BRITISH STANDARD

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710 : 1998

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

The European Standard EN 710 : 1997 has the status of a British Standard

ICS 25.120.30

National foreword

This British Standard is the English language version of EN 710 : 1997.

The UK participation in its preparation was entrusted by Technical Committee MCE/3 Safeguarding of machinery, to Subcommittee MCE/3/10, Foundry machines — Safety, which has the responsibility to:

- aid enquirers to understand the text;
- present to the responsible European committee any enquiries on the interpretation, or proposals for change, and keep the UK interests informed;
- monitor related international and European developments and promulgate them in the UK.

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

Cross-references

The British Standards which implement international or European publications referred to in this document may be found in the BSI Standards Catalogue under the section entitled 'International Standards Correspondence Index', or by using the 'Find' facility of the BSI Standards Electronic Catalogue.

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Summary of pages

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English version

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

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

Sicherheitsanforderungen an Gießereimaschinen und -anlagen der Form- und Kernherstellung und dazugehörige Einrichtungen

This European Standard was approved by CEN on 1997-08-02. CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CEN member.

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CEN

European Committee for Standardization
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Foreword

This European Standard 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 February 1998, and conflicting national standards shall be withdrawn at the latest by February 1998.

For relationship with EU Directives, see informative annex ZA, which is an integral part of this standard.

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

Contents

0 Introduction

This European standard is a type C standard as defined in EN 292-1.

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

In addition, machinery shall comply as appropriate with EN 292-1 and EN 292-2 for hazards which are not covered by this standard and if applicable the other standards referenced in clause **2**.

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 moulds. 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 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

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 286-1 : 1991	*Simple unfired pressure vessels designed to contain air or nitrogen* *Part 1: Design, manufacture and testing*
EN 292-1 : 1991	*Safety of machinery — Basic concepts, general principles for design* *Part 1: Basic terminology, methodology*
EN 292-2 : 1991	*Safety of machinery — Basic concepts, general principles for design* *Part 2: Technical principles and specifications*
EN 292-2/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 distances to avoid crushing of parts of the human body*
EN 418 : 1992	*Safety of machinery — Emergency stop equipment, functional aspects — Principles for design*
ENV 1070	*Safety of machinery — Terminology*
EN 1088 : 1995	*Safety of machinery — Interlocking devices with and without guard locking — General principles and specifications for design*
EN 60204-1 : 1992	*Safety of machinery — Electrical equipment of machines* *Part 1: General requirements*

EN 61310-1 : 1994	*Safety of machinery — Indicating, marking and actuating principles — Part 1: Visual, audible and tactile signals*
prEN 574 : 1991	*Safety of machinery — Two-hand control device*
prEN 614-1 : 1994	*Safety of machinery — Ergonomic design principles Part 1: Terminology and general principles*
prEN 746-2 : 1992	*Industrial thermoprocessing equipment — Part 2: Safety requirements for combustion and fuel handling systems*
prEN 953 : 1992	*Safety of machinery — Guarding of machinery — Fixed and movable guards*
prEN 954-1 : 1996	*Safety of machinery — Safety related parts of control systems Part 1: General principles for design*
prEN 982 : 1995	*Safety of machinery — Safety requirements for fluid power systems and their components — hydraulics*
prEN 983 : 1994	*Safety of machinery — Safety requirements for fluid power systems and their components — pneumatics*
prEN 999 : 1993	*Safety of machinery — Hand/arm speed; approach speed of parts of the body for the positioning of safety devices*
prEN 1005-2 : 1995 (2nd revision)	*Safety of machinery — Human physical performance Part 2: Manual handling of machinery and component parts of machinery*
prEN 1093-1 : 1993	*Safety of machinery — Evaluation of the emission of airborne hazardous substances Part 1: Selection of test methods*
prEN 1265 : 1993	*Noise test code for foundry machines and equipment*
prEN 1539 : 1994	*Dryers and ovens in which flammable substances are released from coating materials — Safety requirements*
prEN 1921 : 1995	*Industrial automation systems — Safety of integrated manufacturing systems — Basic requirements*
prEN 50100-1 : 1992	*Safety of machinery — Electro-sensitive protective devices Part 1: Specifications for general requirements*
ISO 6184-1 : 1985	*Explosion protection systems Part 1: Determination of explosion indices of combustible dusts in air*
ISO/TR 11688-1 : 1995	*Acoustics — Recommended practice for the design of low-noise machinery and equipment Part 1: Planning*

3 Definitions

For the purposes of this standard, the definitions given in ENV 1070 apply.

Other terms, definitions and characteristics are as follows:

Term/Type of machine	Definition/Description, Character, Functions
3.1 Moulding	
3.1.1 ***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).
3.1.2 ***Moulding plant***	All the 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.
3.1.3 ***Disposable mould***	A mould that is destroyed to remove the casting.
3.2 Coremaking	
3.2.1 ***Coremaking machinery***	Machines used to make solid and/or hollow cores. Coremaking machinery is classified into core shooters and core blowers. The principle of core shooting is to rapidly expand compressed air via the sand cylinder into the sand. The cylinder is equipped with openings and a provision for sandfilling (indirect working). The sand is then conveyed along in the airstream. The principle of core blowing is to transport the sand by means of compressed air into the corebox (direct working). The sand is conveyed along in front of the compressed air.
3.2.2 ***Coremaking plant***	All the equipment used to make ready-to-use cores (single cores and/or core assemblies). A plant may consist of a sand preparation plant, coremaking machine, equipment for handling, deflashing, assembling, coating and drying of cores.

Term/Type of machine	Definition/Description, Character, Functions
3.3 Associated equipment	
3.3.1 ***Conditioning equipment***	Equipment and plant used to prepare ready-to-use bonded sands, including equipment for its conveyance and storage.
– 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). – Machines for continuous mixing. These are machines in which the contents are continuously mixed and conveyed to the discharge gate.
– 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).
– 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.
– 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).
– Sand dryers and heaters	Plant consisting of a heating system and/or subsequent cooling equipment.
3.3.2 ***Reclamation equipment***	Equipment and plant including storage and conveying facilities used for the reclamation of used sands by mechanical and/or thermal processing means.
– Sand lump crushers	Machines used to break down lumps of used sand by mechanical means.
– Thermal reclamation ovens	Machines used to destroy the binder by thermal means.
– Mechanical reclamation machines	Machines used to destroy the binder by mechanical means.
– Magnet separators	Machines used to separate ferro-magnetic material from the used sand.
– Screening installations	Machines used to classify used sands (this may be achieved by vibration, rotation or other means).
3.3.3 ***Gassing equipment***	Equipment used to produce and/or condition reactive gases and supply them to the gassing station or into the sand mixture. Typical processes are: **binder system** — **reactive gas** – silicate — CO_2 – urethane — amine – furane resin/peroxide or epoxy resin/peroxide — SO_2 – alkaline resin — methylformate
3.4 Knock-out equipment	Equipment used to separate castings from the moulding box and/or the mould and/or cores from castings.
– 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.
– Rotary knock-out and/or cooling drum	A 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.

Term/Type of machine	Definition/Description, Character, Functions
– 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.
– Knock-out tray	Oscillating conveyor for the separation of casting and moulding material.
3.5 Modes of operation	
3.5.1 ***Setting***	All the steps within a process can be initiated separately and manually in any sequence. Example: mould changing or pattern changing.
3.5.2 ***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).
3.5.3 ***Semi-automatic***	Each cycle or part of a cycle is initiated manually and then proceeds to completion in the pre-determined sequence.
3.5.4 ***Automatic***	Each cycle is initiated by the previous cycle (e.g. continuous operation).

4 Hazards

Significant hazards are those where the risk of being injured through dangerous movements exists (e.g. squeeze and shear points) or sources of hazard occur (e.g. hazardous materials, conduction and radiation of heat, ejection of metal, explosion, ignition of hydraulic fluids, ejection of sand under pressure, unintended unclamping of elevated parts such as moulding boxes or shooting heads).

An assessment of the foreseeable risks arising from the use of the equipment was carried out when this standard was prepared.

Significant hazards have been condensed in the Scope and have been detailed in the table in clause **5**.

5 Safety requirements and measures

The following subclauses detail the hazards, hazardous situations and preventative measures relevant to the classes of machinery detailed in **5.2** to **5.5**.

Annex C gives examples of the areas on the particular machinery class which are considered to be hazardous and the likely means that could be used to counteract these hazards. Annex A exemplifies further specific information on the type of preventative measure to be used for certain machinery classes and should be considered in conjunction with the preventative measures specified in **5.2** to **5.5**.

Where, for clarity, an example of a safety measure is given in the text this shall not be 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.

5.1 General

Machines and equipment shall be designed to eliminate or reduce risks. The purpose of this standard is to assist manufacturers to design their machines and equipment so that the risks arising from their intended use are reduced or eliminated.

The manufacturer shall take into account the requirements of EN 292-2 and EN 60204-1. The safety distances shall be in accordance with EN 294 and EN 349.

NOTE 1. Every attempt has been made in this standard to identify all of the relevant risks. However manufacturers should ensure through their own risk assessment that there are no additional risks not covered by this standard. Where additional risks are present, it is recommended that EN 292-1 and EN 292-2 together with the A and B standards are used as a basis for dealing with these additional risks.

NOTE 2. The manufacturer assumes that operators are properly trained and instructed in the intended use of the machine and in the functioning of any safeguarding.

Tables **5.2** to **5.8** specify the preventative measures required for the different types of machinery and plant during consideration of the significant hazards and risks involved in their operation either:

Column 4: by reference to EN 292

and/or

Column 5: by reference to preventative measure.

Unless otherwise stated, the preventative measures assigned to the identified hazardous situations shall be provided in a cumulative manner.

The tables also reference the appropriate verification means in column 6.

5.1.1 *Fixed guards*

These guards shall be designed in accordance with EN 292-2, EN 294 and prEN 953.

These guards shall also be designed to contain processed materials, fluids or parts that can foreseeably 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 a sufficient distance from the danger zone (see EN 294 : 1992, table 1).

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 and/or for maintenance and setting activities or troubleshooting.

5.1.2 ***Movable guards***

5.1.2.1 *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 and troubleshooting, shall incorporate guard interlocking with dual detection and monitoring. Dual detection may be by two separate switches or by a single switch and detection of guard lock position (see EN 1088).

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

5.1.2.2 *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.

5.1.2.3 *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.

5.1.2.4 *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.

5.1.3 ***Electro-sensitive protective devices (ESPD)***

If electro-sensitive protective devices (see prEN 50100-1 and prEN 50100-2) 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;

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 prEN 999).

5.1.4 ***Two-hand control devices***

If two-hand control devices (see prEN 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 prEN 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;

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 prEN 999).

5.1.5 ***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.

5.1.6 ***Control systems***

Where access to the danger zone is required during normal operation (EN 292-2 : 1991, **4.1.3**) the safety related control systems of the equipment, including the interlocking devices, shall be in accordance with category 4 of prEN 954-1 : 1996.

Where access to the danger zone is not required during normal operation of the machinery (EN 292-2 : 1991, **4.1.2**) but foreseeable access is needed for maintenance and setting activities, troubleshooting or cleaning the safety related control systems of the equipment including the interlocking devices, shall be in accordance with at least category 2 of prEN 954-1 : 1996. The hydraulic and pneumatic equipment shall comply with at least category 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. If the actuator is released any hazardous movements shall be interrupted immediately. Unintentional movements of dangerous parts shall be prevented. When reduced speed of such movements is used to permit maintenance and setting activities the control system in this mode shall comply with category 4 of prEN 954-1 : 1996.

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

Control systems for automatically operated machines and units shall provide for matching emitted signals with the sequence according to the programme. Succeeding steps shall only be initiated after the previous steps are finished.

Limit switches within controls shall be arranged or installed so that no unintended start can be initiated either by unintended actuation of any mechanical limit switches or by the approach of metal parts to electrosensitive limit switches.

The machine shall be so designed that during foreseeable operation it will stop immediately at any point in its cycle when an emergency stop (see EN 418) is activated or a safety function or device (see EN 1088) has become inoperative.

5.1.7 *Manual handling of loads*

For the manual handling of loads (e.g. flasks, setting, removal of cores or patterns, maintenance) see EN 292-2, prEN 614-1 and prEN 1005-2.

5.2 Conditioning and reclamation equipment

5.2.1 *Preventative measures against injuries due to mechanical hazards*

5.2.1.1 *Sand mixers, mills and coolers*

Hazard	**Hazardous situation**	**Risk/Mode of operation**	**Preventative measures according to relevant sections of EN 292**	**Particular preventative measures**	**Verification means ref. clause 6**
1	**2**	**3**	**4**	**5**	**6**
Crushing/ shearing/ Drawing-in	Movement of the mixing and milling tools within the mixing or cooling plate or trough	Injury to hands when sampling from above or at the discharge; cleaning of discharge from outside; cleaning of screw of continuous mixers	**3.22.1**/Part 1 (Fixed guard) **3.22.5**/Part 1 (Interlocking guard with guard locking) **6.2.2**/Part 2 (Provisions for isolation and energy dissipation)	ref. clauses **5.1.1**, **5.1.2** and **5.1.6**	**6.1.1/6.1.2** **6.1.1/6.1.2** **6.1.1**
	Movement of the mixing and milling tools during rotation when they are being removed or reinserted into the mixing plate; Unexpected gravity fall of the raised swivel arm	Injury to arms, head and body when touching tools	**3.23.1**/Part 1 (Interlocking device) **3.8**/Part 2 (Preventing hazards from pneumatic and hydraulic equipment)	ref. clause **5.1.6** Interlocking of the movement of tools with the lifting movement of the swivel arm Means to prevent the falling of the swivel arm: Spring-loaded jacks or lock bolts, check valve or control valve for the swing-out components that lock automatically when there is a pressure drop or release Examples for **3.8**/Part 2 see annex A	**6.1.1**
Crushing/ shearing	Where there is the possibility of entry into the mixer/mill/ cooler	Danger to persons working inside (cleaning or maintenance) from unexpected start-up NOTE. During maintenance, several employees may be working on the conditioning/ reclaiming equipment.	**3.22.5**/Part 1 (Interlocking guard with guard locking) **3.7.2**/Part 2 (Safety against spontaneous restart) **3.7.3** to **3.7.6** and **3.7.10**/Part 2 (Safety against hazards due to failure of the control or malfunction if applicable in a cumulative way) **6.2.2**/Part 2 (Provisions for isolation and energy dissipation)	ref. clauses **5.1.1**, **5.1.2** and **5.1.6** Disconnecting switch for the mixer/mill/cooler with lock-off Access door shall be secured against unintended closing and locking Permanent and clear warning sign 'danger zone' and additional sign 'before entry, the mixer shall be shut-off and secured against restart by the person(s) who enter(s)'	**6.1.1/6.1.2** **6.1.1** **6.1.2** **6.9/6.1.1**
Neglected ergonomic principles	Manual loading	Increased fatigue	**3.6**/Part 2 (Observing ergonomic principles)	See prEN 1005-2	**6.1.1**
Noise	Effects of peripheral work	Loss of awareness	**3.2**/Part 2 (Making machines inherently safe by virtue of ...) **3.6.3**/Part 2 (Avoiding as far as possible noise, vibration, thermal effects) **4**/Part 2 (Safeguarding)	Drives as silent as possible, rpm as low as possible (see ISO/TR 11688-1 : 1993)	**6.7**

5.2 Conditioning and reclamation equipment

5.2.1 *Preventative measures against injuries due to mechanical hazards*

5.2.1.1 *Sand mixers, mills and coolers (concluded)*

Hazard	Hazardous situation	Risk/Mode of operation	Preventative measures according to relevant sections of EN 292	Particular preventative measures	Verification means ref. clause 6
1	**2**	**3**	**4**	**5**	**6**
Interference with speech communication and acoustic signals	Effects of peripheral work	Danger of accident	**3.2**/Part 2 (Making machines inherently safe by virtue of ...) **3.6.3**/Part 2 (Avoiding as far as possible noise, vibration, thermal effects) **4**/Part 2 (Safeguarding)	Drives as silent as possible, rpm as low as possible (see ISO/TR 11688-1 : 1993)	**6.7**

5.2.1.2 *Sand aerators*

Hazard	Hazardous situation	Risk/Mode of operation	Preventative measures according to relevant sections of EN 292	Particular preventative measures	Verification means ref. clause 6
1	**2**	**3**	**4**	**5**	**6**
Crushing/ shearing	The discharge point and the entry point especially of the aerating belt or aerating drum to enclosure creates a pinch point	Injury to hands or upper/lower limbs	**3.22.1**/Part 1 (Fixed guard)	Prevent access into the danger zone by provision of a suitable guard. ref. clauses **5.1.1**, **5.1.2** and **5.1.6**	**6.1.1**
	When maintenance is being carried out		**3.22.5**/Part 1 (Interlocking guard with guard locking) **6.2.2**/Part 2 (Provisions for isolation and energy dissipation)		**6.1.1** **6.1.1/6.1.2**
Noise	Effects of peripheral work	Hearing loss, loss of awareness	**3.2**/Part 2 (Making machines inherently safe by virtue of ...) **3.6.3**/Part 2 (Avoiding as far as possible noise, vibration, thermal effects) **4**/Part 2 (Safeguarding)	Drives as silent as possible, rpm as low as possible, isolation of structure borne noise of aerator casing against the drive, deadening of the aerator casing (see ISO/TR 11688-1 : 1993)	**6.7**
Interference with speech communication and acoustic signals	Effects of peripheral work	Danger of accident	**3.2**/Part 2 (Making machines inherently safe by virtue of ...) **3.6.3**/Part 2 (Avoiding as far as possible noise, vibration, thermal effects) **4**/Part 2 (Safeguarding)	Drives as silent as possible, rpm as low as possible, isolation of structure borne noise of aerator casing against the drive, deadening of the aerator casing (see ISO/TR 11688-1 : 1993)	**6.7**

5.2 Conditioning and reclamation equipment

5.2.1 *Preventative measures against injuries due to mechanical hazards*

5.2.1.3 *Spike disintegrators (disintegrators for used sand)*

Hazard	**Hazardous situation**	**Risk/Mode of operation**	**Preventative measures according to relevant sections of EN 292**	**Particular preventative measures**	**Verification means ref. clause 6**
1	**2**	**3**	**4**	**5**	**6**
Crushing/ shearing	Openings in the machine body could create a pinch point during wheel movement	If during inspection/cleaning/ trouble-shooting there is unintended/ unexpected start-up or the covers are opened before the wheel has stopped then injuries to the operator could result	**3.22.5**/Part 1 (Interlocking guard with guard locking) **6.2.2**/Part 2 (Provisions for isolation and energy dissipation)	ref. clauses **5.1.1**, **5.1.2** and **5.1.6**	**6.1.1** **6.1.1/6.1.2**
Noise	as **5.2.1.2**	as **5.2.1.2**	as **5.2.1.2**	as **5.2.1.2**	**6.7**
Interference with speech communication and acoustic signals	as **5.2.1.2**	as **5.2.1.2**	as **5.2.1.2**	as **5.2.1.2**	**6.7**

5.2.1.4 *Sand lump crushers*

Hazard	**Hazardous situation**	**Risk/Mode of operation**	**Preventative measures according to relevant sections of EN 292**	**Particular preventative measures**	**Verification means ref. clause 6**
1	**2**	**3**	**4**	**5**	**6**
Crushing/ shearing/impact	Openings provided in the machine body for inspection, maintenance of tools, cleaning	Danger from crusher movement if there is unexpected start-up or if the hinged covers are opened before the crusher has stopped. Ejection of lumps	**3.22.5**/Part 1 (Interlocking guard with guard locking) **6.2.2**/Part 2 (Provisions for isolation and energy dissipation)	ref. clauses **5.1.1**, **5.1.2** and **5.1.6**	**6.1.1** **6.1.1/6.1.2**
Noise	as **5.2.1.2**	as **5.2.1.2**	as **5.2.1.2**	Drives as silent as possible, deadening of the crusher casing (see ISO/TR 11688-1 : 1993)	**6.7**
Interference with speech communication and acoustic signals	as **5.2.1.2**	as **5.2.1.2**	as **5.2.1.2**	Drives as silent as possible, deadening of the crusher casing (see ISO/TR 11688-1 : 1993)	**6.7**
Vibration	Machinery vibration may have effects on the adjoining work places	Stress to human joints, nerves and blood vessels due to whole body vibration		Isolation of vibration at the installation of sand lump crushers producing vibrations	**6.8**

