle and rotate around a vertical axis

3.8

quadrant configuration

fixed mould stations are arranged around part of the circumference of a circle, and the nozzle is moved in an arc between stations

3.9

linear configuration

mould stations are arranged in a straight line

3.10

conveyor configuration

moulds travel around a closed loop

3.11

injection process

process of delivering rubber, thermo-plastic or reaction-foaming material through a nozzle into a closed mould

3.12

casting or pouring process

delivery process consisting of 1 or more components which are cast or poured into an open mould

3.13

vulcanizing process

process where rubber material is placed in the mould (unit or direct-on). It is formed and cured using heat and pressure

3.14

fixed covers

fixed guards installed directly at danger points to prevent alone, or together with other parts, unintentional access to the danger points from the covered side

3.15

fixed enclosing guards

fixed guard which, when in position, prevents access to a danger zone by enclosure

3.16

fencing

distance guard around danger zones of a machine or plant which prevents access from outside

3.17

integrated manufacturing system

footwear moulding machine working together with other shoe machines and being operated by a supervisory control system

3.18

mould area

area covered by the moving parts of the mould

3.19

power interlocking

additional independent safety device not associated with a control system, designed to interrupt the power supply to the actuators of the hazardous movements

3.20

recurring access

regular access into the mould area during the normal working cycle

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 (see 4.1 to 4.9 of Table 1).

NOTE Typical outlines of these machines together with significant danger areas are given in Figures 1 to 11, M.1. The figures are given for information only.

The list of significant hazards is based upon EN ISO 14121-1. Also shown are the subclause references to the safety requirements and/or protective measures in the present standard.

Before using the standard it is important to carry out a risk assessment of the footwear moulding machine to check that its significant hazards are identified in this clause.

Table 1 — List of hazards

Danger zone or source of hazard		Type of hazard	Figure/subfigure	Relevant clauses of this standard
4.1	Mechanical hazards			5.2.1.1, 5.2.1.2, 5.2.1.3, 5.2.1.4, 5.2.1.5
4.1.1	Mould area: closing, clamping and opening movements of - last - dummy last - side ring - toe cap device - rising sole mould - lid or cover - ejector	crushing and shearing	1 (1a) 2 (2a, 2d), 3 4 (4c), 5 (5b), 6, 7 8, 9 10 (10c) 11	5.3.1.1.1 5.3.1.2.1 5.3.2.1.1 5.3.2.2.1 5.3.2.3.1 5.3.3.1
4.1.2	Area between fixed safeguarding and parts of machine and moulds, when table rotates or conveyor moves	drawing-in, trapping, shearing or crushing	1 (1b) 4, 5, 6, 7 11	5.3.1.1.2 5.3.2.1.2 5.3.3.2
4.1.3	Operating area			5.3.2.1.3, 5.3.3.3
4.1.3.1	Power operated last rotation	crushing, shearing or impact	1 (1c)	5.3.1.1.3.1
4.1.3.2	Power operated lid rotation		2 (2d), 3	5.3.1.2.4
4.1.3.3	Sole mould turning and shuttling device	crushing and shearing	1 (1f) 2 (2d), 3	5.3.1.1.3.2 5.3.1.2.4
4.1.4	Area beneath rotary table	shearing, crushing, drawing-in, trapping	1 (1e) 4 (4d), 5 (5b), 6, 7 11 (11b2)	5.3.1.1.4 5.3.2.1.4 5.3.3.4

Table 1 — List of hazards (continued)

