

Footwear manufacturing machines — Footwear moulding machines — Safety requirements

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British Standard

ICS 61.060

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- present to the responsible European committee any enquiries on the interpretation, or proposals for change, and keep the UK interests informed;
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Footwear manufacturing machines — Footwear moulding machines — Safety requirements

Machines pour la fabrication des chaussures —
Machines de moulage pour chaussures —
Prescriptions de sécurité

Maschinen zur Herstellung von Schuhwerk —
Schuhformmaschinen — Sicherheitsanforderungen

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CEN

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Foreword

This European Standard 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of an identical text or by endorsement, at the latest by January 1999, and conflicting national standards shall be withdrawn at the latest by January 1999.

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

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0 Introduction

The extent to which hazards are covered is indicated in the scope of this standard. In addition, machinery should comply as appropriate with EN 292 for hazards which are not covered by this standard.

This standard contains safety requirements for footwear moulding machines. It is aimed at designers, manufacturers, suppliers and importers.

1 Scope

1.1 This 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;
- full shoe and boot moulding machines;
- unit sole and footwear component moulding machines.

1.2 This 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 takes account of intended use, foreseeable misuse, component and system failure.

1.3 The following machines are excluded from the scope of this standard unless used for direct-on sole moulding or reaction 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 This standard covers all hazards relevant to the footwear manufacturing industry only. (List of hazards see clause 4).

The standard does not deal with:

- precise technical measures for reducing the risks from fumes;
- 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 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 EN 201 and prEN 1612-2.

1.5 This standard also applies to additional equipment for material handling and operation which are an integral part of the machine such as spraying devices, injection units, casting units, nozzle cleaners, sprue pullers, mould front edge cleaners, activating devices and robots for preparatory and subsequent treatment. The standard does not deal with precise technical measures for reducing the risks from fumes.

1.6 This standard applies to machines manufactured after its date of publication.

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.

- EN 201:1997, *Rubber and plastics machines — Injection moulding machines — Safety requirements*.
- EN 292-1:1991, *Safety of machinery — Basic concepts, general principles for design — Part 1: Basic terminology, methodology*.
- EN 292-2:1991 + A1:1995, *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 349:1993, *Safety of machinery — Minimum gaps to avoid crushing of parts of the human body*.
- EN 418:1992, *Safety of machinery — Emergency stop equipment, functional aspects — Principles for design*.
- EN 457:1992, *Safety of machinery — Auditory danger signals, general requirements, design and testing*. (ISO 7731:1986, modified).
- 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 dimensions — Part 2: Principles for determining the dimensions required for access openings*.
- EN 563:1994, *Safety of machinery — Temperatures of touchable surfaces — Ergonomics data to establish temperature limit values for hot surfaces*.
- EN 574:1996, *Safety of machinery — Two-hand control devices, functional aspects — Principles for design*.
- EN 614-1:1995, *Safety of machinery — Ergonomic design principles — Part 1: Terminology and general principles*.
- EN 626-1:1994, *Safety of machinery — Reduction of risk 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 775:1992 + AC:1993, *Manipulating industrial robots — Safety*. (ISO 10218:1992, modified).
- EN 811:1996, *Safety of machinery — Safety distances to prevent danger zones being reached by the lower limbs*.

EN 842:1996, *Safety of machinery — Visual danger signals — General requirements, design and testing.*

EN 894-1:1997, *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 894-2:1997, *Safety of machinery — Ergonomics requirements for the design of displays and control actuators — Part 2: Displays.*

EN 894-3:1992, *Safety of machinery — Ergonomics requirements for the design of displays and control actuators — Part 3: Control actuators.*

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

EN 954-1:1996, *Safety of machinery — Safety related parts of control systems — Part 1: General principles for design.*

EN 981:1996, *Safety of machinery — System of auditory and visual danger and information signals.*

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.*

prEN 999:1993, *Safety of machinery — The positioning of protective equipment in respect of approach speeds of parts of the human body.*

prEN 1005-2:1993, *Safety of machinery — Human physical performance — Part 2: Manual handling of objects associated to machinery.*

prEN 1005-3:1993, *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 1050:1996, *Safety of machinery — Principles for risk assessment.*