5.2 Conditioning and reclamation equipment

5.2.1 *Preventative measures against injuries due to mechanical hazards*

5.2.1.5 *Screening equipment*

Hazard	**Hazardous situation**	**Risk/Mode of operation**	**Preventative measures according to relevant sections of EN 292**	**Particular preventative measures**	**Verification means ref. clause 6**
1	**2**	**3**	**4**	**5**	**6**
Drawing-in/ trapping/ shearing	Pinch points are created if the doors are opened during rotation of the equipment or doors are not closed before the equipment starts	Injury to the operator during operation, maintenance, cleaning, troubleshooting	**3.22.4**/Part 1 (Interlocking guard)	ref. clauses **5.1.1**, **5.1.2** and **5.1.6**	**6.1.1**

5.2.1.6 *Magnetic separators*

Hazard	**Hazardous situation**	**Risk/Mode of operation**	**Preventative measures according to relevant sections of EN 292**	**Particular preventative measures**	**Verification means ref. clause 6**
1	**2**	**3**	**4**	**5**	**6**
Stabbing or puncture	Unprotected discharge of ferromagnetic material from the magnetic separator Presence of tramp metal in the sand, therefore also danger when operating sand slingers	Danger to eyes and body		Proper metal separation. Shielding of separator discharge without creating pinch points. ref. clause **5.1.1** Warning sign requesting eye protection NOTE. The choice of the magnetic separator depends on the weight and geometry of the iron parts to be separated and either their temperature or surrounding temperature, the degree of the alloy, the velocity of the belt conveyor and - in case of magnetic-belt separators - on the lowest possible distance between the magnet and the belt conveyor. There should be no components of magnetic material within the affected space (e.g. metal sheets, construction parts, idlers).	**6.1.1/6.1.2** **6.9**
Crushing/ drawing-in	Touching of moving parts of the conveyor	Injuries to arms	**3.22.1**/Part 1 (Fixed guard)		**6.1.1/6.1.2**

5.2 Conditioning and reclamation equipment

5.2.2 *Measures against hazards caused by substances*

5.2.2.1 *Mixers/mills, disintegrators, sand lump crushers*

Hazard	**Hazardous situation**	**Risk/Mode of operation**	**Preventative measures according to relevant sections of EN 292**	**Particular preventative measures**	**Verification means ref. clause 6**
1	**2**	**3**	**4**	**5**	**6**
Inhalation of fumes and dusts	Feeding and discharging sand	Danger from breathing quartz dust	**4.2.2.1**/Part 2 (Functions of guards)	Equipment for dust reduction are e.g. enclosed charging and discharging of sand or material accompanied with sand, prevention of spills and leaks, no gravity fed enclosures connected to exhaust systems, possibility for ventilation. ref. clause **7.2**	**6.1.1/6.1.2/ 6.6**
	Feeding and discharging during the reclamation of used sand, mixers for resin-bonded mould and core sand	Damage to health from airborne formaldehyde, phenol, furfurylalcohol both for breathing and for skin contacts	**4.2.2.1**/Part 2 (Functions of guards)	Local exhaust ventilation ref. clause **7.2** Design to avoid the use of excessive binder, to provide for automatic dosing or enclosed dosing and to avoid skin contact	**6.1.1/6.1.2/ 6.6** **6.1.1**
Exothermic reactions	Supply of resin and hardener which cause an exothermic reaction	Fire and explosion hazard when no sand in machine or hoses wrongly connected Injury to respiratory tracts from breathing harmful gases. Cauterization because of skin contact		The supply of resin and hardener shall only be possible if probes within the equipment indicate that there is a sufficient quantity of sand. Connecting hoses shall be marked and designed to prevent interchangeability e.g. with left-hand threads for hardeners and right-hand threads for the other materials (e.g. binders)	**6.1.1**
NOTE. Continuous conveyors are not covered by the scope of this standard. If continuous conveyors are part of the conditioning and reclamation plant and their operation creates a particular risk of dust and fumes the relevant preventative measures also apply to this equipment.					

5.2.2.2 *Sand dryers and heaters*

Hazard	**Hazardous situation**	**Risk/Mode of operation**	**Preventative measures according to relevant sections of EN 292**	**Particular preventative measures**	**Verification means ref. clause 6**
1	**2**	**3**	**4**	**5**	**6**
Explosion	Gas fired equipment	Ignition procedure, control failure, flow failure		See prEN 746-2	**6.1.1/6.1.2**
Trapping	No possibility of escape from inside of walk-in ovens with doors Unintended locking of doors when a person is inside the oven	Trapping inside the equipment during maintenance		Emergency exit, duplicate opening mechanism actuated also from the inside	**6.1.1/6.1.2**

5.2 Conditioning and reclamation equipment

5.2.2 *Measures against hazards caused by substances*

5.2.2.3 *Equipment for the storage and pneumatic conveyance of coal dust or coal dust substitutes and their mixtures with bonding agents*

Hazard	Hazardous situation	Risk/Mode of operation	Preventative measures according to relevant sections of EN 292	Particular preventative measures	Verification means ref. clause 6
1	**2**	**3**	**4**	**5**	**6**
Fire/explosion	Import or creation of undetected burnings or electrostatic chargings in silos and plants for pneumatic conveyance	Burning and injuries by explosion effects		– Steep outflow (at least at an angle of 70° against the horizontal) and rounded edges, if necessary aeration installations for the avoidance of deposits, blockages and bridging	**6.1.1**
	Explosive mixture of dust or vapours	Fire extinguishing		– If aerating installations are used, it shall be possible to operate them with inert gas	**6.1.1/6.4**
	Removal of material bridging within the silos, e.g. after fire extinguishing			– Aeration installations shall only be effective during the dust removal and shall avoid the entry of air into the silos at other times	**6.1.1**
				– It shall be possible to set coal dust silos under inert gas. The appropriate provisions of inert gas shall be calculated so that the total volume of the largest silo can be filled with inert gas. Sufficient inertization is ensured if 2 kg CO_2 or 1 m^3 N_2 are brought in for each m^3 silo volume	**6.1.1/6.4**
				– Silos designed to be situated in areas subject to radiant heat shall be protected from such radiant heat	**6.4.2**
				– Permanent and legible warning signs shall be provided. These shall state at least the following: 'Danger zone No smoking Do not use naked flames in the vicinity of silos or the filling/emptying areas. Flames and/or fires shall only be permitted by the supervision in writing and under strictly controlled procedures which detail any special precautions that need to be taken. Nobody shall go inside to dislodge a bridge'	**6.9**

5.2 Conditioning and reclamation equipment

5.2.2 *Measures against hazards caused by substances*

5.2.2.3 *Equipment for the storage and pneumatic conveyance of coal dust or coal dust substitutes and their mixtures with bonding agents (concluded)*

Hazard	Hazardous situation	Risk/Mode of operation	Preventative measures according to relevant sections of EN 292	Particular preventative measures	Verification means ref. clause 6
1	2	3	4	5	6
Fire/explosion (concluded)				– Shock-pressure-resistant design for the silos and the pipework and equipment. The venting of explosion pressure from the silos shall be into safe areas	**6.3/6.4**
				– Electrostatic earthing of the silos and the pipework, possibility for electrostatic earthing of supply vehicles	**6.1.1/6.1.2**
				– The temperature of the compressed air used for conveying coal dust shall not exceed 80 °C	**6.1.1/6.4**
				– Permanent temperature or CO measuring devices shall be fitted at the silo outflow and above the maximum charge level in the silo. These shall operate automatic alarms and stop the material supply and outflow when limiting values are exceeded Limiting values and information for use see clause **7.3.2.1**	**6.1.1/6.4/6.9**
				– The electrical components inside the installations mentioned above or in the vicinity of filling and emptying areas, shall be suitable for use in an explosive atmosphere	**6.1.1/6.1.2**
				– Provide, in the information for use, instructions on the handling, conveyance and storage of coal dust and coal dust substitutes (see **7.3.2**)	**6.9**
Oxygen deficiency, toxic gases	Suffocation, skin effects	Removal of blockages/ maintenance inside the silo		Warning signs and information for use concerning personal protection equipment and rescue procedures (see **7.3.2.2**)	**6.9**

5.3 Moulding machinery and plants

5.3.1 *Mechanical hazards*

5.3.1.1 *Moulding machinery in general*

Hazard	**Hazardous situation**	**Risk/Mode of operation**	**Preventative measures according to relevant sections of EN 292**	**Particular preventative measures**	**Verification means ref. clause 6**
1	**2**	**3**	**4**	**5**	**6**
Crushing/ drawing-in between moving and stationary machine elements Impact	Swing motion of the squeeze head at jolt moulding machines, squeeze moulding machines, jolt and squeeze moulding machines	The squeeze head can impact with a person	**3.23.4**/Part 1 (Two-hand control device) associated with **3.7.6**/Part 2 (Automatic monitoring) **3.7.2**/Part 2 (Safety against restart) **3.8**/Part 2 (Preventing hazards from pneumatic and hydraulic equipment)	Guarding by location to reduce the possibility of accidental contact by persons or objects. Ensure minimum space between the squeeze head and the immediate surroundings (see EN 349), no entry into danger zone, no operating within danger zone There shall be a defined distance of the two-hand control panel from the danger zone. Protective devices shall be provided, but are not limited to two-hand control devices ref. clauses **5.1.4, 5.1.5** and **5.1.6**	**6.1.1/6.1.2**
Impact, drawing-in/ trapping/ crushing	Turnover and rollover motion at turnover and rollover machines	Impact with a person/drawing-in/ trapping/crushing of parts of body between turnover or rollover frame and stationary machine elements or floor	As above, together with guarding by location and **3.22.1**/Part 1 (Fixed guard)	Guarding by location to reduce the possibility of accidental contact by persons or objects. No entry into danger zone, no operating within danger zone There shall be a defined distance of the two-hand control panel from the danger zone. Protective devices shall be provided, but are not limited to two-hand control devices ref. clauses **5.1.4** and **5.1.5**	**6.1.1/6.1.2**
	Self-acting turnover/rollover at energy failure due to the mass of the moulding box and the pattern	Impact with a person/drawing-in/ trapping/crushing of parts of body between turnover or rollover frame and stationary machine elements or floor	**3.8**/Part 2 (Preventing hazards from pneumatic and hydraulic equipment)	Self-acting turnover/rollover shall be avoided. Examples for **3.8**/Part 2 see annex A ref. clause **5.1.5**	
Impact by loosening of moulding box	Loosening or releasing of the box clamping in case of energy failure/failure of control system/ uncontrolled signals to control valves at turnover and rollover machines, box transfer devices	Impact to parts of body of any person within the danger zone from unexpected falling of the moulding box	**3.7.3** to **3.7.5**/Part 2 (Safety against hazards due to failure of the control or malfunction if applicable in a cumulative way) **3.8**/Part 2 (Preventing hazards from pneumatic and hydraulic equipment) **3.7.2**/Part 2 (Safety against spontaneous restart)	Design of the box clamping device Examples for **3.8**/Part 2 see annex A	**6.1.1/6.1.2** **6.1.1/6.1.2** **6.1.1**

5.3 Moulding machinery and plants

5.3.1 *Mechanical hazards*

5.3.1.1 *Moulding machinery in general (concluded)*

Hazard	**Hazardous situation**	**Risk/Mode of operation**	**Preventative measures according to relevant sections of EN 292**	**Particular preventative measures**	**Verification means ref. clause 6**
1	**2**	**3**	**4**	**5**	**6**
Crushing/ shearing	Swivelling of the squeeze head towards the machine table/moulding box Lifting of the machine table and the moulding box against the squeeze head	Injury to hands when distributing moulding sand after start of the machine	**3.23.4**/Part 1 (Two-hand control device) associated with **3.7.6**/Part 2 (Automatic monitoring)	There shall be a defined distance of the two-hand control panel from the danger zone. Protective devices shall be provided, but are not limited to two-hand control devices. ref. clauses **5.1.4** and **5.1.5**	**6.1.1/6.1.2** **6.1.1**
Crushing/ shearing	Approaching or passing motions of machine parts for the stripping process (pinlifting or frame lifting)	Injury to hands and/or feet	**3.22.1**/Part 1 (Fixed guard) **3.8**/Part 2 (Preventing hazards from pneumatic and hydraulic equipment)	There shall be a defined distance of the two-hand control panel from the danger zone. Examples for **3.8**/Part 2 see annex A ref. clause **5.1.6**	**6.1.1/6.1.2** **6.1.1/6.1.2**
Unhealthy posture or excessive efforts	Manual handling of moulding boxes	Increased fatigue	**4.9**/Part 1 (Hazards generated by neglecting ergonomic principles in machine design) **3.6**/Part 2 (Observing ergonomic principles)	See prEN 1005-2 ref. clause **5.1.7**	**6.1.1**
Noise	Effects on peripheral work, impact noises, vibration noises, noises from the expansion of compressed air	Hearing loss, stress, loss of awareness	**3.2**/Part 2 (Making machines inherently safe by virtue of ...) **3.6.3**/Part 2 (Avoiding as far as possible noise, vibration, thermal effects) **4**/Part 2 (Safeguarding)	If possible, the impact surfaces should be inside the machine. Design of the impact elements, in particular jolt mechanism. Minimizing the jolt cycle time of jolt moulding machines. Avoidance of free expansion of compressed air. (See ISO/TR 11688-1 : 1993)	**6.7**
Interference with speech communication and acoustic signals	Effects on peripheral work, impact noises, vibration noises, noises from the expansion of compressed air	Danger of accident	**3.2**/Part 2 (Making machines inherently safe by virtue of ...) **3.6.3**/Part 2 (Avoiding as far as possible noise, vibration, thermal effects) **4**/Part 2 (Safeguarding)	If possible, the impact surfaces should be inside the machine. Design of the impact elements. Avoidance of free expansion of compressed air. (See ISO/TR 116881 : 1993)	**6.7**

5.3 Moulding machinery and plants

5.3.1 *Mechanical hazards*

5.3.1.2 *Automatic moulding machinery*

Hazard	Hazardous situation	Risk/Mode of operation	Preventative measures according to relevant sections of EN 292	Particular preventative measures	Verification means ref. clause 6
1	2	3	4	5	6
Crushing/ shearing/ drawing-in	Movement of moulds, mould parts, mould tools, moulding material containers, sand filling slides, moulding chambers, moulding boxes, pattern changing devices, core setters	Injuries to various parts of body if there is need for the operator frequently to reach in or stand in the equipment to make operating adjustments	**3.22.1**/Part 1 (Fixed guard) **3.22.4**/Part 1/**3.7.6** Part 2 (Interlocking guard) **3.7.2**/Part 2 (Safety against restart) **3.7.3** to **3.7.5**/Part 2 (Safety against hazards due to failure of the control or malfunction if applicable in a cumulative way) **3.8**/Part 2 (Preventing hazards from pneumatic and hydraulic equipment)	ref. clause **5.1.1** Provide movable guards (clauses **5.1.1**, **5.1.2** and **5.1.6**) or ESPD (clauses **5.1.3** and **5.1.6**) where frequent intervention (i.e. for feeding and/or removing of parts) is required during normal operation Examples for **3.8**/Part 2 see annex A	**6.1.1/6.1.2**
Crushing/ shearing	Movement of moulds, mould parts, mould tools, moulding material containers, sand filling slides, moulding chambers, moulding boxes, pattern changing devices, core setters	Injuries to various parts of the body during troubleshooting, cleaning, adjustment	**3.7.10**/Part 2 (Control mode for setting, teaching, process changeover, fault-finding, cleaning or maintenance) **3.8**/Part 2 (Preventing hazards from pneumatic and hydraulic equipment) **3.7.9**/Part 2 (Selection of control and operating modes)	ref. clause **5.1.6** Location of setting/maintenance points should be outside the danger area Facility for prevention of blockage of moulding sands or its safe clearance Facility to switch to manual and setting mode	**6.1.1/6.1.2**
Crushing/ shearing/ drawing-in	Movement of moulds, mould parts, mould tools, moulding material containers, sand filling slides, moulding chambers, moulding boxes, pattern changing devices, core setters	Injuries to various parts of the body during troubleshooting, cleaning, adjustment		ref. clause **5.1.6** At the release of the power actuators for manual operations, hazardous movements shall stop immediately The position of the control panel shall be so arranged that it offers optimum visibility to the danger zone, or an emergency-stop device is portable or enabling devices shall be present It is possible to depressurize pressure pipes of machine parts Machines or parts of the plant being moved or held by pressure energy shall be protected against hazardous movements caused by a fall or failure of pressure by: – either weighted or spring-loaded jacks or lock bolts or – non-return valves or control valves that are directly attached to the working cylinder and that take their locking position automatically when there is a pipe failure	**6.1.1/6.1.2**

5.3 Moulding machinery and plants

5.3.1 *Mechanical hazards*

5.3.1.2 *Automatic moulding machinery (concluded)*

Hazard	**Hazardous situation**	**Risk/Mode of operation**	**Preventative measures according to relevant sections of EN 292**	**Particular preventative measures**	**Verification means ref. clause 6**
1	**2**	**3**	**4**	**5**	**6**
Noise	Effects on peripheral work, impact noises and striking noises of a limit stop, noises of the expansion of compressed air, noises of mechanical blow-off devices	Hearing loss, stress, loss of awareness	**3.2**/Part 2 (Making machines inherently safe by virtue of ...) **3.6.3**/Part 2 (Avoiding as far as possible noise, vibration, thermal effects) **4**/Part 2 (Safeguarding)	– Impact damping – Fixed stop absorption (if applicable) – Avoidance of free expansion of compressed air – Avoidance of structure-borne noise. (see ISO/TR 11688-1 : 1993)	**6.7**
Interference with speech communication and acoustic signals	Effects on peripheral work, impact noises and striking noises of a limit stop, noises of the expansion of compressed air, noises of mechanical blow-off devices	Danger of accident	**3.2**/Part 2 (Making machines inherently safe by virtue of ...) **3.6.3**/Part 2 (Avoiding as far as possible noise, vibration, thermal effects) **4**/Part 2 (Safeguarding)	– Impact damping – Fixed stop absorption (if applicable) – Avoidance of free expansion of compressed air – Avoidance of structure-borne noise. (See ISO/TR 11688-1 : 1993)	**6.7**

5.3 Moulding machinery and plants

5.3.1 *Mechanical hazards*

5.3.1.3 *Shoot- (blow-) and squeeze moulding machines, impulse moulding- and air flow squeeze moulding machinery (additional requirements to **5.3.1.1**)*

Hazard	**Hazardous situation**	**Risk/Mode of operation**	**Preventative measures according to relevant sections of EN 292**	**Particular preventative measures**	**Verification means ref. clause 6**
1	**2**	**3**	**4**	**5**	**6**
Ejection of sand	Sand escaping from separating lines between – shooting (blowing) or impulse head and filling frame – shooting head and moulding chamber (if applicable) – parts of moulding chamber (if applicable) – filling frame and moulding box – moulding box and pattern plate	Injury to eyes and body during operation	**3.22.1**/Part 1 (Fixed guard) **3.22.4**/Part 1 (Interlocking guard) **3.7.6**/Part 2 (Automatic monitoring) **4.2.2.6**/Part 2 (Hazards from guards)	ref. clause **5.1.6** Interlocking of the ready-to-shoot (impulse/blow) position of the moulding box with the shooting (blowing) process Provide instructions to use a joint surface cleaner before the shooting (impulse/blow) process	**6.1.1/6.1.2** **6.9**
	Sand and/or air blast into the open when moulding boxes are not attached to the feeder	Injuries to eyes, face and other parts of the body	**3.22**/Part 1 (Guard)	ref. clause **5.1.6** Interlocking depending on distance, position and locking pressure for the ready-to-shoot/ impulse working position	**6.1.1/6.1.2**
Impact/crash	Disintegration and flying off of pressurized parts due to inadequacy of mechanical strength	Injuries to eyes, face and other parts of the body	**3.3**/Part 2 (Taking into account design codes, data about material properties, etc.)	Stress analysis for pressure accumulator and filling frame. Ensure that moulding boxes or moulding chambers/filling frames are capable of withstanding the mechanical and pneumatic forces that will be present in the equipment	**6.5**
Noise	as **5.3.1.2**	as **5.3.1.2**	as **5.3.1.2**	as **5.3.1.2**	**6.7**
Interference with speech communication and acoustic signals	as **5.3.1.2**	as **5.3.1.2**	as **5.3.1.2**	as **5.3.1.2**	**6.7**