Danger zone or source of hazard		Type of hazard	Figure/subfigure	Relevant clauses of this standard
4.1.5	Operator's standing area - protruding parts - uneven, sloping, slippery platform - steps	falling, slipping	1 (1g2), 2 (2d), 3, 4, 5 (5b), 6, 7, 8 (8b), 9, 10 (10e), 11	5.2.1.6
4.1.6	Movement of machine due to gravity while being transported	crushing, shearing		5.2.13
4.1.7	Area of injection and pouring mixing unit - movement of nozzle up to mould - traversing movements between filling nozzle and moulds or parts of the machine - at the moving parts of the injection or pouring units	crushing, shearing, drawing-in, trapping, entanglement	1 (1d) 2 (2b, 2c, 2d), 3 4 (4b), 5 (5b), 6, 7, 8 (8b), 9 11 (11b2)	5.3.1.1.5 5.3.1.2.3 5.3.2.1.5 5.3.2.2.2 5.3.3.5
4.1.8	Material feeding aperture in the barrel	trapping, shearing, severing, entanglement	8	5.2.10
4.1.9	Area between rotary or conveyor configuration and auxiliary equipment, e.g. - nozzle cleaner - spraying device - sprue-puller - robots - activating devices	crushing, shearing, trapping and impact	1 (1g1) 6, 7 1 (1g1), 6, 7, M.1	5.2.11
4.1.10	Area between machine with auxiliary equipment and means of transportation, other machines for pre-work and finishing (integrated manufacturing system), e.g. - conveyor for last transportation - handling robot - cooling tunnel	crushing, shearing, trapping and impact	M.1	5.2.12
4.1.11	Mould changing and adjustment	crushing, trapping, shearing, impact	1 (1g) 2, 3 4, 5 (5b), 6, 7 8, 9 10 11	5.2.9.3 5.3.1.2.2 5.3.2.1.6, 5.3.2.1.7 5.3.2.2.3 5.3.2.3.2, 5.3.3.6
4.1.12	Screw changing	Trapping, drawing in, crushing		5.2.9.4

Table 1 — List of hazards (continued)

Danger zone or source of hazard		Type of hazard	Figure/subfigure	Relevant clauses of this standard
4.2	Electrical hazards Electrical contact, directly or indirectly, caused by - component failure - insulation failure - incorrect design, installation or component specifications of the electrical equipment	electric shock, burns		5.2.2
4.3	Thermal hazards			
4.3.1	Accidental contact with hot surfaces, e.g.: - heater bands - nozzle - moulds - heating floors	risk of burns		5.2.3.1
4.3.2	Squirting of hot moulding material - parting line of the mould - between nozzle and mould - purging	risk of burns		5.2.3.2
4.4	Noise Main sources: - screw - hydraulic unit - pneumatic equipment - exhaust equipment	loss of hearing, physiological disorders, interference with speech communication and perception of acoustic signals		5.2.4
4.5	Emission of fumes or skin contact Moulding, spraying and preparation areas: - isocyanate from the PU-moulding material through spillage - overheating of thermo-plastic or rubber material - solvent from the mould release agents - skin contact with moulding materials and solvents	risk of occupational disease (breathing system, skin, nervous system)		5.2.5

Table 1 — List of hazards (concluded)

Danger zone or source of hazard		Type of hazard	Figure/subfigure	Relevant clauses of this standard
4.6	Neglect of ergonomic principles - inadequate local lighting - poor operator posture - excessive effort during loading and unloading - poor control layout and display identification - unsuitable height and size in relation to human body dimensions	risk of occupational disease accidents resulting from poor visibility fatigue physical and mental stress psychological stress musculo-skeletal injury/repetitive strain injury (work related upper limb disorder or WRULD)		5.2.6
4.7	Functional disorders of controls and energy supply - failure of control system (malfunction of safety devices and machine control) - fault of energy supply (irregularity, failure, unexpected reconnection) - electromagnetic disturbances	all possible hazards generated by unexpected dangerous movements (e.g. unexpected start or closing movement)		5.2.8, 5.3.1.1.6, 5.3.2.3.3, 5.3.3.7
4.8	High pressure fluid ejection or ejection of part of a burst component by - failure of hydraulic or pneumatic unit (broken hoses, fittings and pipe work)	injury from hot oil or impact from flexible hoses		5.2.7
4.9	Human error, human behaviour - emergency situation - different operating modes	hazards if the machine is not stopped rapidly in case of an emergency hazards if an error is made when selecting a mode		5.2.9.1 5.2.9.2

5 Safety requirements and/or protective measures

5.1 General

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 12100-2 for relevant but not significant hazards which are not dealt with by this document.