ENV 1070, *Safety of machinery — Terminology.*

EN 1088:1995, *Safety of machinery — Interlocking devices with and without guard locking — General principles and provisions for design.*

prEN 1093-1:1993, *Safety of machinery — Evaluation of the emission of airborne hazardous substances — Part 1: Selection of test methods.*

EN 1612-1:1997, *Rubber and plastics machines — Reaction moulding machines — Part 1: Safety requirements for metering and mixing units.*

prEN 1612-2:1995, *Rubber and plastics machines — Safety — Reaction moulding machines — Requirements for design and construction — Part 2: Reaction moulding plant.*

prEN 1760-1:1994, *Safety of machinery — Pressure sensitive protective devices — Part 1: General principles for the design and testing of pressure sensing mats and pressure sensing floors.*

prEN 1921:1995, *Industrial automation systems — Safety of integrated manufacturing systems — Basic requirements.*

prEN ISO 3740¹⁾, *Acoustics — Determination of sound power levels of noise sources — Guidelines for the use of basic standards and for preparation of noise test codes.*

EN ISO 4871:1996, *Acoustics — Declaration and verification of noise emission values of machinery and equipment.*

prEN ISO 9614-1¹⁾, *Acoustics — Determination of sound power level of noise sources using sound intensity — Part 1: Measurement at discrete points.*

EN ISO 11200, *Acoustics — Noise emitted by machinery and equipment — Guidelines for the use of basic standards for the determination of the emission sound pressure levels at work station and at other specified positions.*

ISO TR 11688-1, *Acoustics — Recommended practice for the design of low-noise machinery and equipment — Part 1: Planning.*

ISO CD 11688-2¹⁾, *Acoustics — Recommended practice for the design of low-noise machinery and equipment — Part 2: Noise generation principles.*

EN ISO 11689:1996, *Acoustics — Procedure for the comparison of noise emission data for machinery and equipment.*

prEN 50100-1:1994, *Safety of machinery — Electrosensitive protective equipment — Part 1: General requirements and tests.*

prEN 50100-2:1994, *Safety of machinery — Electrosensitive protective equipment — Part 2: Particular requirements for systems using active opto-electronic protective devices.*

EN 60204-1:1992, *Safety of machinery — Electrical equipment of machines — Part 1: General requirements.*

EN 60947-5-1:1992, *Control circuit devices and switching elements — Electromechanical control circuit devices.*

3 Definitions

For the purposes of this standard the definitions given in EN 292-1:1991, EN 292-2:1991 + A1:1995 and in ENV 1070:1993 are applicable. In addition, the following definitions apply.

3.1

footwear moulding machines

either injection, pouring or direct-on vulcanizing 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 elastomer, 2-component liquid polyurethane (PU) or rubber

¹⁾ These standards are under preparation in ISO (revision of ISO 3740, publication of ISO 11688-2 pending).

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

the 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

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

3.8

quadrant configuration

the 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

the mould stations are arranged in a straight line

3.10

conveyor configuration

the moulds travel around a closed loop

3.11

injection process

process of delivering rubber, thermoplastic or reaction foaming material through a nozzle into a closed mould

3.12

casting (or pouring) process

delivery process used only with reaction foaming materials consisting of 2 or more liquid constituents which are poured into an open mould from above

3.13

vulcanizing process

a process where a piece of rubber sheet is preheated and placed in the mould (unit or direct-on). It is formed and cured using heat and pressure

3.14

hazardous movement

a motion of a part of the machine which may give rise to injury

3.15

danger points

points on footwear moulding machines which may give rise to personal injury due to controlled-path movements of drives, machinery parts, tools or workpieces. Particular danger points are: pinching and shearing points, stabbing and cutting points, drawing-in and trapping points

3.16

fixed covers

fixed guards installed directly at danger points to prevent alone, or together with other parts, access to the danger points from the covered side (as EN 292-1:1991, 3.22)

3.17

fixed enclosing guard

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

3.18

pressure sensitive mats (PSM) and floors (PSF)

see prEN 17601:1994

3.19

power interlocking

additional independent safety device associated with a control system designed to interrupt the power supply to the actuators of the hazardous movements