5.3 Moulding machinery and plants

5.3.1 *Mechanical hazards*

5.3.1.4 *Moulding plants*

Hazard	**Hazardous situation**	**Risk/Mode of operation**	**Preventative measures according to relevant sections of EN 292**	**Particular preventative measures**	**Verification means ref. clause 6**
1	**2**	**3**	**4**	**5**	**6**
Crushing/ shearing	Movement of moulds, mould parts, mould tools, moulding material containers, sand filling slides, moulding chambers, moulding boxes, pattern changing devices, core setters	Injuries to hands or body during operation, troubleshooting, cleaning	**3.22.1**/Part 1 (Fixed guard) **3.22.4**/Part 1 Interlocking guard **3.7.6**/Part 2 (Automatic monitoring) **3.7.2**/Part 2 (Safety against spontaneous restart) **3.7.3** to **3.7.5**/Part 2 (Safety against hazards due to failure of the control or malfunction) **3.8**/Part 2 (Preventing hazards from pneumatic and hydraulic equipment)	ref. clause **5.1.1** Movable guards, ref. clauses **5.1.1**, **5.1.2** and **5.1.6** Examples for **3.8**/Part 2 see annex A Facility to switch to manual and setting mode ref. clause **5.1.6** At the release of the power actuators for manual operations, hazardous movements shall stop immediately The position of the control panel shall be arranged so that it offers optimum visibility to the danger zone, or portable emergency stop devices or enabling devices shall be present It is possible to depressurize pressure pipes of machine parts Machines or parts of the plant being moved or held by pressure energy shall be protected against hazardous movements caused by a fall or failure of pressure by: – weighted or spring-loaded jacks or lock bolts or – non-return valves or control valves that are directly attached at the working cylinder and that take their locking position automatically when there is a pipe failure Optical and/or audible warning devices that actuate prior to any restarting of the equipment (see EN 61310-1)	**6.1.1/6.1.2** **6.1.1/6.1.2**

5.3 Moulding machinery and plants

5.3.1 *Mechanical hazards*

5.3.1.4 *Moulding plants (continued)*

Hazard	Hazardous situation	Risk/Mode of operation	Preventative measures according to relevant sections of EN 292	Particular preventative measures	Verification means ref. clause 6
1	**2**	**3**	**4**	**5**	**6**
Crushing/ shearing (continued)	Movement of moulds, mould parts, mould tools, moulding material containers, sand filling slides, moulding chambers, moulding boxes, pattern changing devices, core setters	Injuries caused by the need for frequent intervention (setting of cores and chills, cleaning, spraying with parting liquids)	**3.22.4**/Part 1/ and **3.7.6**/Part 2 (Interlocking guard associated with automatic monitoring) **3.7.2**/Part 2 (Safety against spontaneous restart) **3.7.3** to **3.7.5**/Part 2 (Safety against hazards due to failure of the control or malfunction) **3.8**/Part 2 (Preventing hazards from pneumatic and hydraulic equipment)	ref. **5.1.2**, **5.1.3** and **5.1.6** Provide movable guards or ESPD where frequent intervention is required during normal operation. Examples for **3.8**/Part 2 see annex A	**6.1.1/6.1.2**
	Movements of turnover facilities, pouring milling devices, moulding box assembling devices, transfer devices for weights, moulding boxes or pallets, mould punch out units, moulding box separators	Injuries caused by the need for unforeseeable intervention	**3.22.1**/Part 1 (Fixed guard) **3.7.2**/Part 2 (Safety against spontaneous restart) **3.8**/Part 2 (Preventing hazards from pneumatic and hydraulic equipment)	ref. **5.1.1** Warning signs 'Danger zone' and additional sign 'Before entry, plant shall be shut-off and secured against restart'. (See EN 61310-1) ref. **5.1.6** Examples for **3.8**/Part 2 see annex A Optical and/or audible warnings that actuate prior to any restarting of the equipment	**6.1.1/6.1.2/6.9** **6.1.1/6.1.2**
	Moulding box cleaning devices, hydraulic, pneumatic or electric transport and damping units, motor driven roller conveyors, lifting tables	Injuries caused by the need for unforeseeable intervention	**3.22.1**/Part 1 (Fixed guard) **3.7.2**/Part 2 (Safety against spontaneous restart) **3.8**/Part 2 (Preventing hazards from pneumatic and hydraulic equipment)	ref. **5.1.1** Warning signs 'Danger zone' and additional sign 'Before entry, plant shall be shut-off and secured against restart'. (See EN 61310-1) ref. **5.1.6** Examples for **3.8**/Part 2 see annex A ref. **5.1.6** Optical and/or audible warning that actuate prior to any restarting of the equipment	**6.1.1/6.1.2/6.9** **6.1.1/6.1.2**
		Injuries caused by the need for foreseeable intervention or by access for troubleshooting, cleaning or machinery setting	**3.22.4**/ Part 1 and **3.7.6**/Part 2 (Interlocking guard associated with automatic monitoring)	ref. **5.1.1**, **5.1.2** and **5.1.6** Warning signs 'Danger zone' and additional sign 'Before entry, plant shall be shut-off and secured against restart'. (See EN 61310-1)	

5.3 Moulding machinery and plants

5.3.1 *Mechanical hazards*

5.3.1.4 *Moulding plants (concluded)*

Hazard	**Hazardous situation**	**Risk/Mode of operation**	**Preventative measures according to relevant sections of EN 292**	**Particular preventative measures**	**Verification means ref. clause 6**
1	**2**	**3**	**4**	**5**	**6**
Crushing/ shearing (concluded)			**3.7.2**/Part 2 (Safety against spontaneous restart) **3.7.3** to **3.7.5**/Part 2 (Safety against hazards due to failure of the control or malfunction) **3.8**/Part 2 (Preventing hazards from pneumatic and hydraulic equipment)	ref. **5.1.6** ref. **5.1.6** Examples for **3.8**/Part 2 see annex A Machines or parts of the plant being moved or held by pressure energy shall be protected against hazardous movements caused by a drop or failure of pressure by: – either weighted or spring-loaded jacks or lock bolts or – non-return valves or control valves that are directly attached to the working cylinder and that take their locking position automatically when there is a pipe failure Optical and/or audible warning devices that actuate prior to any restarting of the equipment (see EN 61310-1) Foot paths (bridges)	**6.1.1/6.1.2**
Ejection of sand	as **5.3.1.3**	as **5.3.1.3**	as **5.3.1.3**	as **5.3.1.3**	as **5.3.1.3**
Impact/crash	as **5.3.1.3**	as **5.3.1.3**	as **5.3.1.3**	as **5.3.1.3**	as **5.3.1.3**
Unhealthy posture or excessive efforts	Manual core setting	Increased fatigue	**4.9**/Part 1 (Hazards generated by neglecting ergonomic principles in machine design) **3.6**/Part 2 (Observing ergonomic principles)	See prEN 1005-2 The machine shall be designed so that there is no hindrance to the use of technical aids and possibility for good working postures ref. clause **5.1.7**	**6.1.1**
Noise	as **5.3.1.2**	as **5.3.1.2**	as **5.3.1.2**	as **5.3.1.2**	as **5.3.1.2**
Interference with speech communication and acoustic signals	as **5.3.1.2**	as **5.3.1.2**	as **5.3.1.2**	as **5.3.1.2**	as **5.3.1.2**

5.3 Moulding machinery and plants

5.3.1 *Mechanical hazards*

5.3.1.5 *Sandslingers*

Hazard	Hazardous situation	Risk/Mode of operation	Preventative measures according to relevant sections of EN 292	Particular preventative measures	Verification means ref. clause 6
1	**2**	**3**	**4**	**5**	**6**
Impact	Movement of the wheel	Injuries when touching the wheel	**3.22.5**/Part 1 (Interlocking guard with guard locking)	ref. **5.1.1**, **5.1.2** and **5.1.6**	**6.1.1/6.1.2**
Crushing	Movement of the slinger arms In case of movable slingers, movement of travel carriage	 Injuries by slewing and travelling motions	**3.22.1**/Part 1 (Fixed guard) **3.23.5**/Part 1 (Trip device)	 ref. **5.1.6**	**6.1.1/6.1.2**
Stubbing or puncture	Discharge of sand contaminated by ferrous metal	Danger to eyes and body parts by ejected metal		Proper metal separation Warning signs requesting eye protection	**6.9**

5.3.1.6 *Moulding box cams for hoisting, transport and turnover*

Hazard	Hazardous situation	Risk/Mode of operation	Preventative measures according to relevant sections of EN 292	Particular preventative measures	Verification means ref. clause 6
1	**2**	**3**	**4**	**5**	**6**
Inadequacy of mechanical strength	Connection of cams with moulding boxes: Exceeding of stress to connection – insufficient area of connection point – corrosion of connection point – for welded cams faulty welding of connection point	Injuries caused by a fall of moulding box off the lifting device (e.g. rope, chain) caused by insufficient or cracked connection of cam with moulding box or loosening of load suspending device Unintended loosening of cams that are not fixed to the moulding box	**3.3**/Part 2 (Taking into account design codes, data about material properties, etc.)	Stress analysis of welded cams. It is recommended to perform a stress analysis on all hoisted moulding boxes. Brackets for cam connection to reduce bending stresses	**6.7** **6.1.1**

5.3 Moulding machinery and plants

5.3.2 *Measures against hazards caused by substances*

5.3.2.1 *Hazards to health*

Hazard	Hazardous situation	Risk/Mode of operation	Preventative measures according to relevant sections of EN 292	Particular preventative measures	Verification means ref. clause 6
1	**2**	**3**	**4**	**5**	**6**
Inhalation of fumes	During pouring and cooling of sand moulds, increased by thermal up-current	Danger in breathing in CO and decomposing products of moulding material binders (main components see annex B)	**4.2.2.1**/Part 2 (Functions of guards)	Enclosure and local exhaust ventilation NOTE. Currently it is not possible to give common achievable values for concentrations of airborne toxic substances	**6.6.3**

5.3.2.2 *Hazards caused by unexpected discharge of liquid metal and contact with liquid metal/fire or explosion*

Hazard	Hazardous situation	Risk/Mode of operation	Preventative measures according to relevant sections of EN 292	Particular preventative measures	Verification means ref. clause 6
1	**2**	**3**	**4**	**5**	**6**
Burns	Movement of telpher ladles parallel to the moulding line without sufficient space between moving and fixed parts	Bumping and tilting of filled ladles can cause burns by discharge or spillage		Information for use to provide for a distance to stationary parts of at least 0,5 m (except at pouring places)	**6.1.1**
	Unauthorized access to cast moulds	Injuries to feet and legs which come into contact with hot moulds		Foot paths (bridges), passages	**6.1.1**
	Faulty assembly of moulds and/or cores	Eruption/discharge of liquid metal during pouring		Written information for the user (e.g. about personal protection, sand bed)	**6.1.1/6.1.2**
	Hydraulic drives of pouring line/cooling line/displace pallet conveyors	Ignition of hydraulic fluid in case of break of hydraulic pipework or hoses and contact of hydraulic fluids with liquid metal		Protection of hydraulic pipework and hoses against mechanical, chemical and thermal influences. Connection by cutting rings should not be used	**6.1.1**

5.4 Coremaking machinery and plants

5.4.1 *Preventative measures against injuries due to mechanical hazards and high temperature hazards*

Hazard	Hazardous situation	Risk/Mode of operation	Preventative measures according to relevant sections of EN 292	Particular preventative measures	Verification means ref. clause 6
1	2	3	4	5	6
Crushing/ shearing	Closing and opening of the filling device (filling slide)	Injury to hand during cleaning activities and troubleshooting	**3.22.1**/Part 1 (Fixed guard) **3.8**/Part 2 (Preventing hazards from pneumatic and hydraulic equipment)	ref. **5.1.1** Examples for **3.8**/Part 2 see annex A ref. **5.1.6**	**6.1.1/6.1.2**
	Movement of core box parts, shooting position movements, movement of the lifting table, movement of pattern plate, sand containers, gassing plates, core discharge and transfer devices	Operator intervention during operation	**3.22.4**/Part 1 (Interlocking guard) Alternative to **3.22.4**/Part 1 for cold core-production and if no hazard of ejection of sand and if no contact with any heated plates: **3.23.4**/Part 1 (Two-hand control device) or **3.23.5**/Part 1 (Trip device) both combined with **3.7.3** to **3.7.5**/Part 2 (Safety against hazards due to failure of the control or malfunction if applicable in a cumulative way) **3.7.6**/Part 2 (Automatic monitoring) **3.7.2**/Part 2 (Safety against spontaneous restart) **3.8**/Part 2 (Preventing hazards from pneumatic and hydraulic equipment).	ref. **5.1.1**, **5.1.2** and **5.1.6** ref. **5.1.4** ref. **5.1.3** ref. **5.1.6** ref. **5.1.6** ref. **5.1.6** Examples for **3.8**/Part 2 see annex A	
Crushing/ shearing/ impact	Hydraulic/ pneumatic/ electromechanical clamping of shoot head, shoot plate, gassing plate	Falling of the shoot head, shoot plate, gassing plate due to incorrect clamping/control during setting or troubleshooting	**3.7.3** to **3.7.5**/Part 2 (Safety against hazards due to failure of the control or malfunction if applicable in a cumulative way) **3.8**/Part 2 (Preventing hazards from pneumatic and hydraulic equipment)	Examples for **3.8**/Part 2 see annex A	**6.1.1/6.1.2**
Burns by contact	Assembling and separation of hot coreboxes	During operation of hot-box core or shell core machinery	**3.22.1**/Part 1 (Fixed guard) **3.22.4**/Part 1 (Interlocking guard) see movement of core box parts	ref. **5.1.1** ref. **5.1.1**, **5.1.2** and **5.1.6**	**6.1.1/6.1.2**

5.4 Coremaking machinery and plants

5.4.1 *Preventative measures against injuries due to mechanical hazards and high temperature hazards (continued)*

Hazard	Hazardous situation	Risk/Mode of operation	Preventative measures according to relevant sections of EN 292	Particular preventative measures	Verification means ref. clause 6
1	**2**	**3**	**4**	**5**	**6**
Burns by flame combustion	Fuel heated coreboxes	Heating flame in case of unexpected automatic ignition during control activities or troubleshooting		Any burner of fuel handling systems shall meet the requirements of EN 746-2. In addition for open burners the following measures apply: Interlocking of the ignition process with the mode of operation 'manual/setting'. During control activities and troubleshooting no automatic ignition of open burner shall take place	**6.1.1/6.1.2**
Ejection of sand (cold or hot sand)	Separating lines between shooting- or blowhead and the corebox and the parting lines of the corebox	During operation	**3.22.1**/Part 1 (Fixed guard) **3.22.4**/Part 1 (Interlocking guard)	– Interlocking of the ready to shoot (blow) position of the corebox with the shooting (blowing) process ref. **5.1.2** and **5.1.6** – Protective shielding – Use seals between joint surfaces	**6.1.1/6.1.2**
Impact/crash	Parts of core boxes blown-off by air pressure due to inadequacy of mechanical strength.	During operation	**3.3**/Part 2 (Taking into account design codes, data about material properties, etc.)	Corebox clamping device shall be capable of withstanding the foreseeable forces The manufacturer shall inform the user that: – coreboxes shall be capable of withstanding both mechanical and pneumatic forces and shall allow simultaneous introduction and exhaust of air – inspections for changes and loss of material integrity shall be conducted on a regular basis	**6.5**
Crushing/ shearing	Movement of power-driven guards	Injuries in the zone of closing edges	**4.2.2.6**/Part 2 (Hazards from guards)	Measures against hazards due to closing edges ref. **5.1.2**	**6.1.1**
Unhealthy posture or excessive efforts	Removal of parts	Increased fatigue	**4.9**/Part 1 (Hazards generated by neglecting ergonomic principles in machine design) **3.6**/Part 2 (Observing ergonomic principles)	see prEN 1005-2 The machine shall be designed so that there is no hindrance to the use of technical aids and possibility for good working postures ref. **5.1.7**	**6.1.1**
Noise	Effects on peripheral work, impact noises and striking noises of a limit stop, noises of the expansion of compressed air, noises of mechanical blow-off devices	Hearing loss, stress, loss of awareness	**3.2**/Part 2 (Making machines inherently safe by virtue of ...) **3.6.3**/Part 2 (Avoiding as far as possible noise, vibration, thermal effects) **4**/Part 2 (Safeguarding)	Impact damping, sound absorption, isolation of structure borne noise, sound-absorbing design and arrangement of blowing nozzles, machinery enclosure, deadening of sand hopper (see ISO/TR 11688-1 : 1993)	**6.7**

5.4 Coremaking machinery and plants

5.4.1 *Preventative measures against injuries due to mechanical hazards and high temperature hazards* *(concluded)*

Hazard	**Hazardous situation**	**Risk/Mode of operation**	**Preventative measures according to relevant sections of EN 292**	**Particular preventative measures**	**Verification means ref. clause 6**
1	**2**	**3**	**4**	**5**	**6**
Interference with speech communication and acoustic signals	Effects on peripheral work, impact noises and striking noises of a limit stop, noises of the expansion of compressed air, noises of mechanical blow-off devices	Danger of accident	**3.2**/Part 2 (Making machines inherently safe by virtue of ...) **3.6.3**/Part 2 (Avoiding as far as possible noise, vibration, thermal effects) **4**/Part 2 (Safeguarding)	Impact damping, sound absorber, isolation of structure borne noise, sound-absorbing design and arrangement of blowing nozzles, machinery enclosure, deadening of sand hopper (see ISO/TR 11688- 1 : 1993)	**6.7**

5.4 Coremaking machinery and plants

5.4.2 *Measures against hazards caused by substances (hazards to health, fire/explosion hazards)*

Hazard	**Hazardous situation**	**Risk/Mode of operation**	**Preventative measures according to relevant sections of EN 292**	**Particular preventative measures**	**Verification means ref. clause 6**
1	**2**	**3**	**4**	**5**	**6**
Inhalation of harmful gases, vapours	Opening of core boxes, core removal (thermal up-current of hot gases and vapours) spraying core boxes, gassing procedure, core handling and core washing/coating	Inhalation of formaldehyde, phenol (shell core, hotbox method), TEA, DMEA (cold box), SO_2 (SO_2 – method), methylformate, furfurylalcohol/ phenol (cold-setting), other alcohols for core coating (Main components see annex B)	**4.2.2.1**/Part 2 (Functions of guards)	Possibility to reduce emissions with extensive shielding and local exhaust as close as possible to the source of the gases and vapours. During hot-box and shell coremaking the vapours can only be collected by a tightly closed hood above the coremaking station	**6.6**
				Information to the user about the required rate of exhaust air from the equipment For the cold-box, SO_2 – and methylformates processes:	**6.9**
				– the cores shall only be gassed in enclosed coremaking machines or by closed gassing systems under vacuum	**6.1.1/6.1.2**
				– the gassing process shall be interlocked with the position of the gassing plate and the negative pressure in such a way that the gassing unit can only be operated when the gassing plate is in its operating position and the exhaust system is on	**6.1.1/6.1.2**
	Core coating/drying	Inhalation of alcoholic vapours	**4.2.2.1**/Part 2 (Functions of guards)	An integrated container for coatings and the route of the washed cores between this container and the dryer should be hooded to contain vapours. ref. **7.2**	**6.1.1/6.1.2/6.6**
Fire/explosion	Dealing with coldbox-catalysts, organic peroxides, methylformates storage	Ignition sources, in case of storage of peroxides/gassing equipment		The electrical components in the storage for organic peroxides and in the gassing equipment shall be suitable for use in an explosive atmosphere.	**6.1.1/6.1.2**
	Core coating/drying	Unintended ignition of alcohol-based coatings or dilutings		Integrated containers for coatings (dip tanks, reclaiming tanks) shall be made of non-flammable material and shall be stable. The containers shall be equipped with covers that overlap the outside edge.	**6.1.1**
				The manufacturer shall inform the user of the need for fire extinguishing facilities.	**6.9**