For hazards which are to be reduced by the application of a type B-standard such as EN 294, EN ISO 13850, EN 547 etc., the manufacturer shall carry out a risk assessment to establish the requirements of the B-standards which are to be applied. This specific risk assessment is part of the general risk assessment of the machine.

5.2 Common requirements for all footwear moulding machines

5.2.1 Mechanical hazards

5.2.1.1 All moving transmission parts and drive mechanisms which give rise to danger shall be enclosed by fixed enclosing guards which satisfy EN 953. The guards shall comply with EN 294:1992, Tables 1, 3 and 4 as relevant.

They shall have a fixing system remaining attached to the guards or to the machinery.

5.2.1.2 Unless required otherwise by 5.3 and with consideration of risk assessment in accordance with EN ISO 14121-1, hazardous movements of machinery parts other than transmission and drive mechanisms, parts of the mould and work pieces shall be safeguarded by:

- fixed enclosing guards which satisfy EN 953;
- fencing which satisfies A.3,
- interlocking guards which as a minimum satisfy B.1,
- at trapping points: Mechanical trip devices which satisfy C.1,

or in case of technical impossibility of adopting the previous solutions

- fixed covers which satisfy A.1,
- control guard according to 5.2.8.6 for the mould area.

The guards shall comply with EN 294:1992, Tables 1, 3 and 4 as relevant. Table 1 does not apply to fixed covers.

The fixing systems of fixed enclosing guards, fences (with the exception of the fence supports) and fixed covers shall remain attached to the guards or to the machinery.

5.2.1.3 Where protective measures as given in 5.2.1.2 cannot be provided, devices shall be provided which will achieve a shut down of the hazardous motion before the danger point is reached.

Devices which will achieve this are

- trip devices which satisfy Annex C, such as
 - laser scanner (C.6),
 - electro-sensitive protective devices (C.2, C.3 and C.5) including such devices with start function (C.4) and
 - mechanical trip devices or pressure sensitive bars (C.1),
- two-hand control devices which satisfy D.1,

unless required otherwise by 5.3.

5.2.1.4 Safeguards are not required where access to dangerous parts is prevented by construction elements with limitation of openings to the values of Table 4 of EN 294:1992.

5.2.1.5 Safeguards are not required if the maximum force of moving parts is limited to 150 N and the contact pressure is limited to 50 N/cm² and in case of non power operated movements.

5.2.1.6 The surface of an area where the operator is standing for recurring manual intervention shall be even, and steps, slopes and protruding parts shall be avoided according to EN ISO 14122-1 and EN ISO 14122-2.

5.2.2 Electrical equipment

5.2.2.1 Electrical systems and equipment shall be in accordance with EN 60204-1. With respect to some clauses of EN 60204-1, stated hereafter, the following shall apply:

- **4.3:**
A.C. supplies: 4.3.2;
D.C. supplies: 4.3.3.
- **6.2:**
protection in accordance with 6.2.2 or 6.2.3 and, where applicable, 6.2.4.
- **9.2.5.3/4:**
stop function and emergency switching-off: Categories 0 or 1
- **9.4:**
the safety related parts of the control system shall meet the requirements of 5.2.8.2 and 5.2.8.3 of this standard.
- **11.3:**
degree of protection: IP 54.

5.2.2.2 All operating control devices requiring frequent adjustment for altering process settings shall be located outside the electrical control cabinet.

NOTE Control devices requiring frequent adjustment are controls intended, for instance, for variation of feed, speed, time, temperature or pressure.

5.2.3 Thermal protection

5.2.3.1 Hot surfaces

Hot surfaces within reach the accessibility of which is not directly required for the working process, shall be avoided or safeguards provided against accidental contact such that, the temperatures of burn threshold for the material concerned and a contact time of less than 1 s, given in EN ISO 13732-1, are not exceeded. Selected values on the basis of EN ISO 13732-1 are given in Annex K.