3.20

recurring access

a regular access into the mould area during the normal working cycle

3.21 safety distance (S)

see 3.29 of ENV 1070:1993

3.22

approach speed (K)

a constant giving the operator's speed of movement when using a two-hand control device, an electrosensitive protective device or a pressure sensitive safety device

3.23

additional safety distance (C)

a distance which takes into account movement towards the hazard point prior to activation if using electrosensitive protective devices

3.24

over-all response time (T)

the time between actuation of the safety device and the machine coming to a stop or the hazard being removed, taking into account wear and tear, maximum pressure and maximum closing speed of the machine; and assuming it to be equipped for normal intended use

3.25

fencing

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

3.26

integrated manufacturing system

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

3.27

operating area

the zone of a machine which includes:

- the area of manual loading and unloading;
- the operator's standing area.

3.28

mould area

an area covered by the moulding parts

4 List of hazards

4.1 The significant hazards of footwear moulding machines are outlined in Table 1, **4.3** to **4.10**.

4.2 The danger zones which give rise to mechanical hazards are illustrated in Figures 1 to 11. The figures are given for information only.

5 Safety requirements and/or measures

5.1 Common requirements for all footwear moulding machines

5.1.1 Mechanical equipment

5.1.1.1 All transmission machinery, drive mechanisms and moving machinery parts which give rise to danger shall be enclosed by fixed enclosing guards which satisfy EN 953:1997.

5.1.1.2 Unless required by **5.2** and with consideration of risk assessment in accordance with EN 1050:1996, hazardous movements of tooling and workpieces shall be safeguarded by:

- fixed enclosing guards which satisfy EN 953:1997;
- fixed covers which satisfy **A.1**;
- mechanical trip devices at trapping points which satisfy **C.1**;
- fencing which satisfies **A.3**; or
- interlocking guards which as a minimum satisfy **B.1**.

5.1.1.3 Where protective measures as given in **5.1.1.2** cannot be provided, devices shall be provided which will effect a shut down of the hazardous motion before the danger point is reached.

Devices which will effect this are:

- trip devices which satisfy **C.1** or **C.2**, such as electrosensitive protective devices;
- mechanical trip devices or pressure sensitive bars;
- two-hand control devices which satisfy **D.1**, unless not specifically required by **5.2**.

5.1.1.4 Safety distances shall comply with Tables 1, 3 and 4 of EN 294:1992.

5.1.1.5 Until such time as a B standard for maximum forces and contact pressures is agreed, 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.

5.1.1.6 *Operator's standing area.* The area where the operator is standing for recurring manual intervention shall be even, and steps, slopes and protruding parts shall be avoided.

5.1.2 Electrical equipment

5.1.2.1 Electrical systems and equipment shall be in accordance with EN 60204-1:1992.

5.1.2.2 All operating controls requiring adjustment for altering process settings shall be located outside the electrical control cabinet.

NOTE Controls for routine electrical adjustment are, for instance, to vary feed, speed, time, temperature or pressure.

5.1.3 Thermal protection

5.1.3.1 Hot surfaces

Hot surfaces within reach which are not directly required for the working process shall be avoided or safeguarded against accidental contact.

This stipulation can be met by protecting the hot contact surfaces by means of insulation materials or additional covers so that in accordance with EN 563:1994 the minimum temperatures of burn threshold for the contact time of less than 1 s are not exceeded. Selected values on the basis of Figures 2, 5 and 6 of EN 563:1994 are given in annex J.

NOTE Materials containing asbestos should not be used for insulation.

5.1.3.2 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. The covers shall be fitted in such a way that in case of squirting the hot moulding material is diverted downwards.