5.5 Knock-out equipment

Hazard	**Hazardous situation**	**Risk/Mode of operation**	**Preventative measures according to relevant sections of EN 292**	**Particular preventative measures**	**Verification means ref. clause 6**
1	**2**	**3**	**4**	**5**	**6**
Crushing/ shearing	Between fixed and oscillating/ reciprocating parts and springs	Injuries to parts of body	**3.2**/Part 2 (Making machines inherently safe by virtue of ...)	Minimum distances as in EN 349 otherwise guarding according to **5.1.1**	**6.1.1/6.1.2**
Entanglement	Rotating shafts, drive mechanisms	Injuries to parts of body	**3.22.1**/Part 1 (Fixed guard) **6.1.1**/Part 2 (Emergency stopping device)		**6.1.1/6.1.2**
Drawing-in	Rotary drums, drives	Injuries to parts of body	**3.22.1**/Part 1 (Fixed guard)		**6.1.1/6.1.2**
Impact/burns due to spillage	Ejection/falling of hot parts (hot sand/metal) out of the knock-out device			Provide spillage guard ref. **5.1.1**	**6.1.1/6.1.2**
Burns	Ignition of hydraulic fluids of hydraulic drives	as **5.3.2.2**		as **5.3.2.2**	as **5.3.2.2**
Inhalation of fumes and dust	Separation and destruction of sand moulds, spreading of dust increased by thermal upcurrent	Danger of breathing in quartz dust, CO and other released products from moulding material binders and/or coal dust		Provide enclosures and local exhaust ventilation Information to the user about the rate of exhausted air required for the equipment	**6.6** **6.9**
Noise	Effects on peripheral work, impact of moulding boxes and castings on the grid surface	Hearing loss, stress, loss of awareness	**3.2**/Part 2 (Making machines inherently safe by virtue of ...) **3.6.3**/Part 2 (Avoiding as far as possible noise, vibration, thermal effects) **4**/Part 2 (Safeguarding)	Optimization of the exciting forces, enclosure and/or deadening	**6.7**
Interference with speech communication and acoustic signals	Effects on peripheral work, impact of moulding boxes and castings on the grid surface	Danger of accident	**3.2**/Part 2 (Making machines inherently safe by virtue of ...) **3.6.3**/Part 2 (Avoiding as far as possible noise, vibration, thermal effects) **4**/Part 2 (Safeguarding)	Exciter force optimization, enclosure and/or deadening	**6.7**
Vibration	Whole body vibration having effects on other work places	Stress to human joints		Isolation of vibration source during installation of knock-out equipment	**6.8**
Low frequency oscillations (1 Hz – 100 Hz), infrasound	Percussions	Disturbance of well-being		Isolation of vibration during installation of knock-out equipment, minimization of amplitudes, avoidance of resonance between the exciting frequency and the natural frequency of the components	**6.8**

5.6 Handling of machines and heavy component parts for maintenance and repair

Hazard	**Hazardous situation**	**Risk/Mode of operation**	**Preventative measures according to relevant sections of EN 292**	**Particular preventative measures**	**Verification means ref. clause 6**
1	**2**	**3**	**4**	**5**	**6**
Crushing	Handling and hoisting of large parts	Injuries caused by slippage or falling parts	**6.2.3**/Part 2 (Provisions for easy and safe handling of machines and their heavy component parts)	Stress analysis of welded attachments	**6.5**
Excessive efforts	Handling of large parts		**3.6**/Part 2 (Observing ergonomic principles)	See prEN 1005-2 Possibility to apply lifting and/or tilting tables and devices ref. clause **5.1.7**	**6.1.1**

5.7 Fire/explosion when coating moulds and cores

Hazard	**Hazardous situation**	**Risk/Mode of operation**	**Preventative measures according to relevant sections of EN 292**	**Particular preventative measures**	**Verification means ref. clause 6**
1	**2**	**3**	**4**	**5**	**6**
Fire/explosion	Mould/core coating/drying	Through deliberate ignition of flammable coatings or diluting mediums after coating (e.g. dipping or spraying) to dry moulds and cores		Requirements for integrated containers for coatings, see clause **5.4.2.1** Spray booths or cabins shall be provided for the coating of moulds and cores by alcoholic spraying coatings. They shall be made of non-flammable materials and shall be provided with exhaust installations that prevent the escape of spraying material Within the spraying booths or cabins, measures shall be taken to prevent an ignition of the explosive atmosphere The electrical components in cabins or spraying booths shall be explosion-proof Requirements for mould and core varnish dryers and ovens see prEN 1539	**6.1.1** **6.1.1/6.1.2** **6.1.1/6.1.2**

5.8 Maintenance and setting activities

Hazard	**Hazardous situation**	**Risk/Mode of operation**	**Preventative measures according to relevant sections of EN 292**	**Particular preventative measures**	**Verification means ref. clause 6**
1	**2**	**3**	**4**	**5**	**6**
Crushing/ shearing	Deliberate or accidental wrong actuation of machine movements	Danger to persons working inside due to unexpected start-up	**6.2.2**/Part 2 (Provisions for isolation and energy dissipation **3.7.8** to **3.7.10**/Part 2 (Lockable mode selection switch/Control modes for machinery setting, cleaning or adjustment)	Multi-pole disconnecting switches for equipment. See also EN 418 and EN 60204-1/clause control functions Mode selection switch see **5.1.6** Location of setting/ maintenance points outside the danger area if possible. The disabling of safety devices by mode selection shall also simultaneously switch to setting mode (see **5.1.6**) When the power actuators for setting mode are released hazardous movements shall stop immediately ref. **5.1.6** The position of the control panel shall be so arranged that it offers optimum visibility into the danger zone or portable emergency-stop or enabling devices shall be present It shall be possible to depressurize supply pipes of machine parts For machines with pressure accumulators the pressure discharge of the accumulator shall be actuated either automatically on disconnection, or it shall be possible to relieve the pressure by means of a manually actuated self-closing valve. In this case the relief valve and the actuating mechanism for the energy supply shall be labelled as follows: 'Attention, prior to repair the pressure accumulator system must be depressurized'	**6.1.1/6.1.2**

5.8 Maintenance and setting activities *(concluded)*

Hazard	Hazardous situation	Risk/Mode of operation	Preventative measures according to relevant sections of EN 292	Particular preventative measures	Verification means ref. clause 6
1	**2**	**3**	**4**	**5**	**6**
Crushing/ shearing (concluded)	Failure of components of electronic control systems and uncontrolled orders to control valves or electric drives	Danger to persons working inside due to unexpected start-up		Circuits with additional contacts actuated by movement of machine parts or guards. ref. **5.1.6**	**6.1.1/6.1.2**
	– Unexpected movements as a consequence of return of the motive energy or the clamping energy after previous drop or failure of energy	Danger to persons working inside by unexpected start-up	**3.8**/Part 2 (Preventing hazards from pneumatic and hydraulic equipment)	Examples for **3.8**/Part 2 see annex A	
	– Unexpected movements of machine parts due to drop or failure of pressure or unexpected generation of pressure	Several employees may be working on the equipment of the moulding plant without optical or acoustical connection to each other		Jacks and/or supporting and arresting devices when working under raised machine parts or within the danger zone of machines that are depressurized but normally work in a pressurized state It shall be possible to relieve residual pressure from the supply pipes of machine parts Machines or parts of the plant being moved or held by pressure energy shall be protected against hazardous movements caused by a drop or failure of pressure by either: – weighted or spring-loaded jacks or lock bolts or – non-return valves or control valves that are directly attached to the working cylinder and that take their locking position automatically when there is a pipe failure Advice to the user to instruct operators and maintenance staff ref. **7.2**, **7.3** and **7.4**	
Unhealthy posture or excessive efforts	Manual handling	Increased fatigue	**3.6**/Part 2 (Observing ergonomic principles)	The machine shall be designed in such a way that there is no hindrance for technical aids for handling	**6.1.1**

6 Verification of the safety requirements and preventative measures according to clause 5

Verification can be achieved by a variety of methods (e.g. by inspection of the machine, of the associated equipment and the associated documents, appropriate testing and analysis, as mentioned in column 6 of tables **5.2** to **5.5**).

Where verification is more complex than simple inspection, the following points should be borne in mind.

For verification it might be helpful to provide a guideline, preferably in the form of a list or a table, that indicates danger zones, reaching distances, the presence and the functioning of interlocking guards with and without guardlocking, hold-to-run control devices, two-hand controls, trip devices, limited movement control devices, safety circuits, interlockings, main switches, emergency-stopping devices, if necessary sound protection measures, seals and joint surfaces and capture devices for inhalable harmful substances generated during operation, as applicable.

Verification includes in particular the following criteria.

6.1 Safety systems

Interlocks (EN 292-1, EN 1088), safety systems (EN 292, prEN 574, prEN 50100, prEN 746-2), guarding (prEN 953), emergency-stop (EN 418), isolation and energy dissipation, dosing of substances, electrical apparatus for potentially explosive atmospheres:

6.1.1 design and/or construction, provision and function;

6.1.2 its location.

6.2 Electrical safety

6.2.1 test in accordance with EN 60204-1, clause **13**;

6.2.2 provision of earthing.

6.3 Pressure release of dust explosions

6.3.1 design and/or construction, provision and function;

6.3.2 ensure venting into a safe area;

6.3.3 equipment for provision of earthing.

6.4 Explosiveness of coal dust or coal dust substitutes

6.4.1 determination according to ISO 6184-1;

6.4.2 absence of radiant heat and/or naked flames in the area surrounding the storage.

6.5 Stress analysis

Stress analyses for hoisting points, cams and/or for parts designed to withstand pressure have been carried out, if applicable.

6.6 Airborne substances generated during operation

Verification in accordance with prEN 1093-1.

6.7 Noise

Verification in accordance with prEN 1265.

6.8 Vibration

Check design and/or construction for provision of vibration isolation and its efficiency, if applicable.

6.9 Safety marking

Check information for use/warnings, need for a sign and its provision on the equipment.

7 Information for use

7.1 Marking

7.1.1 A durable plate containing at least the following information shall be affixed to the machine at a point visible after installation:

– name and address of the manufacturer;

– mandatory marking;

– year of construction;

– designation of series or type, if any;

– serial number/machine number, if any;

– rating information (mandatory for electrotechnical products: for example, voltage, frequency, power, etc. and for machinery intended for use in a potentially explosive atmosphere).

7.1.2 The electrical equipment on all types of machines shall have affixed durable plates containing their characteristic data, according to EN 60204-1, including casing protection grade.

7.1.3 Where it is not possible to avoid hazards by means of design and where adequate protective devices are not applicable, information on hazards and their prevention shall be given in information for use and by warning signs (see also EN 61310-1).

7.1.4 The warning signs shall be fitted in positions where they are clearly visible. The colour of these plates shall stand out from the background to which they are fixed. Any wording (see also EN 61310-1) shall be legible and permanent.

7.2 Technical data and description for safety

The technical description shall provide information concerning the avoidance of hazards and hazardous emissions of noise, vibration, radiation, gases and dusts. If information on reduction of the emission of gases and dusts is not available, the manufacturer shall inform the user that verification or field testing shall be made.

NOTE. Currently it is not possible to give common achievable values for concentrations of airborne toxic substances.

The technical description shall provide information concerning safety devices and safety measures for the intended use, transport, assembling and disassembling, e.g. protection against turning over, falling of elevated parts, hazards due to non-relieved pressures, malfunction of programmable electronic systems, temperature, fire or potentially explosive atmospheres.

7.3 Operation manual

7.3.1 *Operating instructions in general*

For each machine, the manufacturer shall supply a manual of operating instructions, including all auxiliary systems. These instructions, accompanied by diagrams, drawings and leaflets (when applicable), shall contain at least the following details (see also **5.5** of EN 292-2):

– rating details;

– type of machine;

– installation and transport; mass;

– particular types of hazard (e.g. electrical current, hydraulics, machine or material parts flying off, emission of gases, steams, dusts, noises, vibration, access restrictions for particular reasons);

– declaration of airborne noise emissions according to EN 292-2/A1 : 1995 annex A, clause **1.7.4** f) determined according to prEN 1265;

– intended use of the machine;

– the level of training required for the operation of the machinery (qualification and instruction);

– foreseeable misuse;

– safety and regulating equipment (including in particular that such equipment must not be removed from the machine);

– exclusion of liability in case of unauthorized modifications of the machine;

– definition of residual risks (i.e. hydraulic/ pneumatic, ejection of material, explosion, fire, dust, free chemicals, contact with hot parts);

– informing and warning users about residual risks; particular risks in case of access or handling on special occasions (maintenance, troubleshooting) shall be pointed out in the instruction handbook and on the machine by markings/symbols referring to the nature of hazard;

– starting, operating and shut down;

– action in the event of faults or irregularities and abnormal operation;

– references for preventing hazardous conditions;

– when personal protection equipment should be used and what type is recommended.

Personal protection equipment should be used to prevent damages due to the risk

– of contact with molten metal (masses), hot surfaces, reactive or toxic chemicals during operation, maintenance and repair work;

– of dust during maintenance and repair work in parts of sand conditioning and reclamation plants, especially silos and mixers/mills.

7.3.2 *Storage and pneumatic conveyance of coal dust*

7.3.2.1 *Fire detection*

The manufacturer shall provide information concerning the storage and pneumatic conveyance of coal dust or coal dust substitutes and their mixtures with bonding agents (when applicable).

In case of temperature survey the limiting value should be defined, e.g. for coal 80 °C.

In case of CO survey, its limiting value should be determined as being 20 % higher than the highest CO-concentration occurring after the filling of the coal dust silo without removal of coal dust or without supply of fresh air for a period of 48 hours.

If the limiting value is determined, the strip charts of the CO-measuring instrument (if applicable) shall be monitored.

NOTE. If the CO-concentration increases in a parabolic manner, a smoulder fire (burning) should be assumed to be occurring.

If the CO-concentration asymptotically approaches a limiting value, it can be assumed that there are no irregularities in the silo filling.

7.3.2.2 *Health and rescue aspects on accessible silos*

If a coal dust silo is designed for access, the manufacturer shall provide for information concerning personal protection equipment to avoid risks to health due to: oxygen deficiency and toxic gases in the operator's breathing air, skin contact with skin reactive substances according to the information of the supplier of coal dust or coal dust substitutes. He shall also provide for information concerning rescue procedures for persons having access to the silo.

7.3.3 *Storage and use of reactive chemicals*

The manufacturer shall inform the user to ensure that:

– ignition sources (open fires, electrical ignition sources, spark creating tools, excessively high surface temperature, smoking) are prevented when dealing with cold box catalysts, organic peroxides and methylformates;

– catalysts and methylformates are stored outside the working areas;

– organic peroxides are stored sun-protected in separate buildings at temperatures between +10 °C and +25 °C;

– dealing with resin and hardener may not create danger by exothermic reactions.

7.4 Maintenance manual

A maintenance manual shall be provided by the manufacturer. The maintenance manual shall contain instructions on the checks that need to be carried out, instructions for maintenance and repair work for all parts of the machinery given in clause **5** and **7.3.1** to **7.3.3** and the protective measures against hazards mentioned in clause **5**.

The manual shall include an inspection programme for protective devices and shall indicate the recommended frequency of inspection.

NOTE. The frequency of inspection should be commensurate with the importance and known reliability of that device.

A list of spare parts and wear parts, if applicable, clearly identifiable, shall be provided.

The maintenance manual shall indicate the levels of skill required of maintenance personnel for different interventions.

Annex A (normative)

Examples of solutions for 3.8 of EN 292-2 *Preventing hazards from hydraulic and pneumatic equipment*. See figure A.1 to figure A.12 (schemes Hy 1 to Hy 12) and figure A.13 to figure A.18 (schemes Pn 2 to Pn 11)

Problem	**Examples of solutions (schemes with indication of category according to prEN 954-1)**	**Explanation**
Devices for height holding of loads used in equipment such as lifting tables, assembling and separating devices, transformers, punch-out equipment, tilting devices of ovens and pouring equipment resp. clamping of lifted parts. – Intervention only necessary for repair and maintenance activities	Load holding valves possible, but only in connection with a fixed arrangement of deliberately inserted mechanical height holding devices for screwed-down safeguards (figure A.1) – Category B No particular requirements if pipes are positioned before the height holding valve	The solution represents a reduction of the requirement according to **3.8**. The provisions for the control have been kept on a low level to reduce costs It is possible to reduce the requirements provided that an intervention for repairs is only effected under consideration of **3.23.6** of EN 292-1
– Occasional or periodical intervention necessary for operational purposes	– controlled non-return valve mounted directly at the cylinder – Category 1 – lowering brake-check valve mounted directly at the cylinder – Category 1 – mechanical latchings coupled with guard, also effective in intermediate positions – no fault – hydraulic/pneumatic clamping devices – Category 1 Special requirement to be fulfilled if pipes are positioned before the height holding valve – control of valves not through programmable controller – the conditioning of the hydraulic oil is essential/pressure filtration if possible (figures A.2, A.3, A.4, A.5, A.13 and A14)	Regular load holding valves do not fulfil the safety level mentioned in **3.8**. In general, regular load holding valves cannot be excluded from faults with respect to 'non-closure' and 'ineffectiveness of the spring'. In case of failure, they take the 'unsafe' position whereas a non-return valve is closed by the load pressure Pipe-break safety devices alone are not sufficient as they only respond to a fast lowering flow and their response is dependent upon viscosity and accurate adjustment
Stopping of horizontally moved masses (intervention necessary for operational purposes)	– directional control valve, proven with regard to safety, with locking position (e.g. for small masses and speeds) – Category 1 – directional control valve, proven with regard to safety, with locking position plus pressure limiting valve (in the control line or bypass for the reduction of pressure peaks) for bigger masses and higher speeds The pressure limiting valve shall be type-tested and equipped with an effective adjusting fuse (figures A.6, A.7, A.8 and figures A.15, A.16) – Category 1	The use of pressure limiting valves for the reduction of pressure peaks during the slowing down of bigger masses is possible since there is no potential energy The use of pressure limiting valves is possible on condition that the control spring cannot become ineffective and that a suitable adjusting device (plumbing) is provided. These two conditions are met by the use of type-tested pressure limiting valves The use of pressure limiting valves with a control spring that cannot become ineffective is necessary in order to adjust the reliability of this control variant to the reliability of a disconnection by the arresting position of a valve alone
Stopping of horizontally moved masses (intervention necessary for operational purposes)	– redundancy by installation of directional control valves to identify failure Used as one measure against unintentional movement in case of increased danger (figure A.9) – Category 4	Correct function of the control system is always given even when one single fault occurs. Identification of failure on time by electrical monitoring of position of both valves within each cycle.

Annex A (normative)

Examples of solutions for 3.8 of EN 292-2 *Preventing hazards from hydraulic and pneumatic equipment*. See figure A.1 to figure A.12 (schemes Hy 1 to Hy 12) and figure A.13 to figure A.18 (schemes Pn 2 to Pn 11) *(concluded)*

Problem	**Examples of solutions (schemes with indication of category according to prEN 954-1)**	**Explanation**
Pressure relief of pipe systems and sections of systems with or without pressure accumulator, if hazardous movements after disconnection are possible	– manual locking and relief valves, lockable in the 'Off' position depending on the degree of danger – automatic locking and relief valves (figures A.10, A.11, A.12 and figures A.17, A.18) – automatic: Category 1 – manual: no fault	Total disconnection and disconnection of sections are both possible. Hydraulic and pneumatic systems must be widely capable of being relieved. However, hazardous movements, such as the fall of lifted parts, shall be avoided To bring the safety level of manual and automatic shut-off and depressurization into line, an electrical monitoring of valve position (with respect to pneumatic pressure monitoring), with a corresponding processing by control, may be required in case of automatic relief, depending on the degree of danger This can be applied as a substitute measure for the lockability of the manual shut-off device as well as for the visual pressure indication, especially in case of disconnection of sections
Installation of pipework	Additionally for height holding loads with intervention during operation: – solid pipes with welded or flanged threads between cylinder and valve (no cutting ring screwing) – hose pipes only in exceptional cases	Additional requirements are necessary if the height holding of loads is effected hydraulically For preference a direct mounting of the height valve at the cylinder should be chosen Hose pipes to be used only in exceptional cases, but then defined requirements concerning testing, dimensioning, installation, monitoring and replacement shall be observed
Setting and maintenance activities	main switch or main section switch for all energies (normally lockable) – measures against wrong start-up (e.g. at emergency actuators of valves) – mechanical restraint devices (**3.23.6** of EN 292-1) – possibility of relief with pressure indication	In connection with setting and maintenance activities, but also for fault detection and rescue of persons, clear markings at the relevant control valves have to be applied that correspond to the wiring diagram and illuminated diagrams (if any)

Annex A (normative)

Examples of connection for 3.8 of EN 292-2 *Preventing hazards and pneumatic equipment*

NOTE. The following examples of connections, figure A.1 to figure A.12 (schemes Hy 1 to Hy 12) and figure A.13 to figure A.18, (schemes Pn 2 to Pn 11) demonstrate only the safety related components of the control system. For correct function further components are usually necessary.