5.2.3.2 Hot moulding materials

To avoid injuries caused by squirting or splashing of hot moulding material the mould and nozzle areas shall be safeguarded by covers which satisfy A.1 or A.2. The covers shall be fitted in such a way that in case of squirting the hot moulding material is diverted downwards.

5.2.4 Noise control

5.2.4.1 Noise control at source by design

When designing the machine, the available information and technical measures to control at source the noise from machine parts, tools, hydraulic, pneumatic and extraction equipment, shall be taken into account, see for example EN ISO 11688-1. Examples of noise control measures are:

- a) reduction of vibration through static and dynamic balancing of rotating parts;

- b) reduction of vibration within the machine by reducing both the mass of moving parts and their acceleration;
- c) reduction of impactive over-clearance of rotational bearings by application of positive pre-loading;
- d) proper choice and design of energy transfer components to eliminate bouncing;
- e) proper choice and design of transmission components (gears, pulleys, belts, bearings etc.);
- f) proper design of machine structures taking into account vibration damping and avoidance of structural resonance.

NOTE EN ISO 11688-2 provides useful information on noise generation mechanisms in machinery.

5.2.4.2 Noise control by protective measures

Examples of noise control measures are:

- a) noise enclosures, screens fitted to the machinery, silencers;
- b) sound deadening of pneumatic discharges, vibration damping of hydraulic circuits.

5.2.4.3 Noise reduction by information

Appropriate information shall be given - see also 7.4.

The above list is not exhaustive. Other noise control measures with the same or better efficiency can be used by a manufacturer.

5.2.5 Fumes detrimental to health

If the intended use concerning the specific materials to be processed and the auxiliary products to be used is known by the manufacturer, the design shall include measures against the possible harmful emissions of fumes that can be caused. If necessary on the basis of his risk assessment, the manufacturer shall offer integral extraction equipment or an extraction provision for connection to an external exhaust system. The capacity of this provision shall be sufficient for the intended use of the machine in accordance with Clause 6 of EN 626-1:1994. The instructions for use shall give information on the necessity and the limits of this equipment (see 7.3).

If the manufacturer has no information about the specific use and, therefore, is not able to include in his design appropriate measures against the possible emissions of fumes, he shall at least formulate the general principles to be observed against this hazard in the information for uses (see 7.3).

NOTE Fumes detrimental to health are e.g. fumes of parting compounds, solvents, thermoplastics, duroplastics, thermoplastic elastomere, 2-component-liquid-polyurethane and rubbers.

5.2.6 Ergonomics

Machine design shall take into account the ergonomic principles described in 4.8 of EN ISO 12100-2:2003 and EN 614-1.

In particular, the design shall take account of:

- the operating height;
- operator posture and movement;
- operator physical strength especially during setting, in accordance with EN 1005-2 and EN 1005-3;

- ease of access and compatibility of control actuators according to EN 894-3;
- operator access to the working area in accordance with EN 547-1, EN 547-2 and EN ISO 14122-1, if necessary, a suitable platform in accordance with EN ISO 14122-2 shall be provided; the platform shall be non-sloping;
- design of displays in accordance with EN 894-2;
- additional local lighting on the machine in accordance with EN 1837.

5.2.7 Pressurized fluid systems

Equipment of hydraulic and pneumatic systems shall satisfy 4.10 of EN 12100-2:2003, EN 982 and EN 983.

Flexible pipes containing pressurized hydraulic or pneumatic fluids shall be protected by sufficient distances or by guards to prevent wear caused by other machine parts.

5.2.8 Control systems

5.2.8.1 Control systems shall comply with the following general requirements:

- for electrical system: 5.2.2 of the present standard and Clause 9 of EN 60204-1:2006;
- for pneumatic systems: the requirements of EN 983;
- for hydraulic systems: the requirements of EN 982.

5.2.8.2 Safety related parts of the control systems shall be designed in accordance with the principles of EN ISO 13849-1. Safety related parts are for example emergency stopping systems, mode selection devices, safety interlocking systems for guards, safety devices, the monitoring of safety functions, emergency system for the ventilation in case of explosion risk.