Table 1 — List of hazards

Danger zone or source of hazard	Type of subhazard	Figure	Sub-figure
4.3 Mechanical hazards			
4.3.1 Moulding area: closing, clamping and opening movements of: — last — dummy last — side ring — toe cap device — rising sole mould — lid of cover — ejector	crushing and shearing	1; 2; 3; 4; 5; 6; 7; 8 9; 10; 11	1.1; 2.1; 2.3 4.1; 5.1; 8.1 10.1
4.3.2 Area between fixed safeguarding and parts of machine and moulds when table rotates or conveyanor moves	drawing-in, trapping, shearing or crushing	1 4; 5; 6; 7; 11	1.2
4.3.3 Operating areas		2; 3; 4; 5; 6; 7; 8; 9; 10; 11	2.3 8.1 10.3
4.3.3.1 Power operated last rotation	crushing, shearing or impact	1	1.3
4.3.3.2 Power operated lid rotation			
4.3.3.3 Sole mould turning and shuttling device	crushing and shearing	1	1.4
4.3.4 Area beneath rotary table or conveyor	shearing, crushing, drawing-in, trapping	1; 4; 5 6; 7; 11	1.5; 4.2; 5.1 11.1
4.3.5 Operator's standing area — protruding parts — uneven, sloping, slippery platform — steps	falling, slipping, tripping	1; 2; 3; 4 5; 6; 7; 8 9; 10	1.6; 2.3 5.2; 5.4; 8.1 10.3
4.3.6 Movement of machine due to gravity while being transported	crushing, shearing		
4.3.7 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; 2; 3 4; 5; 6; 7 8; 9; 10 11	1.7; 2.2; 2.3 4.3; 5.3 8.1; 10.1 11.2

Table 1 — List of hazards (continued)

Danger zone or source of hazard	Type of subhazard	Figure	Sub-figure
4.3.8 Material feeding aperture in the barrel	trapping, shearing, severing, entanglement		
4.3.9 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 6; 7	1.8
4.3.10 Area between machine with auxiliary equipment and means of transportation, other machines for prework and finishing, e.g. — conveyor for last transportation — handling robot — cooling tunnel	crushing, shearing, trapping and impact	12	
4.3.11 Mould changing and adjustment	crushing, trapping, shearing, impact	1; 2; 3; 4 5; 6; 7; 8 9; 10; 11	1.9 5.2; 5.4
4.4 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		
4.5 Thermal hazards 4.5.1 Accidental contact with hot surfaces e.g. — heater bands — nozzle — moulds — heating floors	risk of burns		
4.5.2 Squirting of hot moulding material — parting line of the mould — between nozzle and mould — purging	risk of burns		
4.6 Noise — screw — hydraulic unit — pneumatic equipment	loss of hearing, interference of speech communication and perception of acoustic signals		

Table 1 — List of hazards (continued)

Danger zone or source of hazard	Type of subhazard	Figure	Sub-figure
4.7 Emission of fumes or skin contact Moulding, spraying and preparation areas: — isocyanate from the PU-moulding material through spillage — overheating of thermoplastic 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)		
4.8 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)		
4.9 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)	all possible hazards generated by unexpected dangerous movements (e.g. unexpected start or closing movement)		
4.10 High pressure fluid ejection or ejection of part of a burst component by failure of hydraulic or pneumatic unit (broken hoses, fittings and pipework)	injury from hot oil or impact from flexible hoses		

5.1.4 Noise

Noise reduction shall be carried out by using one or more of the following features:

- 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 preloading;
- 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;
- g) sound deadening of pneumatic discharges, vibration damping of hydraulic circuits.

5.1.5 Fumes detrimental to health

Reduction of risk to health from hazardous substances shall be carried out by observing the state of the art and clause 6 of EN 626-1:1992.

Where the process generates fumes which may be hazardous to health, the machine shall be designed so as to enable extraction equipment to be connected. It may be necessary for the manufacturer to fit suitable capture hoods. Because of the fumes they will vary for each material it is not possible to deal with precise precautions.

5.1.6 Ergonomics

Machine design shall take into account the ergonomic principles described in 3.6 of EN 292-2:1991.

In particular, the design shall take account of:

- the operating height;
- operator posture and movement;
- operator physical strength especially during setting, in accordance with prEN 1005-2:1993 and prEN 1005-3:1993;
- ease of access and compatibility of control actuators according to EN 894-1:1997;
- operator access to the working area in accordance with EN 547-1:1996 and EN 547-2:1996; if necessary, a suitable platform shall be provided; the platform shall be non-sloping, and the surface shall be made of non-slip material;
- design of displays in accordance with EN 894-2:1997.

5.1.7 Pressurized fluid systems

Equipment of hydraulic and pneumatic systems shall satisfy 3.8 of EN 292-2:1991, EN 982:1996 and EN 983:1996.