Only safety related components are shown. Usually further components are necessary for correct functions. Other solutions are available but are not illustrated here. The manufacturer is asked to check the circuit diagrams for correct function before using them (if applicable).

Annex A (normative)

Examples of connection for 3.8 of EN 292-2 *Preventing hazards from hydraulic and pneumatic equipment* *(continued)*

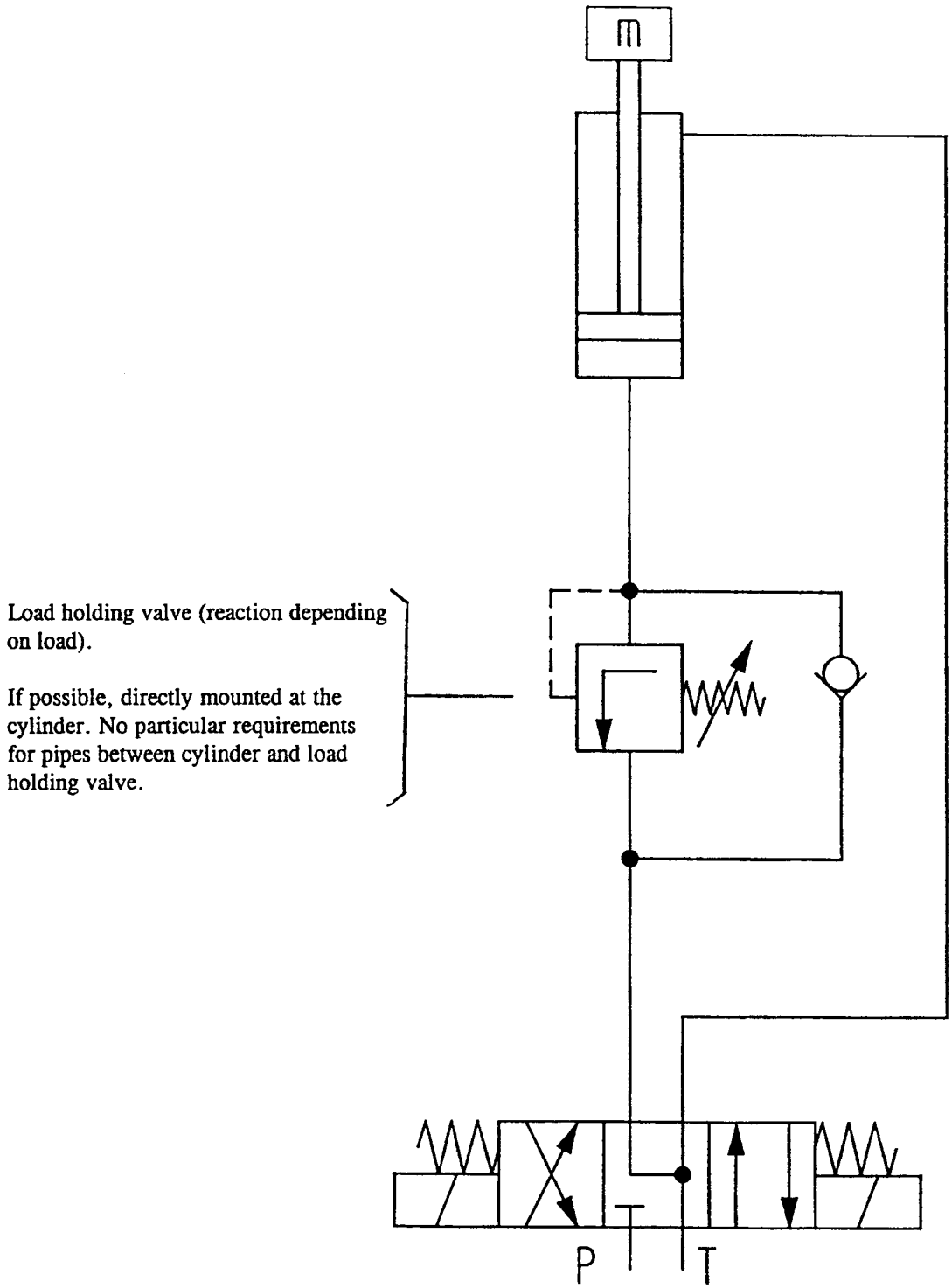


Figure A.1 Holding height of loads; scheme Hy 1
Intervention only for repair and maintenance purposes.
For use only in connection with mechanical blocking devices.

Annex A (normative)

Examples of connection for 3.8 of EN 292-2 *Preventing hazards from hydraulic and pneumatic equipment* *(continued)*

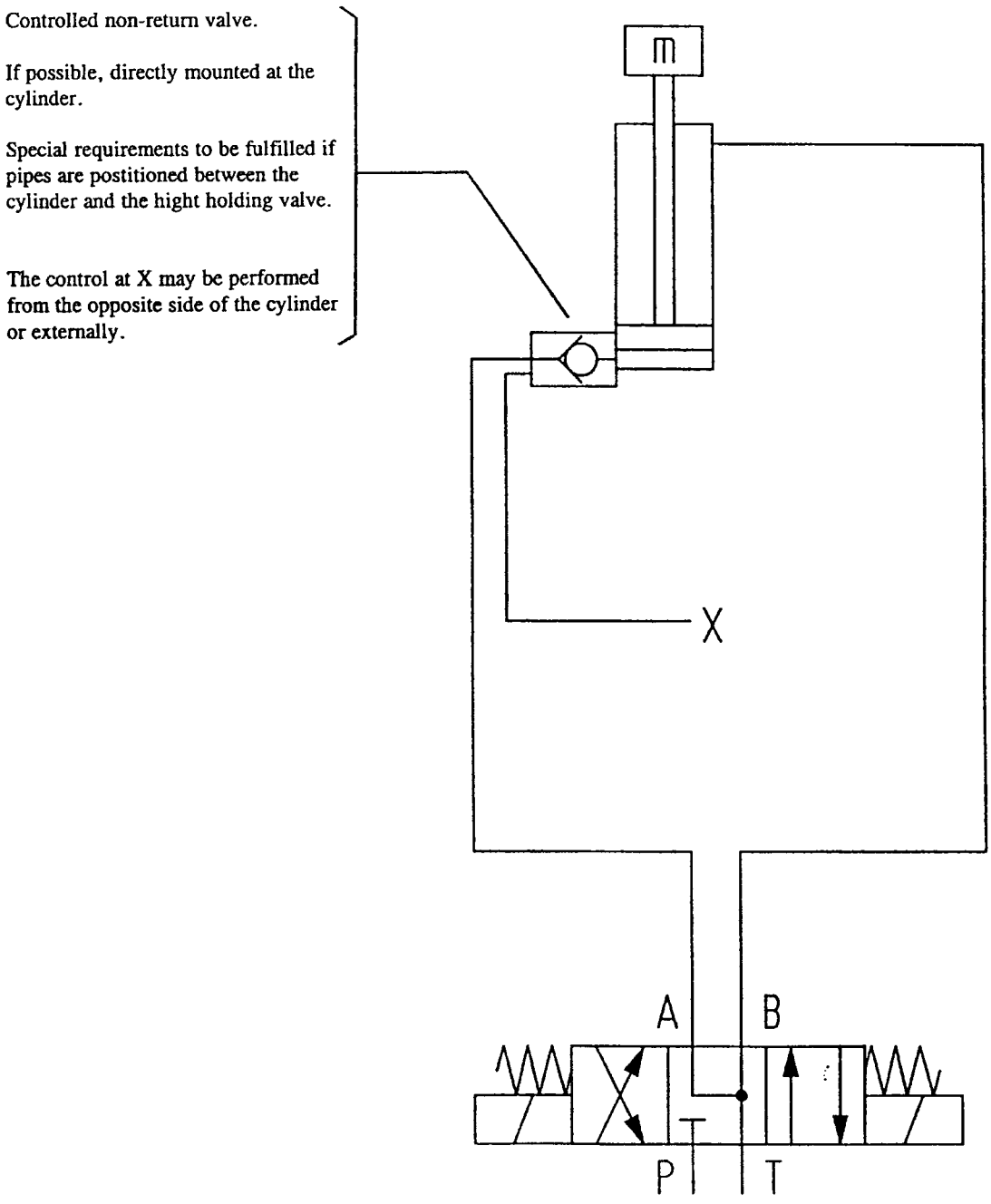


Figure A.2 Holding height of loads; scheme Hy 2

Operational intervention necessary occasionally or at cyclic intervals.

Annex A (normative)

Examples of connection for 3.8 of EN 292-2 *Preventing hazards from hydraulic and pneumatic equipment* *(continued)*

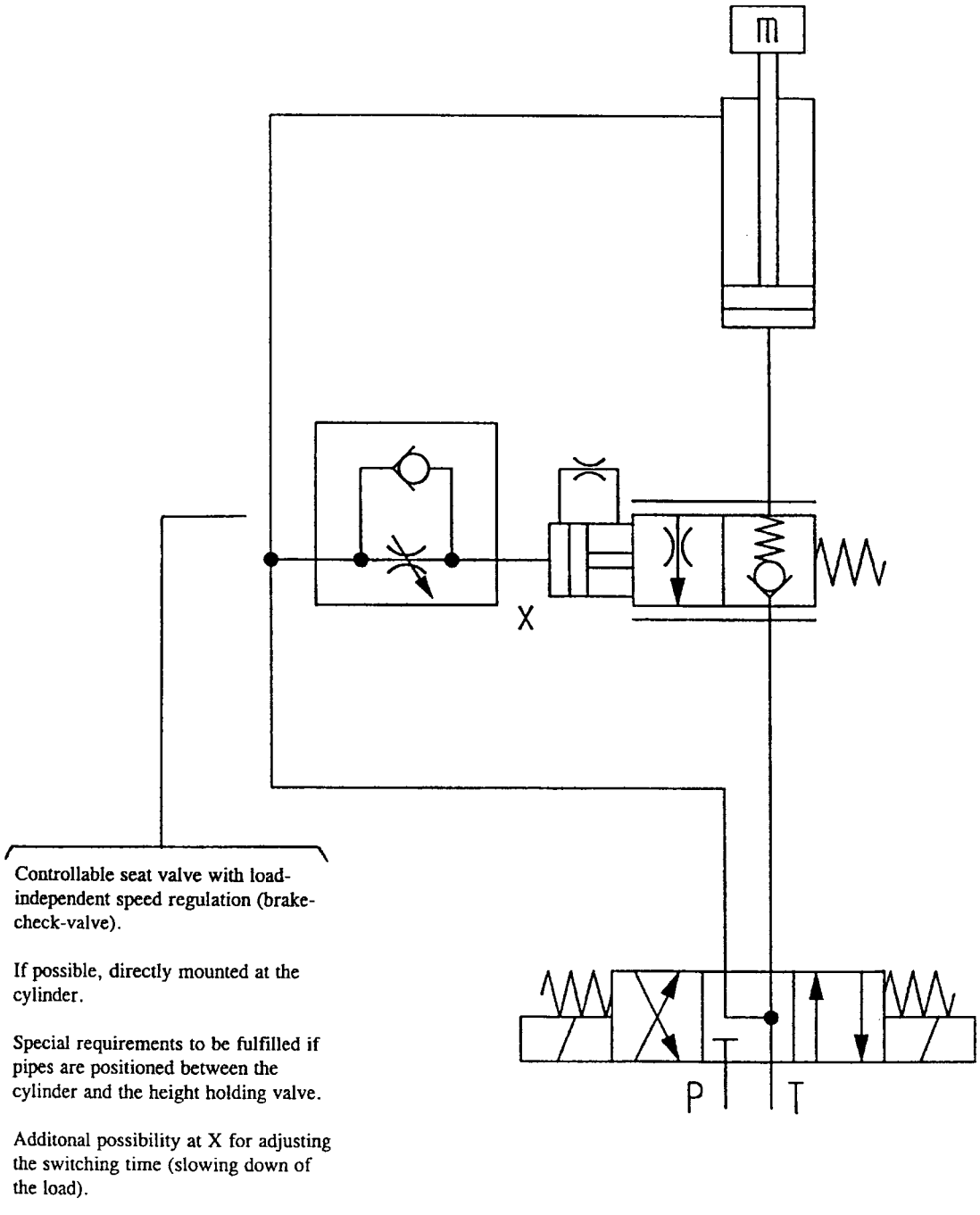


Figure A.3 Holding height of loads; scheme Hy 3

Operational intervention necessary occasionally or at cyclic intervals.

Annex A (normative)

Examples of connection for 3.8 of EN 292-2 *Preventing hazards from hydraulic and pneumatic equipment* *(continued)*

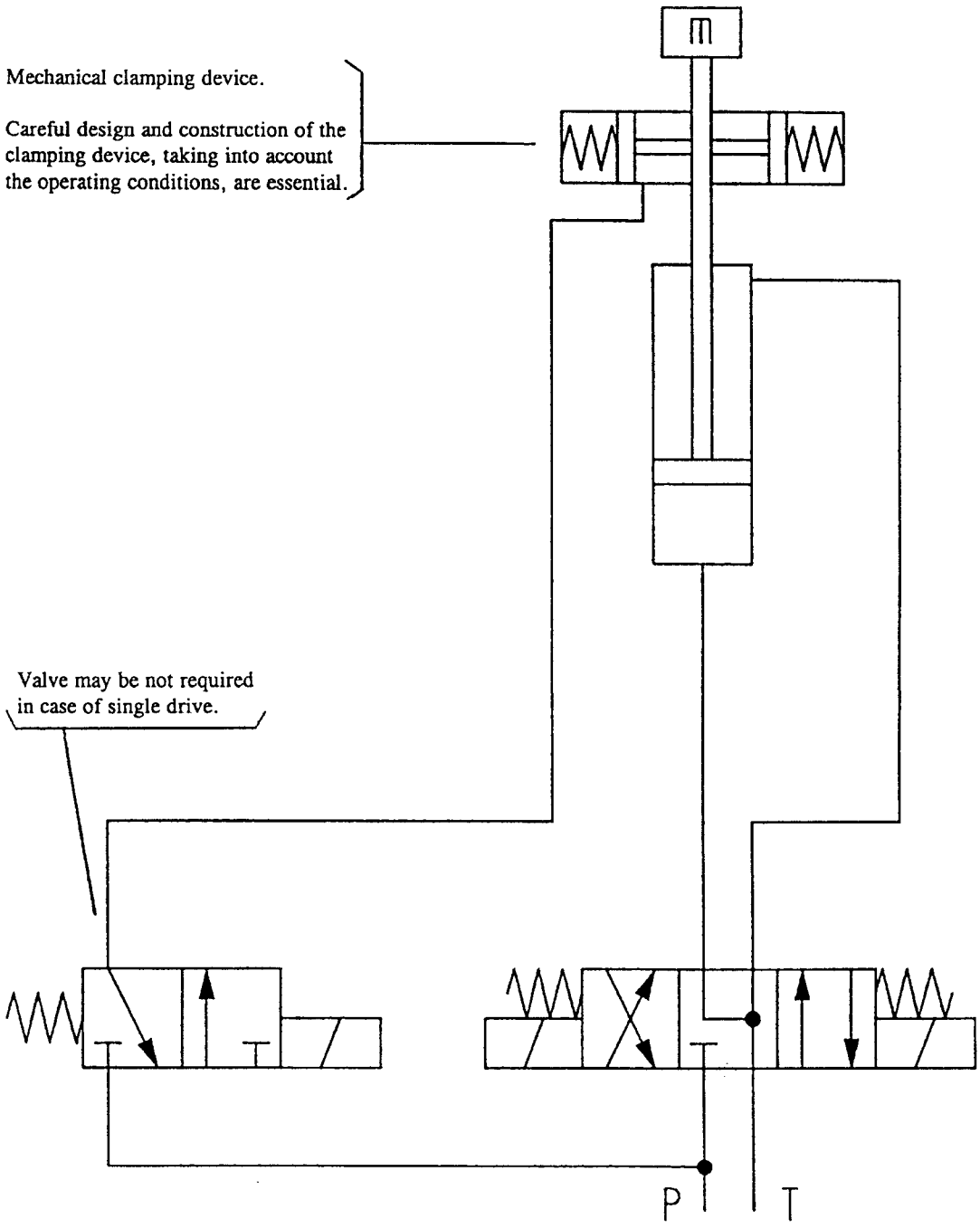
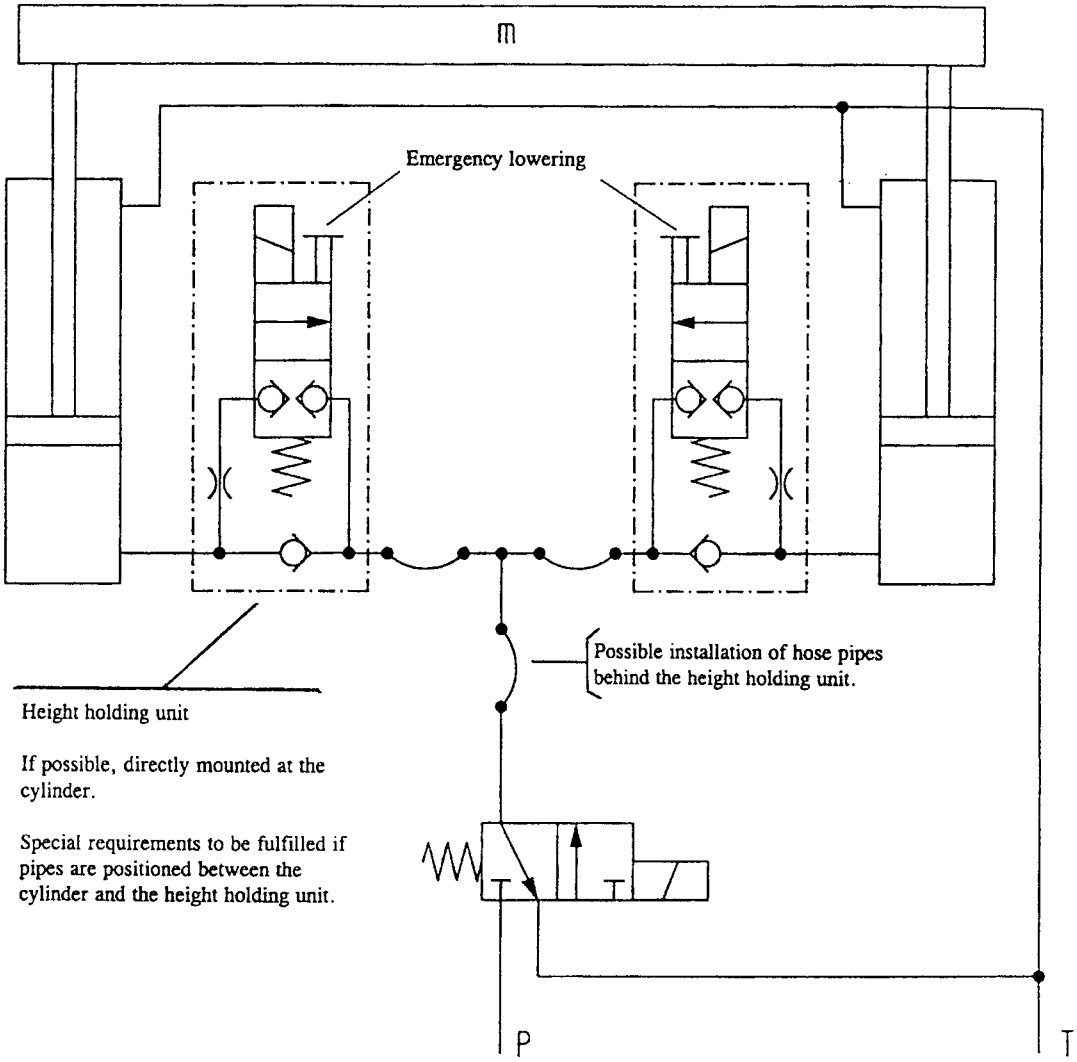


Figure A.4 Holding height of loads; scheme Hy 4

Operational intervention necessary occasionally or at cyclic intervals.

Annex A (normative)

Examples of connection for 3.8 of EN 292-2 *Preventing hazards from hydraulic and pneumatic equipment* *(continued)*



Constructional requirements:

Each cylinder shall be dimensioned to withstand the total load pressure occurring in a case of defect

Figure A.5 Holding height of loads; scheme Hy 5

Example of switching arrangement for pouring furnace hydraulics.

Walking under the load occasionally necessary for operational purposes.