5.2.8.3 Unless otherwise stated the following principles apply:

- safety related parts of pneumatic and hydraulic control systems shall at least comply with the category 1 of EN ISO 13849-1;
- safety related parts of electrical/electronic control systems shall at least comply with category 3 of EN ISO 13849-1 unless otherwise stated in this European Standard. Depending on the risk assessment, the safety related part of the control system related to the emergency stop system shall at least comply with category 1.

This requirement includes that safety related functions shall not solely rely on normal traditional programmable electronic systems (PES): the required safety category shall be realised by the use of, for example, an additional hardwired circuit, a redundant solid state channel, or other provisions for redundancy:

- when using a category 2 (based on the risk assessment) the test interval shall be as short as required and not more than 4 h;
- the parts of the control system processing the signal of a safety device shall comply at least with the safety category of that device.

5.2.8.4 Interlocking devices for safeguards and devices for muting of safeguards shall only be operated by position sensors (pressure, time or programme controlled commands of interlocks alone are not permitted). Electrical position sensors shall comply with EN 60947-5-1 and be appropriate for functioning in the positive mode according to EN 1088. According to 5.1 of EN 1088:1995, non positive mode actuation is only allowed in conjunction with a detector with positive mode actuation, notably to avoid common cause failures.

5.2.8.5 Appropriate provisions shall be provided, taking into account the requirements of EN 1037, EN 982, EN 983, EN 60204-1, against all hazards related to failure of the power supply, including irregularities, unexpected reconnection after interruption of the power supply or when the control circuit has been switched off.

The stipulation for preventing uncontrolled dangerous movements caused by gravity in the case of a power failure is met

- by automatically functioning mechanical restraint or frictional mechanical restraint devices, or
- for pneumatic and hydraulic control systems by providing an additional pilot-controlled check valve. This shall consist of a seated valve fitted, where possible, directly to the cylinder. If direct fitting is not possible, then rigid pipe work with flanged or welded fittings shall be used between the valve and cylinder.

The stipulation for preventing uncontrolled dangerous movements caused by unexpected reconnection of the power supply is, for electro-pneumatically controlled machines, met by means of pressure switches acting on the machine control.

5.2.8.6 If a control guard as defined in 3.25.6 of EN ISO 12100-1:2003 is used, it shall meet the requirements of 5.3.2.5 of EN ISO 12100-2:2003 as well as those of EN 1088:1995 and B.3 with regard to interlocking. In addition the control guard shall meet the requirements of Annex J.

Closing the guard may restart hazardous movements on machines only where

- a) access is required for each normal operating cycle and
- b) it is not possible to stand inside the area surrounded by the guard.

Guards shall be completely closed before the machine can operate.

The control guard may be manually or power operated. If the control guard is power operated, closure may be initiated by a push-button, timer or a single beam photoelectric device satisfying category B of EN ISO 13849-1.

Power operated guards shall be fitted with a trip device which satisfies C.1, unless they comply with 5.2.1.5.

Where there is recurring access into the mould area, power operated guards shall be manually initiated.

5.2.8.7 Where machines are equipped with electro-sensitive protective devices, movement may restart automatically once the area protected by the device is vacated by the operator provided that a) and b) of 5.2.8.6 are applied. This device shall satisfy C.4.

5.2.8.8 On machines where access to the processing area is not required for normal operation (automatic machines) restart shall not be possible by closing the guard, respectively leaving the area protected by the electro-sensitive protective device but only after activating a manual operating control.

5.2.8.9 Foot-actuated controls which actuate hazardous motion and which are not firmly connected to the machine, as well as foot-actuated controls at standing working positions, shall be safeguarded against accidental operation by provision of a cover around the foot-actuated control.

5.2.8.10 The machines shall have sufficient immunity in relation with electromagnetic disturbances to enable them to operate safely as intended and not fail to danger when exposed to the levels and types of disturbances intended by the manufacturer.

The manufacturer shall select or design, install and wire the equipment and sub-assemblies taking account of the recommendations of the suppliers of the sub-assemblies.