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

5.1.8 Control systems

5.1.8.1 Electrical control systems shall be in compliance with clause 9 of EN 60204-1:1992.

Pneumatic control systems shall be in compliance with EN 983:1996.

Hydraulic control systems shall be in compliance with EN 982:1996.

5.1.8.2 Control guard: a control guard is a guard as defined in 3.25.6 of ENV 1070 which meets 4.2.2.5 of EN 292-2:1991 as well as EN 1088:1995 and B.3 of this standard with regard to interlocking.

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 954-1:1996.

Power operated guards shall be fitted with a trip device which satisfies C.1, unless they comply with 5.1.1.5.

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

5.1.8.3 Where machines are equipped with electrosensitive protective devices, movement may restart automatically once the area protected by the device is vacated by the operator provided that a) and b) of 5.1.8.2 are applied. This device shall satisfy C.3.

5.1.8.4 Interlocks may only be operated and safeguards may only be muted by position sensors. Electrical position sensors shall satisfy EN 60947-5-1:1992.

Pressure, time or programme controlled commands alone are not permitted.

5.1.8.5 Devices shall be fitted, in accordance with EN 1037:1995 which prevent uncontrolled dangerous movements caused by irregularities, failure or unexpected reconnection of the power supply, or where the control circuit had been switched off.

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

- by 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 pipework 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 electropneumatically controlled machines, met by means of pressure switches acting on the machine control.

5.1.8.6 Unless required by **5.1.8.7** or **5.2**, safety related parts of the machine control systems:

- shall be of at least the same category as the safeguarding used; and
- shall, however, as a minimum meet category 1 (**7.2.2**) of EN 954-1:1996.

5.1.8.7 Safety related parts of control systems shall be designed in such a manner that one failure of any electrical component cannot cause the automatic start of a hazardous movement, corresponding to category 2 or 3 of EN 954-1:1996.

When using category 2 the test interval shall be at least 4 h.

The use of programmable electronic systems (PES) shall not reduce any level of safety laid down in this standard. When a machine is fitted with PES, safety related functions shall not rely solely on it. This requirement is met, by for example:

- an additional hardwired control system;
- duplicated solid state channel; or
- other provisions for redundancy.

5.1.8.8 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.

5.1.9 Additional safety devices

5.1.9.1 Emergency stop

Unless not specifically required by **5.2**, the emergency stop shall be either category 0 or category 1, depending on whichever stops all movements in the shortest possible time.

For functional aspects and requirements see EN 418:1992.

For specific requirements for electrical equipment see **9.2.2**, **9.2.5.4** and **10.7** of EN 60204-1:1992.

5.1.9.2 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 according to **3.7.9** and annex A, **1.2.5** of EN 2922:1991, which can be locked in each position.

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.

5.1.9.3 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 bypass the operator's safeguard during mould changing or adjustment, one of the following shall be utilized:

- low force or manual mould closing (see **5.1.1.5**);
- a limited movement device;
- a two-hand control which satisfies **D.1** and is synchronous in operate;
- a hold-to-run control which satisfies **E.2**.

5.1.9.4 Screw changing on polyurethane machines

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.

5.1.10 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:

- a restricted opening which satisfies EN 294:1992, Table 4; or
- an interlocking guard which satisfies **B.1**.

5.1.11 Auxiliary equipment

Access to all danger zones around the machine and auxiliary equipment (see Figure L.1) shall be prevented by a surrounding fence which satisfies **A.3.1**.

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.3.2**.

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 electrosensitive protective device which satisfies **C.2** may be used as a perimeter safeguard.

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

For robots (spraying and roughing robots) see also EN 755:1992.

5.1.12 Integrated manufacturing systems

Footwear moulding machines working together with other shoe machines and being operated by a supervisory system access to all danger zones around the machines shall be prevented by a surrounding fence which satisfies **A.3**. With respect to:

- starting conditions;
- emergency stops;
- the level of safety related parts of control systems;
- safety during setting, programming, programme, verification, maintenance and trouble shooting.

Observe in particular the requirements of prEN 1921:1995.