Annex A (normative)

Examples of connection for 3.8 of EN 292-2 *Preventing hazards from hydraulic and pneumatic equipment* *(continued)*

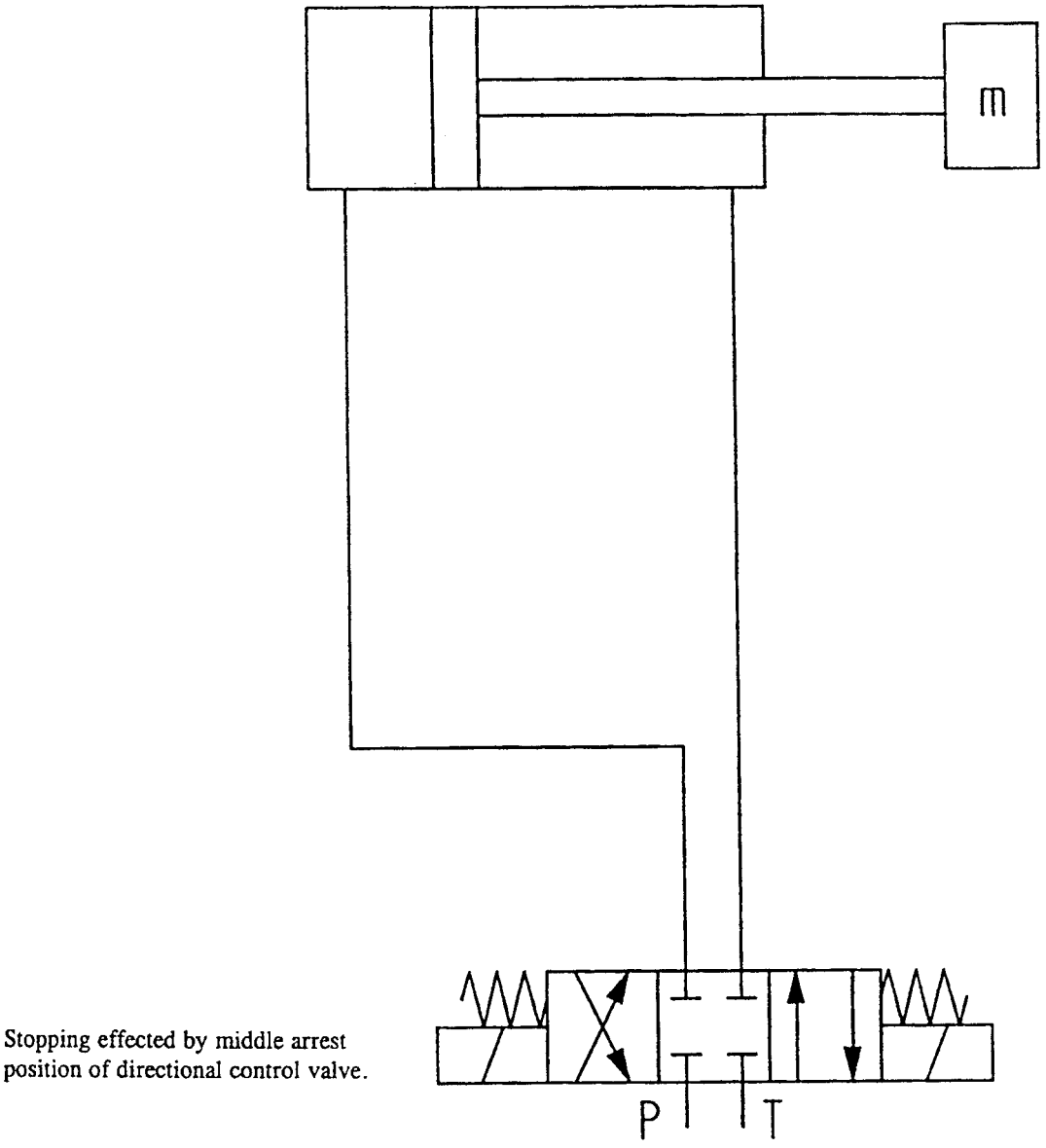


Figure A.6 Stopping of horizontally moving masses; scheme Hy 6

Example of connection for movements with low kinetic energy.

Operational intervention necessary occasionally or at cyclic intervals.

Annex A (normative)

Examples of connection for 3.8 of EN 292-2 *Preventing hazards from hydraulic and pneumatic equipment* *(continued)*

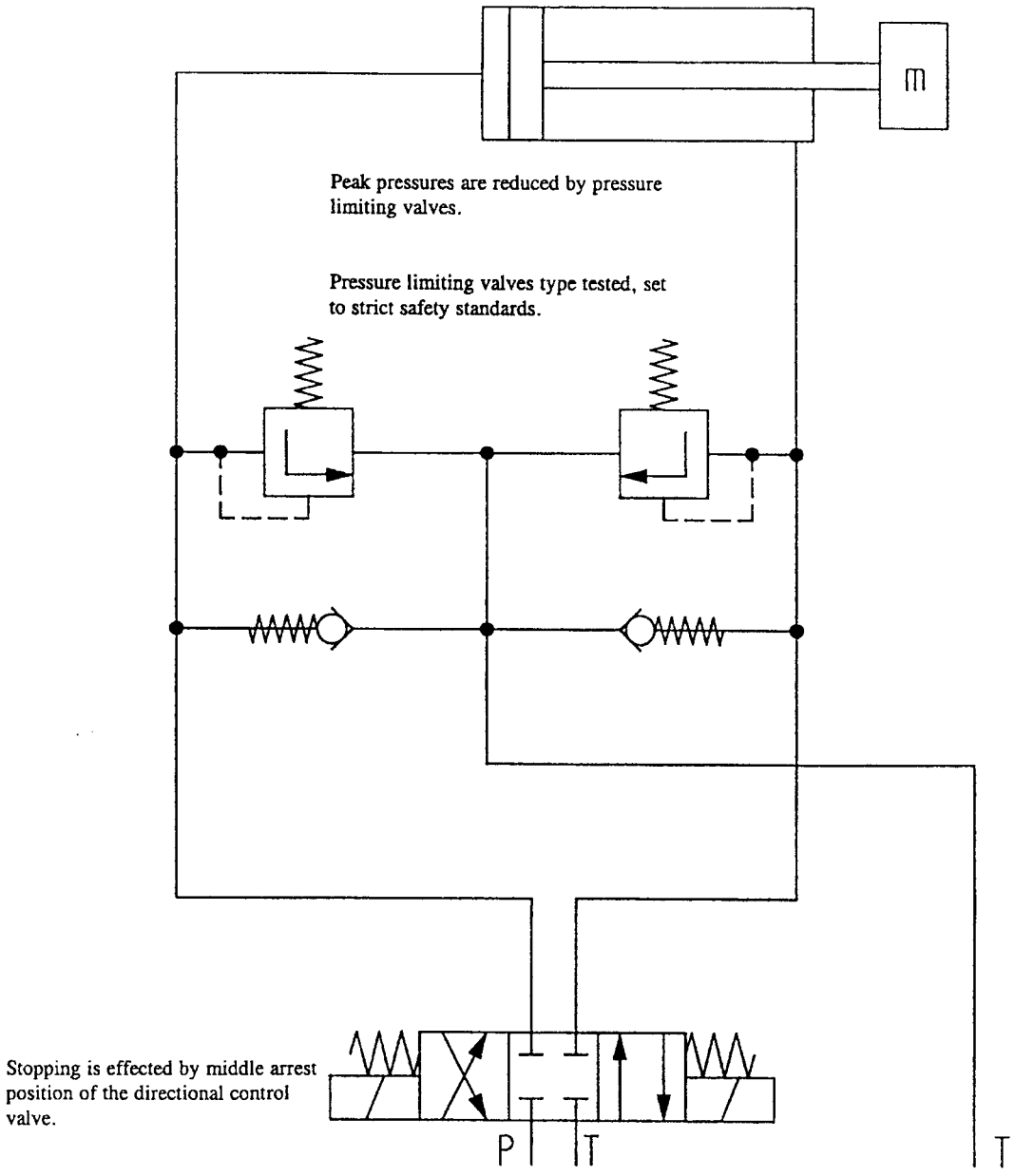


Figure A.7 Stopping of horizontally moving masses; scheme Hy 7

Example of connection for movements with higher kinetic energy.

Pressure limiting valves positioned in the main circuit.

Operational intervention necessary occasionally or at cyclic intervals.

Annex A (normative)

Examples of connection for 3.8 of EN 292-2 *Preventing hazards from hydraulic and pneumatic equipment* *(continued)*

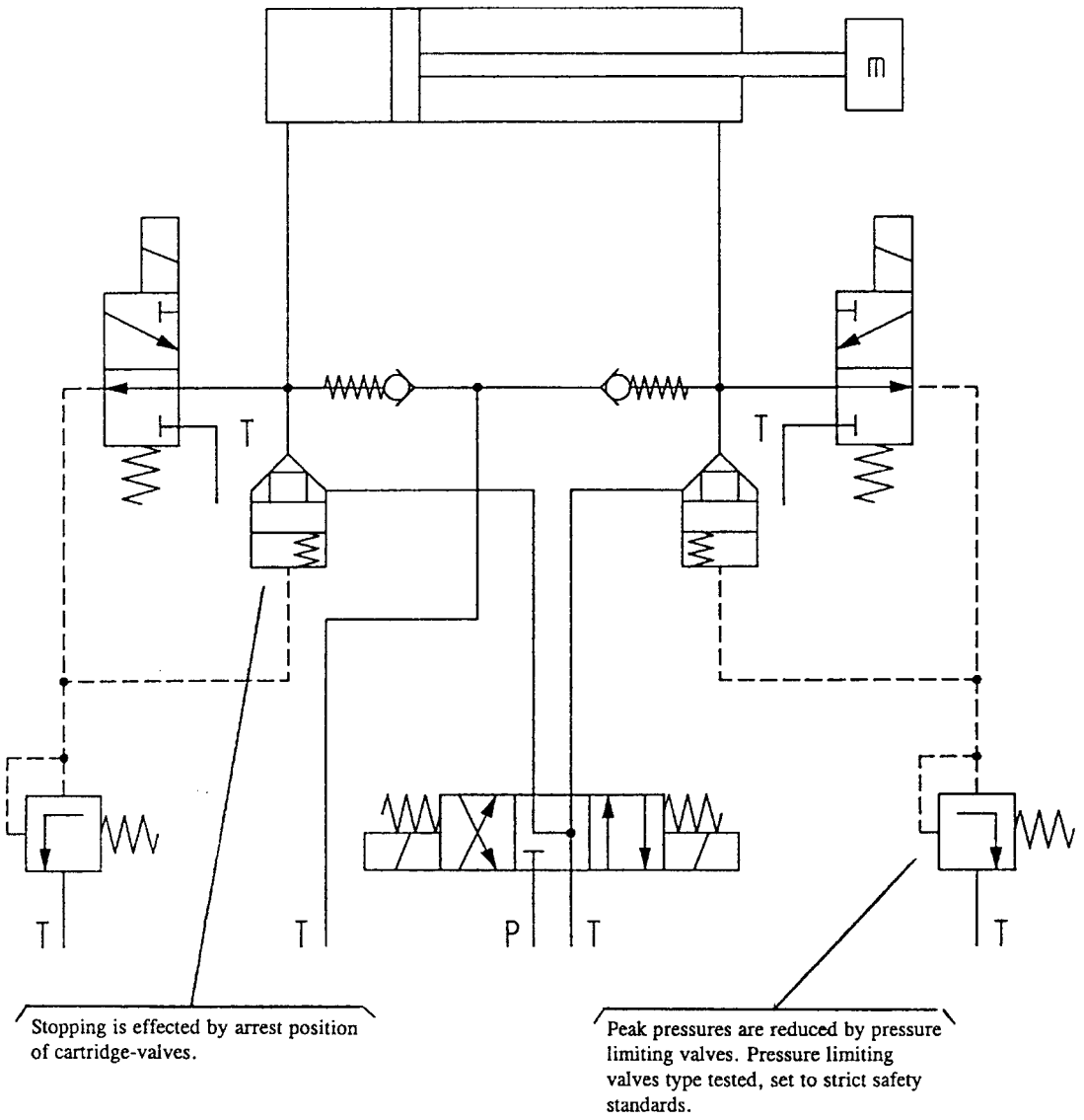


Figure A.8 Stopping of horizontally moving masses; scheme Hy 8

Example of connection for movements with higher kinetic energy.

Pressure limiting valves positioned in the control circuit.

Operational intervention necessary occasionally or at cyclic intervals.

Annex A (normative)

Examples of connection for 3.8 of EN 292-2 *Preventing hazards from hydraulic and pneumatic equipment* *(continued)*

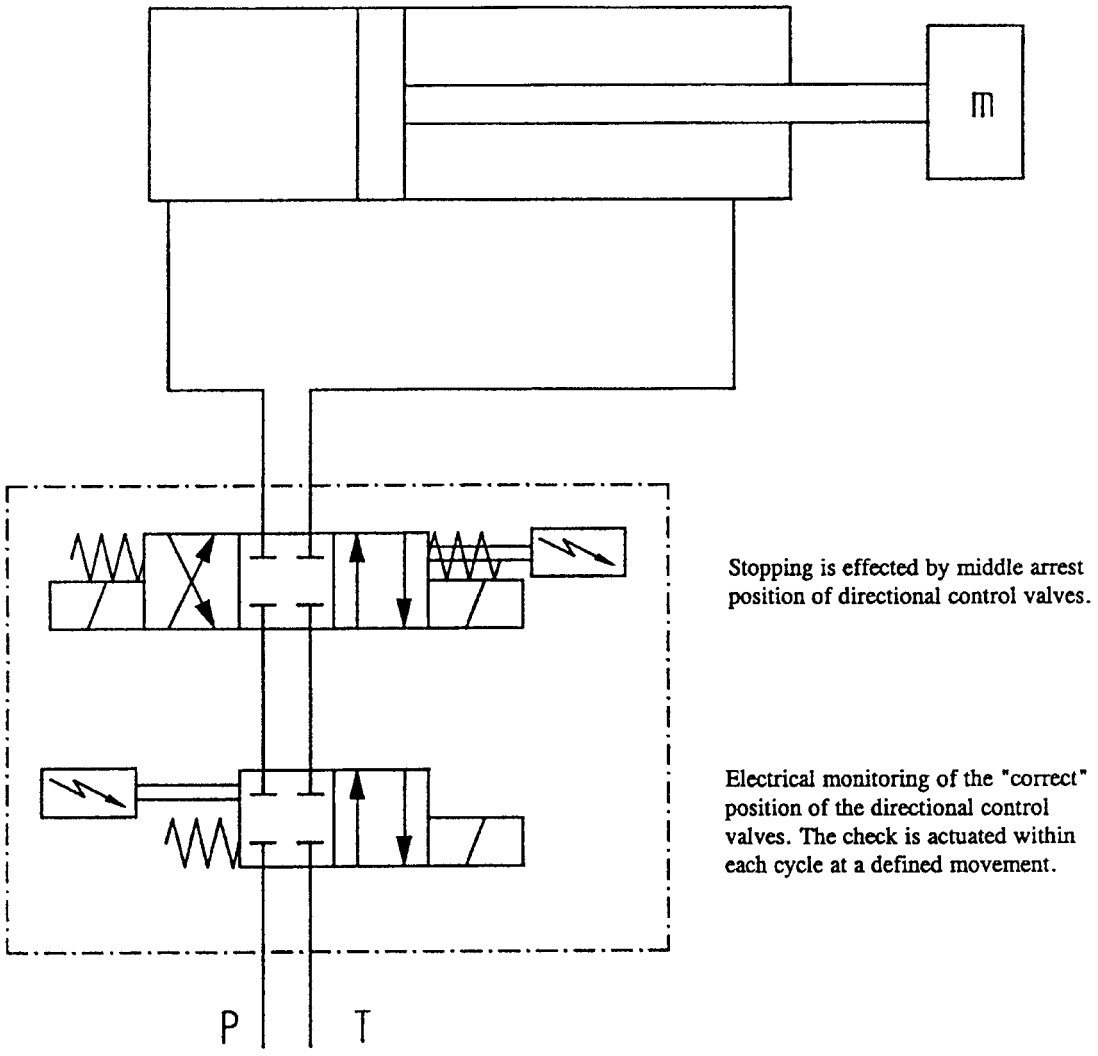


Figure A.9 Stopping of horizontally moving masses; scheme Hy 9

Example of connection for controlled self-monitoring movement.

Cyclical intervention necessary for operational purposes, increased danger.

Annex A (normative)

Examples of connection for 3.8 of EN 292-2 *Preventing hazards from hydraulic and pneumatic equipment* *(continued)*

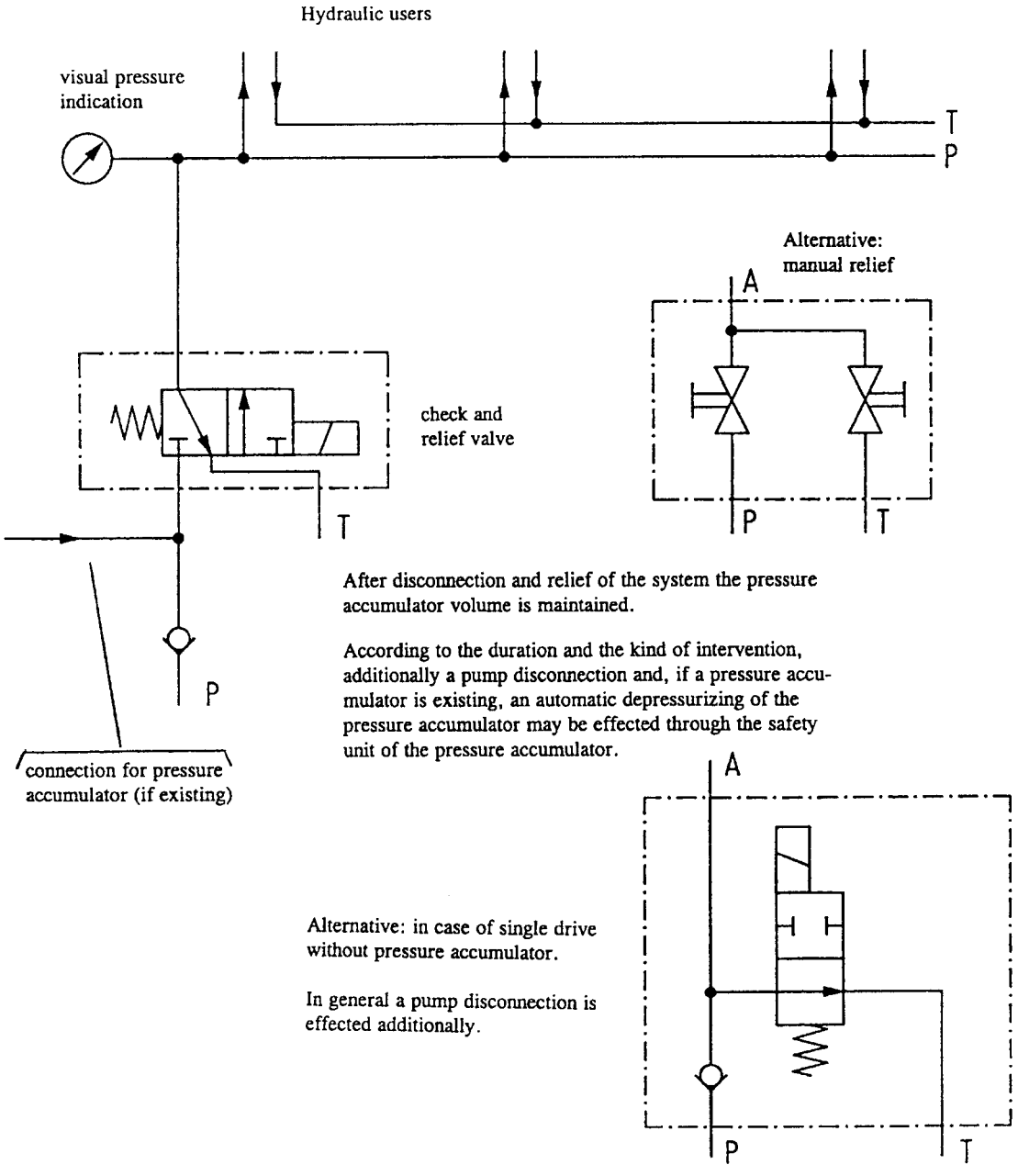
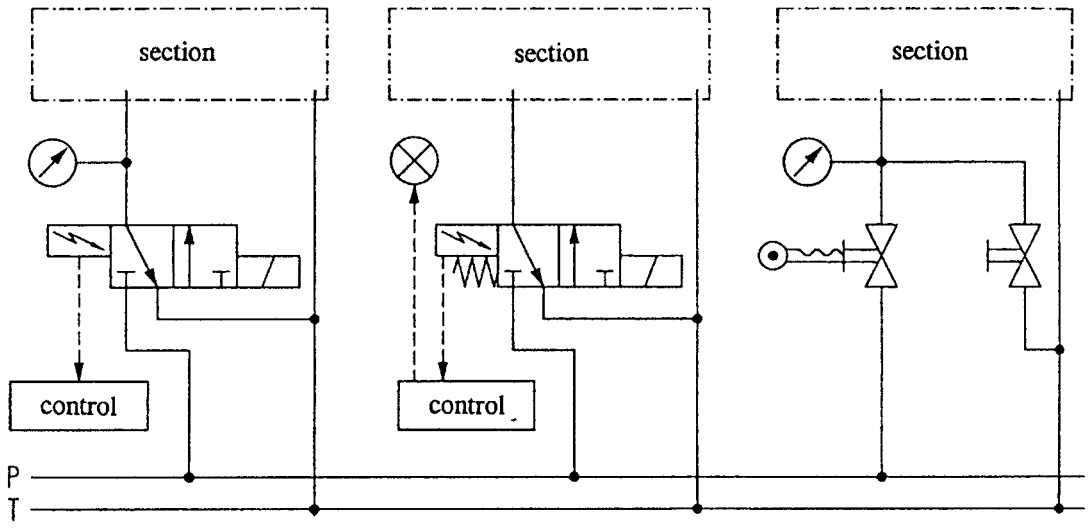


Figure A.10 Pressure relief of hydraulic systems; scheme Hy 10

Examples for connection for hydraulic systems with or without pressure accumulator.
Total shut down.