5.2.9 Additional safety devices

5.2.9.1 Emergency stop

The emergency stop shall meet the requirements of EN ISO 13850. Electrical emergency stops shall comply with EN 60204-1:2006, 9.2.5.4.2. For other types of energy, the emergency stops shall comply with the first two paragraphs of that clause.

5.2.9.2 Mode selection device

Machines designed for several operating modes or which can be operated by means of various safety devices operating at different levels shall be equipped with mode selection devices in accordance with 4.11.9 and 4.11.10 of EN ISO 12100-2:2003. Each position shall be secured e.g. by the use of a lock or an access code etc.

Operating modes are, e.g. automatic operation, hand controlled operation, mould changing, adjustment.

The act of mode selection by itself shall not initiate operation. Separate actuation by the operator shall be required.

5.2.9.3 Mould changing and adjustment

Provision shall be made to positively locate and secure the mould.

On footwear moulding machines where frequent mould changes are required, it shall be possible to achieve these safely and quickly. Where it is necessary to by-pass the operator's safeguard during mould changing or adjustment, one of the following shall be utilised, unless otherwise specified by 5.3:

- low force or mould closing satisfying 5.2.1.5;
- a two-hand control which satisfies D.1 and is synchronous in operate;
- a hold-to-run control device which satisfies E.1 or E.2.

5.2.9.4 Screw changing on polyurethane machines

5.2.9.4.1 Access to the danger zone of the continuously rotating screw shall be prevented by interlocking guards with guard locking according to B.8. It shall be possible to open the guard only after rotating and traversing movements of the screw have stopped.

The requirement is also met if the machine is designed such

- that the danger zone is safeguarded by interlocking guard according to B.1 and
- the rotating screw shall be switched off before it is possible to initiate traversing movements and
- that traversing movement stops immediately by opening the interlocking guard.

5.2.9.4.2 If screw changing is achieved by dismantling of the mixing unit an interlocking device according to B.1 shall be provided.

5.2.10 Material feeding

On footwear moulding machines where an aperture in the barrel is required for material feeding access to the injector screw shall be prevented either by

- restricted opening which satisfies EN 294:1992, Table 4, or

— an interlocking guard which satisfies B.1.

5.2.11 Auxiliary equipment

Auxiliary equipment may be for example: Nozzle cleaners, spraying devices, sprue-pullers, robots and activating devices.

Access to all danger zones around the machine and auxiliary equipment (see Figure M.1) shall be prevented by a surrounding fence which satisfies A.3.

The fencing should be designed and arranged in such a manner that it is not possible to remain in the danger zone with the guard closed. Where this is impossible, additional requirements shall be met which satisfy A.3.

The necessary interlocking system according to B.1 shall prevent access to all dangerous movements of the footwear moulding machines and the auxiliary equipment itself.

Alternatively an electro-sensitive protective device which satisfies C.2 and C.5, may be used as a perimeter safeguard.

NOTE For robots see also EN ISO 10218-1.

5.2.12 Integrated manufacturing systems

Footwear moulding machines working together with one or more machines and being operated by a supervisory system (integrated manufacturing system) shall be safeguarded by fencing which meets the requirements of A.3.

The fencing shall be designed and arranged in such a manner that it is not possible to remain in the danger zone with the gate closed. Where impossible, additional requirements according to A.3 are to be met.

Additionally integrated manufacturing systems shall meet the requirements of Annex M.

With respect to safety during setting, programming, testing and maintenance, trouble shooting, integrated manufacturing system shall meet the requirements of Annex I.

NOTE 1 An integrated manufacturing system is, for instance, a direct-on system consisting of automated auxiliary equipment, transfer equipment and machines for pre work and finishing (see Annex M, Figure M.1).

NOTE 2 Additional guidance on the safety of integrated manufacturing systems can be found in ISO 11161.

5.2.13 Aids for transportation

Footwear moulding machines and their auxiliary equipment shall be constructed and equipped in such a manner that they can be safely transported. The requirement is met by providing points for fitting the transport means and a machine frame design which allows the use of a fork lift truck or a roller truck. Any special equipment or procedure required for safe transportation or installation of the machine shall be supplied with the machine, and described in the instructions for use.