NOTE For major aspects see informative annex L. An integrated manufacturing system is, for example, a direction system consisting of automated auxiliary equipment, transfer equipment and machines for prework and finishing (see annex L, Figure L.1).

5.1.13 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 requirements are met by providing holes for transport hooks and a machine frame design which allows the use of a fork lift truck or a roller truck.

5.2 Requirements for specific types of footwear moulding machines

5.2.1 Direct-on sole moulding machines

(see Figures 1, 2 and 3)

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

5.2.1.1.1 Mould area (Figure 1.1)

5.2.1.1.1.1 Machines shall be constructed in such a manner that the following hazardous automated mould movements can only take place behind guards:

- last lowering;
- mould ring closing;
- toe cap closing;
- bottom plate lifting.

Fixed guards shall satisfy EN 953:1997 and **A.1**, fencing **A.3**, and interlocking guards EN 1088:1995 and **B.1**.

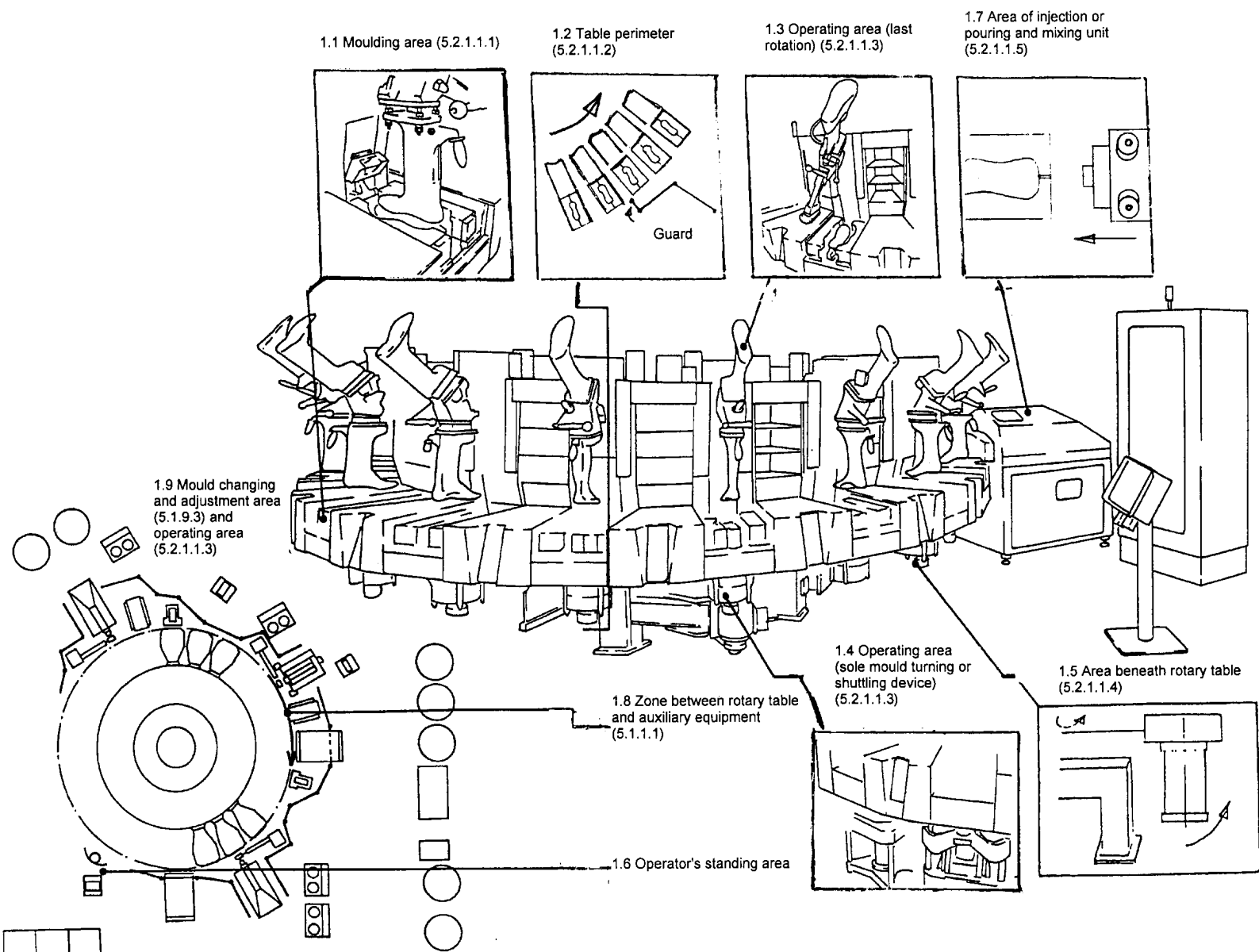


Figure 1 — Direct-on sole moulding machine (mobile station with rotary configuration) (5.2.1.1)

5.2.1.1.1.2 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 574:1996 and **D.1**.

5.2.1.1.2 *Table and conveyor perimeter* (Figure 1.2)

Trapping points between guards and moving parts shall be protected by trip devices which stop all hazardous movements.

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

5.2.1.1.3 *Operating area* (Figures 1.3, 1.4)

5.2.1.1.3.1 Power operated last rotation outside the area protected by guards as per **5.2.1.1.1** 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 button of the hold-to-run control device shall be situated on a vertical panel at the outer edge of the rotating or conveying plane.

5.2.1.1.3.2 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 satisfying prEN 953:1992 and annex A.

5.2.1.1.4 *Area beneath rotary table or conveyor system*

Access to danger points beneath the rotary table or conveyor shall be prevented by guards according EN 953:1997 and EN 294:1992, Table 4. 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 8 mm.

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

The stipulation is also met by:

- following EN 349:1993; and
- providing a footguard strip on the inside edge of the operator's platform.

5.2.1.1.5 *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 and prevent access to all dangerous movements, e.g. table rotation, injector forward and mould close. The injector may reverse if no additional hazards are created.