Annex A (normative)

Examples of connection for 3.8 of EN 292-2 *Preventing hazards from hydraulic and pneumatic equipment* *(continued)*



Check and relief valve:		Manual shut-down and relief possibility:
Visual pressure indication	Electrical "pressure" remote indication	Visual pressure indication
The electrical monitoring of position and corresponding processing by control is:		P-side at least lockable in "OFF" position
here equalized with the lockability of the manual shut-down possibility.	here equalized with the lockability of the manual shut-down possibility and the visual pressure indication.	

Pump disconnection and if necessary depressurizing of the pressure accumulator is not obligatory.

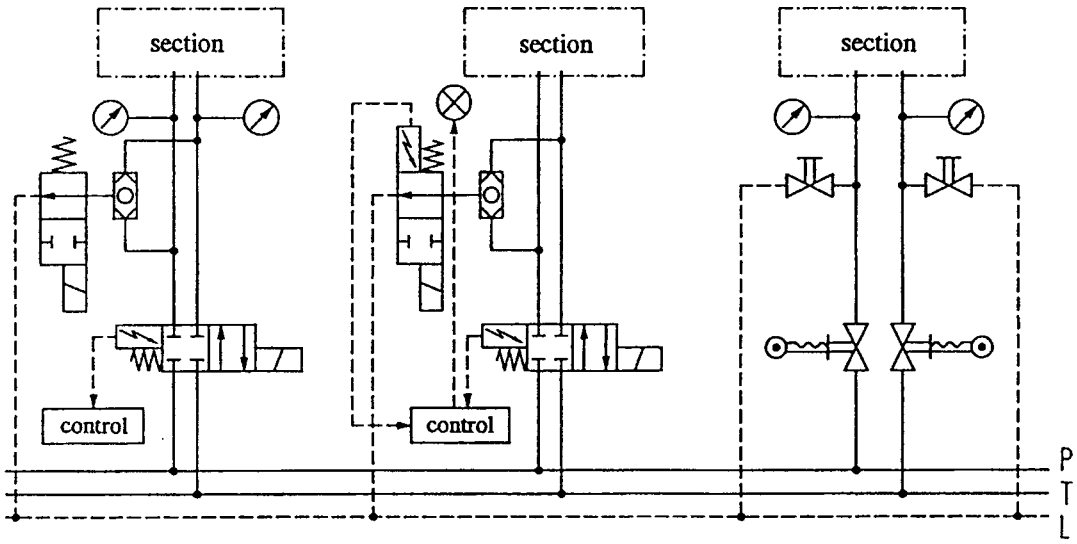
Solution is only possible if reservoir pipe is not exposed to pressure or only to low pressure.

Figure A.11 Pressure relief of hydraulic systems; scheme Hy 11

Examples of connection for hydraulic systems with or without pressure accumulator.
Disconnection of particular sections.

Annex A (normative)

Examples of connection for 3.8 of EN 292-2 *Preventing hazards from hydraulic and pneumatic equipment* *(continued)*



Separate check and relief valves:		Manual shut-down and relief possibility:
Visual pressure indication	Electrical "pressure" remote indication. The electrical monitoring of position of the pressure relief valve and corresponding processing by the control is equivalent with the visual pressure indication.	Visual pressure indications P and T-side lockable in "OFF" position.
The electrical monitoring of position of the check valve with corresponding processing by the control is equalized with the lockability of the manual shut-down possibilities.		

Pump disconnection and if necessary depressurizing of the pressure accumulator is not obligatory.
Solution primarily if reservoir pipe is exposed to higher pressure.

Figure A.12 Pressure relief of hydraulic systems; scheme Hy 12

Examples of connection for hydraulic systems with or without pressure accumulator.
Disconnection of particular sections.

Annex A (normative)

Examples of connection for 3.8 of EN 292-2 *Preventing hazards from hydraulic and pneumatic equipment* *(continued)*

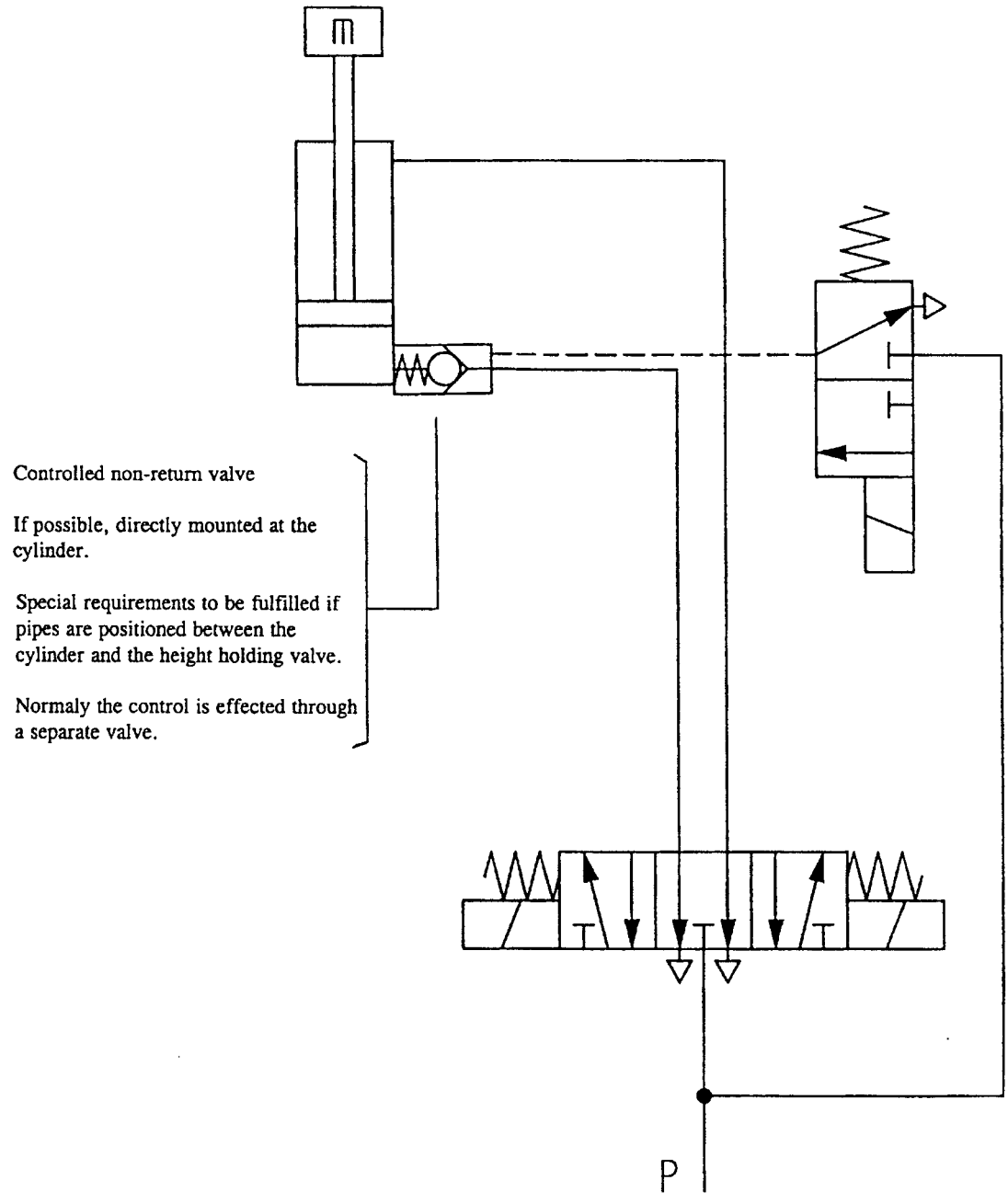


Figure A.13 Holding height of loads; scheme Pn 2

Operational intervention necessary occasionally or at cyclic intervals.

Annex A (normative)

Examples of connection for 3.8 of EN 292-2 *Preventing hazards from hydraulic and pneumatic equipment* *(continued)*

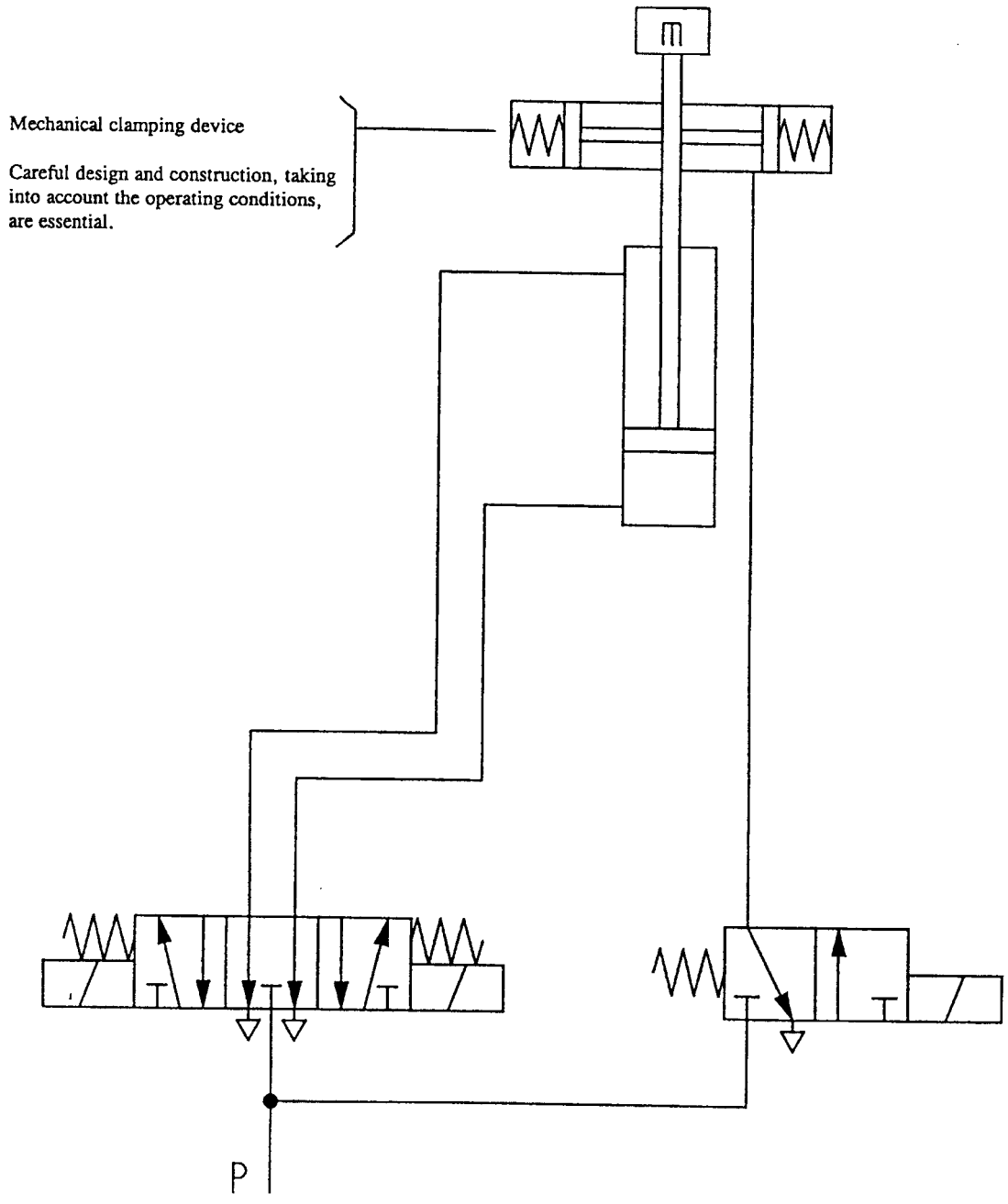
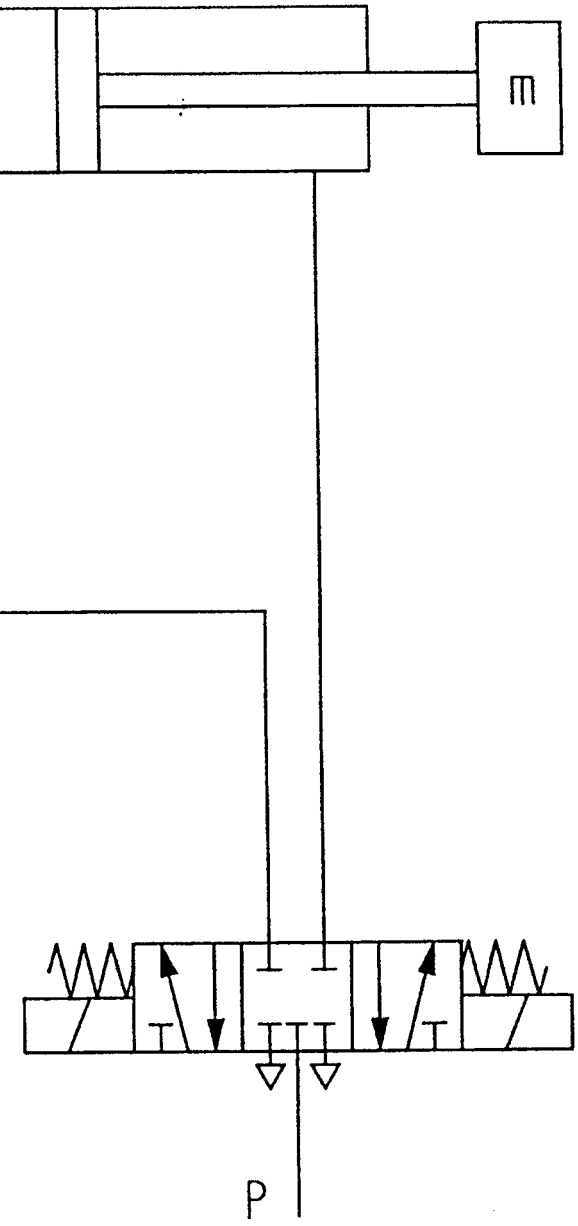


Figure A.14 Holding height of loads; scheme Pn 4

Operational intervention necessary occasionally or at cyclic intervals.

Annex A (normative)

Examples of connection for 3.8 of EN 292-2 *Preventing hazards from hydraulic and pneumatic equipment* *(continued)*



Stopping effected by middle arrest position of directional control valve.

The volume of pipework may have effects on the after running.

Figure A.15 Stopping of horizontally moving masses; scheme Pn 6

Example of connection for movements with low kinetic energy.

Operational intervention necessary occasionally or at cyclic intervals.

Annex A (normative)

Examples of connection for 3.8 of EN 292-2 *Preventing hazards from hydraulic and pneumatic equipment* *(continued)*

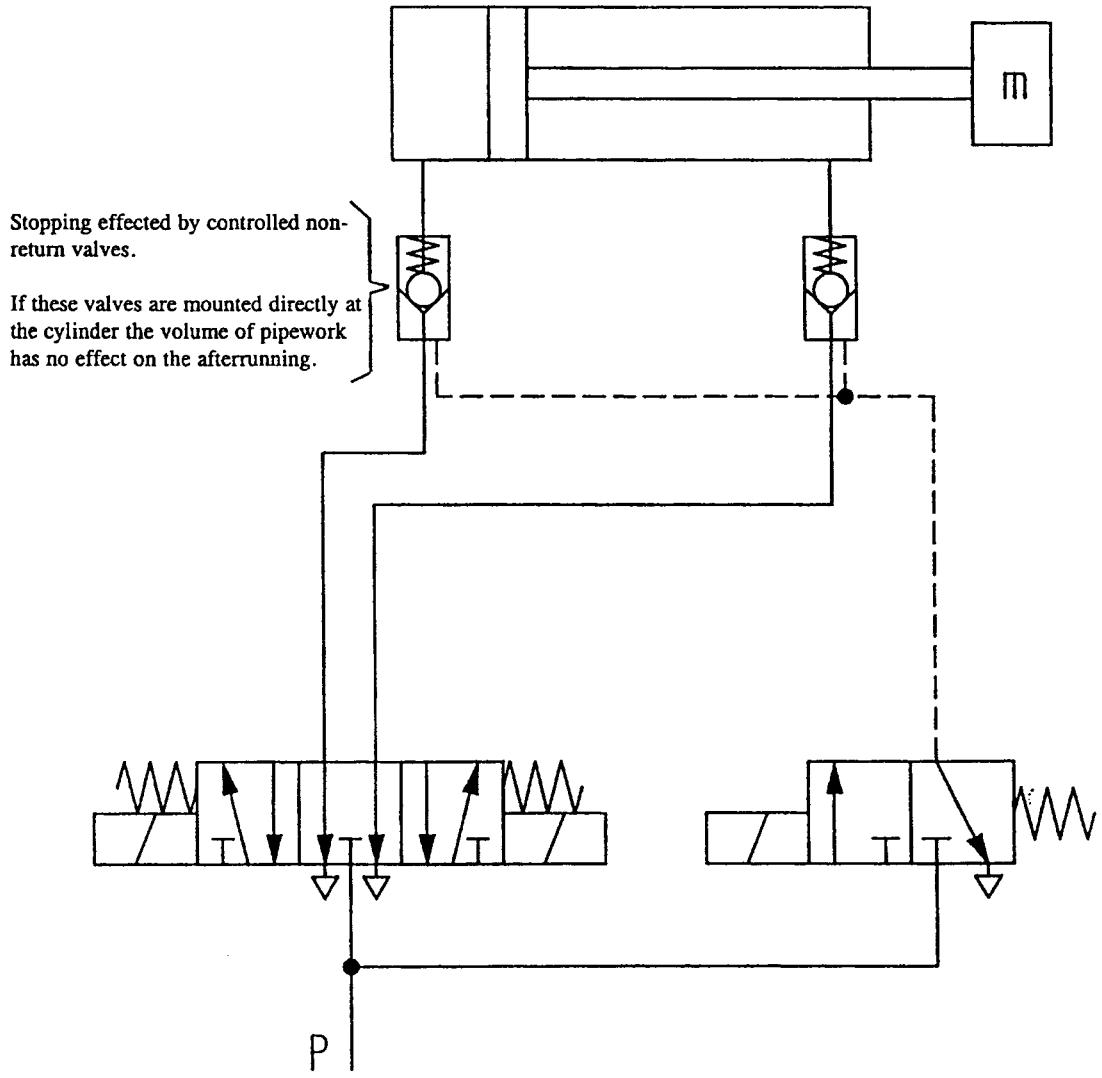


Figure A.16 Stopping of horizontally moving masses; scheme Pn 7

Example of connection for movements with higher kinetic energy.

Operational intervention necessary occasionally or at cyclic intervals.