NOTE Information for use and removal see 7.3.

5.3 Requirements for specific types of footwear moulding machines

5.3.1 Direct-on sole moulding machines (see Figures 1, 2 and 3)

5.3.1.1 Mobile station with rotary or conveyor configuration (see Figure 1)

5.3.1.1.1 Mould area (Figure 1)

5.3.1.1.1.1 Machines shall be designed in such a manner that the hazardous automated mould movements can only take place behind guards. In general hazardous automated mould movements include:

- last movement;
- mould ring movement;
- toe cap movement;
- bottom plate movement.

Fixed guards shall satisfy EN 953 and A.1, fencing A.3, and interlocking guards EN 1088 and B.1.

5.3.1.1.1.2 Guards are not required where recurrent access to the danger zone is required for normal operation, provided the hazardous mould movements are actuated by a two-hand control which satisfies EN 574 and D.1.

5.3.1.1.2 Table and conveyor perimeter (Figure 1)

Trapping points between guards and moving parts shall be protected by trip devices which stop all hazardous movements. For avoiding access the gap shall be limited to ≤ 150 mm.

A suitable trip device is a pendulum flap which satisfies C.1.

5.3.1.1.3 Operating area (Figure 1)

5.3.1.1.3.1 Power operated last rotation outside the area protected by guards as per 5.3.1.1.1 shall not be possible, unless the last carrier is at its upper limit position and a hold-to-run control which satisfies E.1 is provided.

The buttons of the hold-to-run control device shall be situated on a vertical panel at the outer edge of the rotating or conveying plane.

5.3.1.1.3.2 Machines shall be constructed in such a manner that hazardous automated movement of the sole mould turning or shuttling device can only take place behind guards.

These guards can be

- fencing in accordance with A.3;
- interlocking guards in accordance with B.1;
- fixed guards as defined in 3.2 of EN 953:1997.

5.3.1.1.4 Area beneath rotary table or conveyor system

Access to danger points beneath the rotary table or conveyor shall be prevented by fixed guards according EN 953 and EN 294:1992, Table 4, or interlocking guards in accordance with B.1. These guards shall not create additional hazards and the gap between the top of the guard and the underside of the table shall be equal to or less than 6 mm.

NOTE Guards consisting of flexible material may be used to avoid danger caused by variation of this gap during machine movement.

An acceptable solution is also, if

- height beneath rotary table is ≥ 500 mm and providing a toe-plate on the inside edge of the operator's platform, so that shoes falling beneath rotary table are avoided, or
- switching rope, placed totally around the table, is provided, which meets the requirements of EN ISO 13850:2006, 4.5.

5.3.1.1.5 Area of injection or pouring

The danger zones in the area of injection or pouring units shall be protected by interlocking guards or fixed guards combined with interlocking guards.

Opening of the interlocking guard shall stop the automatic cycle (table rotation, injector forward and mould close) and the guard shall prevent access to all dangerous parts before they are at standstill. The injector or pouring head may reverse if no additional hazards are created. Material ejection may be controlled with the guard open.