Material ejection may be controlled with the guard open.

Interlocking guards shall satisfy EN 1088:1995 and **B.1**. Guards shall satisfy EN 953:1997, 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**.

5.2.1.2 *Static station with linear configuration* (see Figures 2 and 3)

5.2.1.2.1 *Mould area*. Access to the dangerous mould and injector movements from the sides and rear of the machine shall be prevented by fixed or interlocking guards.

Fixed guards shall comply with EN 953:1997 and annex A. Interlocking guards shall comply with EN 1088:1995 and **B.1**.

5.2.1.2.2 *Dangerous powered motion* during normal operation, mould setting, adjustment and similar work shall be actuated by a two-hand control which satisfies EN 574:1996 and **D.1**.

5.2.1.2.3 *Area of injection or pouring*. On machines where the injector(s) move from station to station (see Figure 3), access to the traverse area shall be prevented by fencing which satisfies **A.3**.

Interlocks on the access gates in the fencing shall satisfy EN 1088:1995 and **B.1**.

The interlocking device shall stop all dangerous movements within the fenced area but movements need not be interrupted if they are protected by additional separate guards satisfying EN 953:1997.

5.2.1.2.4 *Operating area*

Safeguarding shall be in compliance with subclauses **5.2.1.1.3.1** and **5.2.1.1.3.2**.

5.2.2 *Unit sole and footwear component moulding machines*

5.2.2.1 *Mobile station with rotary or conveyor configuration* (see Figures 4, 5, 6 and 7)

5.2.2.1.1 *Mould area*

Machines shall be constructed in such a manner that the following hazardous automated mould movements can only take place behind guards:

- lid or cover movements;
- ring movements;
- bottom plate lifting and turning;
- last turning.

Fixed guards shall satisfy EN 953:1997 and **A.1**, fencing **A.3**, and interlocking guards EN 1088:1995 and **B.3**.

5.2.2.1.2 *Table and conveyor perimeter*

Safeguarding shall be in compliance with subclause **5.2.1.1.2**.

5.2.2.1.3 *Operating area*

5.2.2.1.3.1 In the operator's area all hazardous movements of the mould shall be prevented by a power interlocking system which satisfies annex G. Alternatively guards shall remain locked until all hazardous movements have stopped.

The interlocking guard with guard locking shall satisfy EN 1088:1995 and **B.8**.

Mould closing may be initiated by a control guard satisfying **5.1.8.2**.