Annex A (normative)

Examples of connection for 3.8 of EN 292-2 *Preventing hazards from hydraulic and pneumatic equipment* *(continued)*

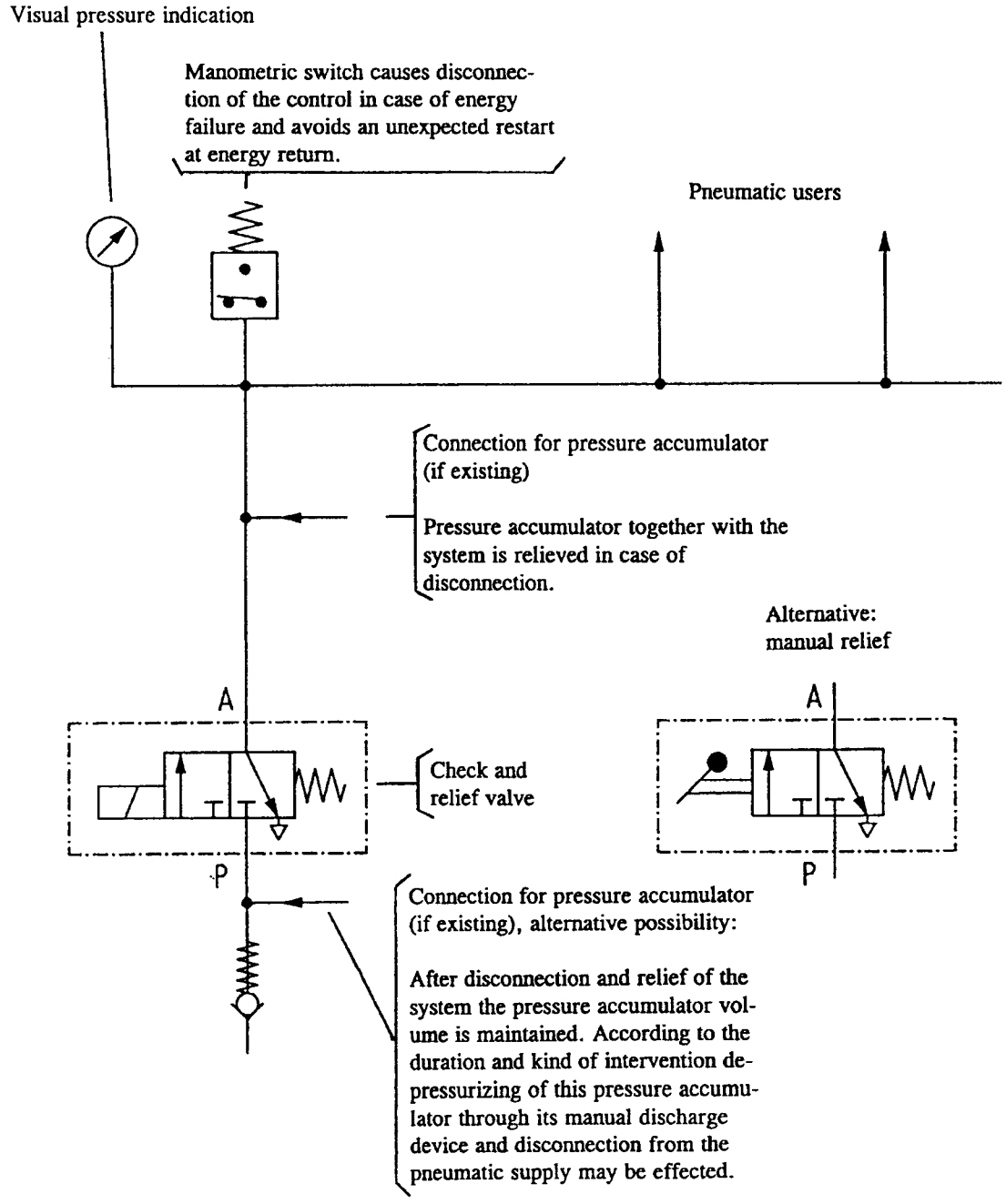
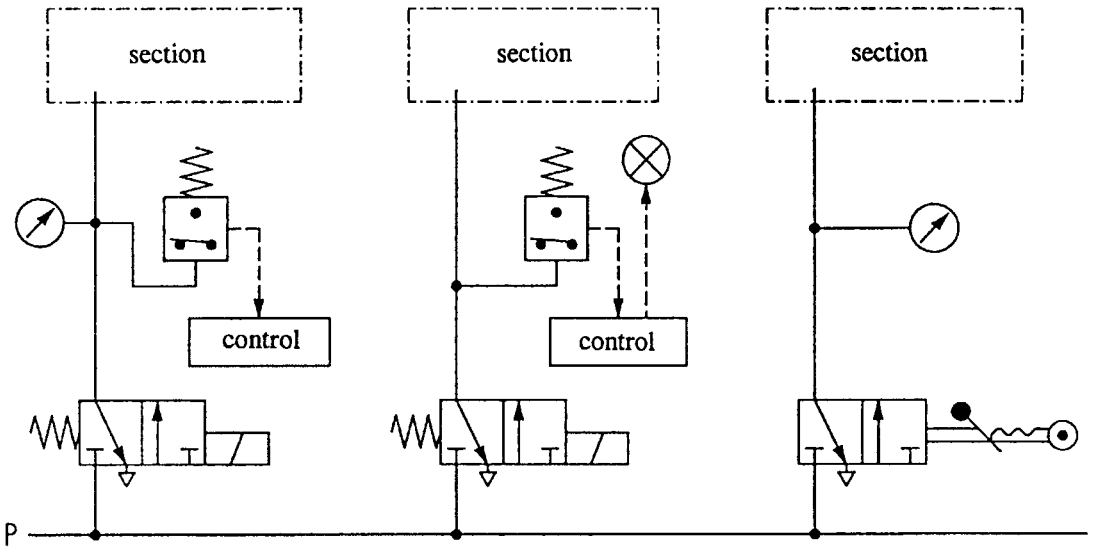


Figure A.17 Pressure relief of pneumatic systems; scheme Pn 10

Examples for connection for pneumatic systems with or without pressure accumulator.
Total shut-down.

Annex A (normative)

Examples of connection for 3.8 of EN 292-2 *Preventing hazards from hydraulic and pneumatic equipment* *(concluded)*



Check and relief valve:		Manual shut-down and relief possibility:
Visual pressure indication	Electrical "pressure" remote indication	Visual pressure indication
The electrical monitoring of position and corresponding processing by the control is:		Valve lockable in "OFF" position
here equalized with the lockability of the manual shut-down and relief possibility	here equalized with the lockability of the manual shut-down and relief possibility and the visual pressure indication	
Depressurizing of preceding pressure accumulators and disconnection from pneumatic supply is not obligatory.		

Figure A.18 Pressure relief of pneumatic systems; scheme Pn 11

Examples of connection for pneumatic systems with or without pressure accumulator.
Disconnection of particular sections.

Annex B (informative)

Main components of hazardous gases and fumes during the application of moulding material binders and coatings for cores and moulds

B.1 List of components

	Formaldehyde	Other alcohols	Furfurylalcohol	Phenol	Cresol	Benzene	Carbon monoxide	Sulfur dioxide	Triethylamine	Dimethylethylamin	Methylformate
Betaset-method	X										X
SO_2 - method								X			
Pouring line						X	X				
Coatings for cores and moulds		X									
Cold-setting oils and core-oils											
Hot box method, furane resin	X		X								
Hot-box method phenolic resin	X			X	X						
Shell-core method	X			X	X						
Urethane reactants (e.g. Cold-box method)									X	X	
Furane resin, Cold-setting	X		X								
Phenolic resin, Cold-setting	X			X	X						
Waterglass binder with carbonhydrate containing additions											
Clay-bonded moulding materials with pulverized coal											

Annex B (informative)

Main components of hazardous gases and fumes during the application of moulding material binders and coatings for cores and moulds *(concluded)*

B.2 Main components

For supervision of noxious matters for job evaluation the procedures mentioned in table B.1 and the corresponding main components should be considered in particular.

B.3 Evaluation of concentration

It is recommended to take the following aspect into account when taking decisions about the necessity and the extent of technical measures.

The sum of the partial concentrations (weighted according to the limiting value) of the recommended main components should not exceed the value of 1.

$$\frac{C_1}{LV_1} + \frac{C_2}{LV_2} + \frac{C_3}{LV_3} + \frac{C_n}{LV_n} \leq 1$$

$$\sum_{i=1}^{i=n} \frac{C_i}{LV_i} \leq 1$$

for all $\frac{C_i}{LV_i} \geq 0{,}1$

Values $\frac{C_i}{LV_i} \leq 0{,}1$ are not considered

C_1, C_2, C_3 and C_n signify the concentrations and LV_1, LV_2, LV_3 and LV_n the corresponding limiting values.
In case of exceeding the evaluation index, measures for the reduction of noxious matters should be taken.

B.4 Example

The following evaluation index marks $\frac{C}{LV}$ of noxious matters have been determined at the base of a shell-moulding plant with phenol-cresol resins.

Noxious matter	**Concentration** C (ppm)	**Limiting value** LV (ppm)	**Evaluation index mark** $\frac{C}{LV}$
Formaldehyde	C_F	LV_F	$\frac{C_F}{LV_F} = 0{,}8$
Cresol	C_C	LV_C	$\frac{C_C}{LV_C} = 0{,}08$
Phenol	C_P	LV_P	$\frac{C_P}{LV_P} = 0{,}08$

The sum value of the partial concentrations weighted according to the limiting value.

$\sum_{i=1}^{i=n} \frac{C_i}{LV_i}$ amounts for the main components formaldehyde and phenol 0,8 + 0,4 = 1,2

The evaluation index of the main component Cresol, that is with 0,08 lower than 0,1, is not considered in the sum value calculation.

Annex C (normative)
Hazardous areas and corresponding preventative measures

C.1 Example of a coremaking machine (see 5.4)

Description of the position numbers used in figures C.1 and C.2:

– **Position 1.1:** Control panel: control systems, e.g. for interlocking of the clamping position of the core box, the frictional connection of core box and shoot head with the shoot process, see figure C.1 and operating procedure c) in figure C.2:

see **5.1.6**;

see **5.8** and **3.7.5**, **3.7.6** and **3.7.8** to **3.7.10** of EN 292-2;

– **Position 1.2:** Interlocking of the gassing process with the position of the gassing plate and the negative pressure of the exhaust system, see procedure d) in figure C.2. In case of curing-processes with fuel-heated core-boxes: interlocking of the ignition process with the mode of operation 'manual/setting' to avoid automatic ignition during troubleshooting;

– **Position 1.3 to 1.8:** Pneumatic/hydraulic equipment, see position 1.3 in figure C.1, procedures b), c) and f) in figure C.2 and annex A.

Pressure release valve for the control system (position 1.3 in figure C.1) to cut off unintentional movements of:

– the filling slide (position 1.4 in figure C.2);

– core-box parts (position 1.5 in figure C.2);

– shooting/sand filling/gassing plate (position 1.6 in figure C.2);

– lifting table, pattern plate;

and check valve to prevent declamping of:

– core-box parts (position 1.7 in figure C.2); or

– lifted components e.g. shoot head (position 1.8 in figure C.2), shoot plate and gassing plate;

see **5.1.6** and **3.8** of EN 292-2;

– **Position 2.1:** Capability of core-box supports to withstand mechanical and pneumatical forces due to air pressure, see procedure c) in figure C.2: see **3.3** of EN 292-2;

– **Position 3.1:** Fixed enclosing guard, see example of a housing in figure C.1: see **5.1.1**;

Protection against mechanical hazards and unintentional ejection of sand, containment of gases and noise; see **3.22.1** of EN 292-1 and **3.6.3** and **4.2.2.1** of EN 292-2;

– **Position 3.2:** Movable guards for maintenance, setting and troubleshooting, see figure C.1: see **5.1.2.1** and **3.22.4** of EN 292-1; maintenance and setting activities inside the machine see **5.8**;

– **Position 3.3:** Movable guard for core discharge, see figure C.1: see **5.1.2.1**, **5.1.2.3**, **5.1.2.4** and **3.22.4** of EN 292-1.

Annex C (normative)
Hazardous areas and corresponding preventative measures *(continued)*

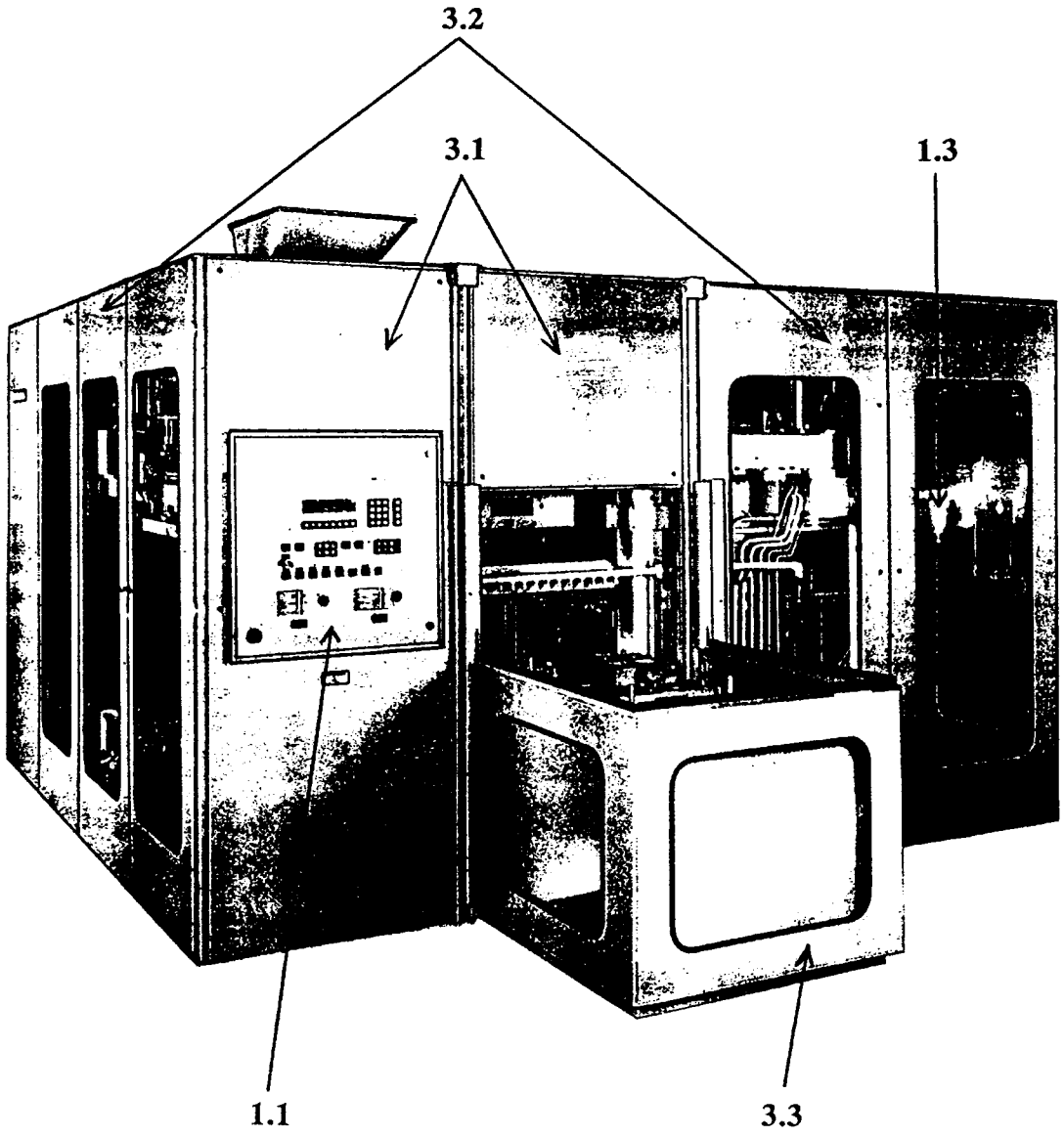


Figure C.1 Hazardous areas and corresponding preventative measures
Example: type of coremaking machine (see **5.4**).

Annex C (normative)
Hazardous areas and corresponding preventative measures *(concluded)*

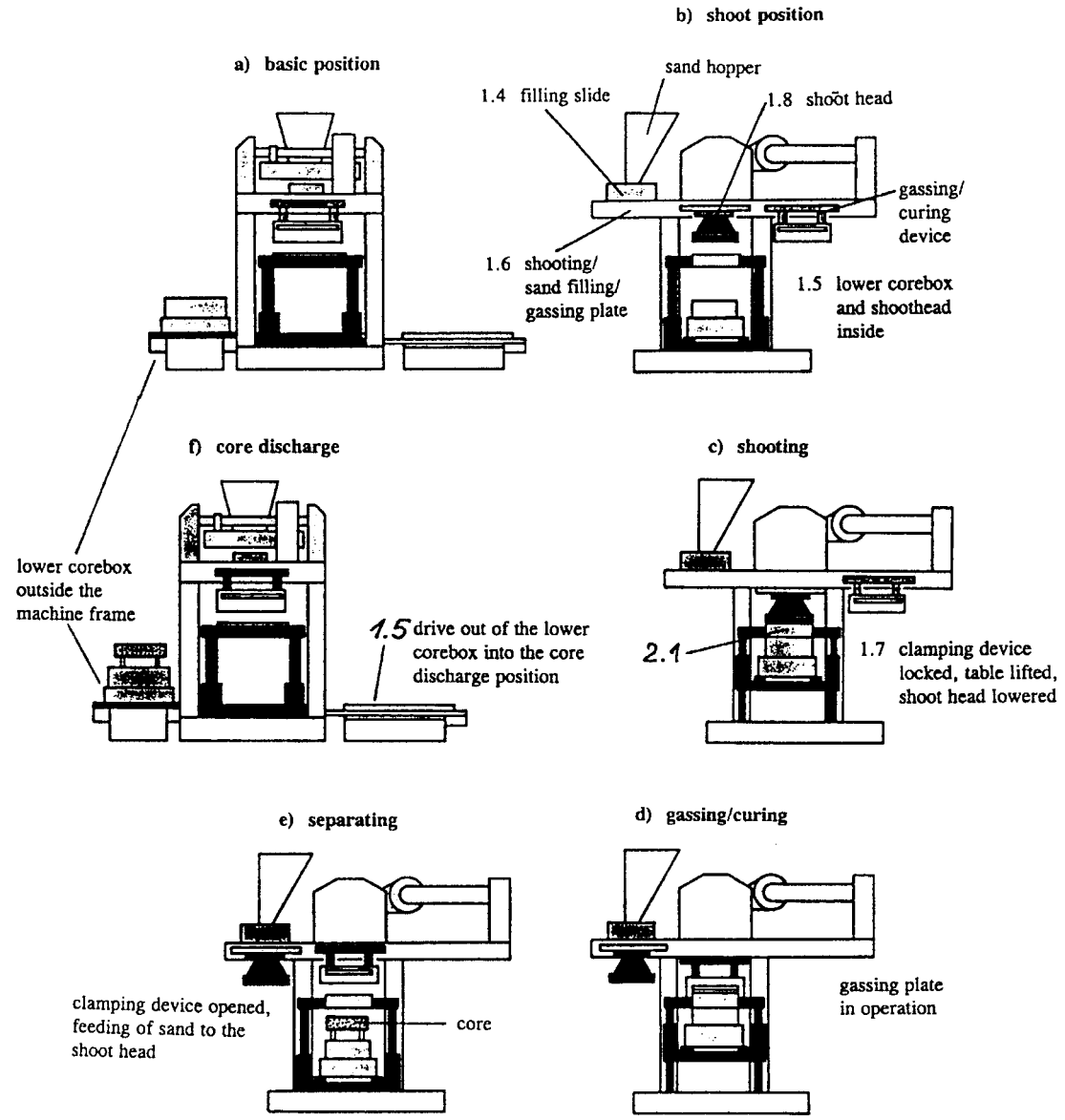


Figure C.2 Hazardous areas and corresponding preventative measures
Example: type of coremaking machine at different operating procedures a) to f) (see **5.4**).

Annex ZA (informative)

Clauses of this European Standard addressing essential requirements or other provisions of EU directives.

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 the following EU Directives:

Machinery Directive	89/392/EEC;
its amendments	91/368/EEC, 93/44/EEC and 93/68/EEC;
Low Voltage Directive	73/23/EEC.

Compliance with the clauses this standard provides one means of conforming with the specific essential requirements of the Directive concerned and associated EFTA regulations.

WARNING: Other requirements and other EU Directives may be applicable to the product(s) falling within the scope of this standard.

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