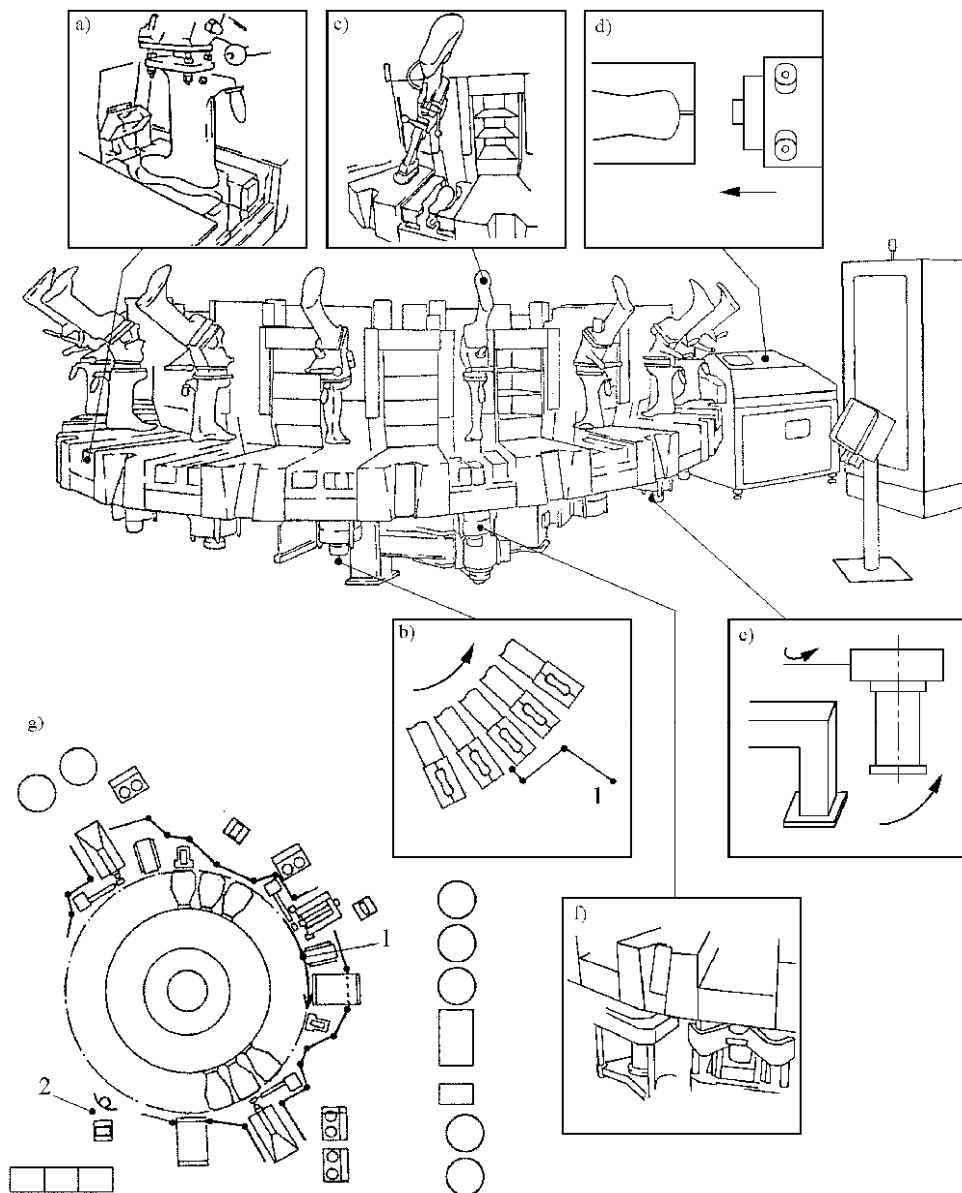
Interlocking guards shall satisfy EN 1088 and B.1.

Guards shall satisfy EN 953, EN 294:1992, Table 1 and Annex A.

If it is possible to reach the mould closing area, the interlocking device shall satisfy B.3.

5.3.1.1.6 Safety related parts of control systems

Deviating from 5.2.8.3 safety related parts of control system shall meet the requirements of category 1 of EN ISO 13849-1 (see examples in G.2).



Key

- a) moulding area (5.3.1.1.1)
- b) table perimeter (5.3.1.1.2)
- 1 guard
- c) operating area (last rotation) (5.3.1.1.3.1)
- d) area of injection or pouring and mixing unit (5.3.1.1.5)
- e) area beneath rotary table (5.3.1.1.4)
- f) operating area (sole mould turning or shuttling device) (5.3.1.1.3)
- g) mould changing and adjustment area (5.2.9.3) and operating area (5.3.1.1.3)
- 1 zone between rotary table and auxiliary equipment (5.2.11)
- 2 operator's standing area (5.2.1.6)

Figure 1 — Direct-on sole moulding machine (mobile station with rotary configuration) (5.3.1.1)