BRITISH STANDARD

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Foundry machinery — Safety requirements for ladles, pouring equipment, centrifugal casting machines, continuous and semi continuous casting machines

The European Standard EN 1247:2004 has the status of a British Standard

ICS 25.120.30

National foreword

This British Standard is the official English language version of EN 1247:2004.

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

— aid enquirers to understand the text;

— present to the responsible international/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.

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Foundry machinery - Safety requirements for ladles, pouring equipment, centrifugal casting machines, continuous and semi continuous casting machines

Machines de fonderie - Prescriptions de sécurité concernant les poches, les matériels de coulée, les machines à couler par centrifugation, les machines à couler en continu ou en semi-continu

Gießereimaschinen - Sicherheitsanforderungen für Gießpfannen, Gießeinrichtungen, Schleudergießmaschinen, kontinuierliche und halbkontinuierliche Stranggießmaschinen

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Contents

Foreword

This document (EN 1247:2004) has been prepared by Technical Committee CEN/TC 202 “Safety requirements of 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of an identical text or by endorsement, at the latest by February 2005, and conflicting national standards shall be withdrawn at the latest by February 2005.

This document has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association, and supports essential requirements of EU Directive(s).

For relationship with EU Directive(s), see informative Annex ZA, which is an integral part of this document.

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Introduction

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

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

When provisions of this type C standard are different from those which are stated in type A or type B standards, the provisions of this type C standard take precedence over the provisions of the other standards, for machines that have been designed and built according to the provisions of this type C standard.

This document covers: the equipment concerned, the hazards and hazardous situation as well as all events during construction, operation and maintenance normally foreseeable.

1 Scope

This document specifies requirements to be met by the manufacturer for the foreseeable significant hazards due to design, construction and installation, during commissioning, operation, maintenance, and decommissioning of the following machines and equipment which are used directly and indirectly for the manufacture of castings:

— Ladles;

— Pouring equipment;

— Centrifugal casting machines for production of tubes (only machines with horizontal or oblique axis of rotation);

— Continuous and semi continuous casting machines for non-ferrous metals.

This document specifies the safety requirements in addressing the following items:

— controls;

— protection against:

  — mechanical hazards, movement of machines and material, ejection of parts, material, liquids and gases, implosion, structural instability;

  — electric hazards;

  — explosion, fire, scalds, contact with hot parts (burns), gases and flames;

  — noise and vibration;

  — thermal radiation;

  — harmful by-products, poisoning, pollution of operators air;

  — impact;

  — deterioration of worker’s health;

  — shearing;

  — crushing;

— maintenance, provision for warning systems.

It is assumed that

— normal operation of equipment falling within this scope may involve the intervention of personnel;

— machines are operated by skilled and adequately trained persons;

— machines are used with adequate workplace lighting conforming to local regulations, or to EN 12464-1.

This document does not specify the safety requirements for machines in combination and for ancillary plant, melting, holding, drying and/or heating equipment, crane installations, winches, conveyors or handling systems which could be an integral part of the above equipment, or ladles which are specific to steelworks or ladles forming part of a crane or ladles for pouring by a casting machine or vessels used for molten metal transport on public highway, or continuous or semi continuous casting equipment which is specific to steelworks, or ladles which are carried by hand.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN 349:1993, *Safety of machinery — Minimum gaps to avoid crushing of parts of the human body.*

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

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

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

EN 746-2:1997, *Industrial thermoprocessing equipment — Part 2: Safety requirements for combustion and fuel handling systems.*

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

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

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

EN 1070:1998, *Safety of machinery — Terminology.*

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

EN 1265:1999, *Noise test codes for foundry machines and equipment.*

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

EN 60519-1:1993, *Safety in electroheat installations; Part 1: General requirements (IEC 60519-1:1984).*

EN 61310-1:1995, *Safety of machinery — Indication, marking and actuation — Part 1: Requirements for visual, auditory and tactile signals (IEC 61310-1:1995).*

EN 61310-2:1995, *Safety of machinery — Indication, marking and actuation — Part 2: Requirements for marking (IEC 61310-2:1995).*

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

EN ISO 11688-1/AC:1998, *Acoustics — Recommended practice for the design of low-noise machinery and equipment — Part 1: Planning (ISO/TR 11688-1:1995).*

EN ISO 12100-1:2003, *Safety of machinery — Basic concepts, general principles for design — Part 1: Basic terminology, methodology (ISO 12100-1:2003).*

EN ISO 12100-2:2003, *Safety of machinery — Basic concepts, general principles for design — Part 2: Technical principles and specifications (ISO 12100-2:2003).*

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

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

EN ISO 14122-3:2001, *Safety of machinery — Permanent means of access to machinery — Part 3: Stairs, stepladders and guard-rails (ISO 14122-3:2001).*

prEN ISO 14122-4:2002, *Safety of Machinery — Permanent means of access to machinery — Part 4: Fixed ladders (ISO/DIS 14122-4:1996).*

ISO 7745:1989, *Hydraulic fluid power — fire-resistant (FR) fluids — Guidelines for use.*

CENELEC R044-001, 1999, *Safety of machinery — Guidance and recommendations for the avoidance of hazards due to static electricity.*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in EN 1070:1998 and the following apply.

3.1
Ladle
tiltable vessel with or without hanger with or without refractory lining designed to contain, transport and discharge molten material (see Annex B, Figures B.1 and B.2).

NOTE The tilting movement is often achieved by power driven tilting drives. Sometimes ladles are bottom discharging. In this case discharging is achieved by moving a stopper rod (see Annex B, Figure B.2) or a hydraulically or pneumatically driven bottom slide gate nozzle. Ladles are usually transported by hoists and have their own hanger which is integral to the ladle. Sometimes ladles are transported by floor based trucks or fork lift trucks.

3.2
tundish
refractory lined vessel with a discharge at its bottom which may be interposed between the ladle and the mould in teeming

3.3
pouring equipment
mechanically or electrically driven device (see Annex B, Figure B.6) which stores and delivers molten metal to the mould as part of an automatic or semi automatic integrated casting plant

NOTE: This equipment consists of a vessel, heated or unheated, with or without a metering device, for delivery of molten metal to the mould by gravity, or by applying air or inert gas pressure or vacuum onto the surface of the molten metal in the vessel. Heated vessels are also called furnaces.

3.4
centrifugal casting machine
machine to manufacture tubes by centrifugal means. The axis of the tube coincides with the axis of rotation and where the thickness of the tube is determined by the dimensions of the mould and the amount of metal cast (see Annex B, Figure B.7). The said axis may be horizontal or oblique (vertical axis of rotation is excluded, see Clause 1)

3.5
continuous and semi continuous casting machine
machine which provides a regular or intermittent supply of liquid metal (for this document: non-ferrous metal only, see Clause 1) to a mould, from where the solidified product leaves under gravity or by powered means

Depending upon the direction in which the bar leaves the tundish distinction is made between vertical and horizontal casting. Additionally, distinction is made between continuous and semi continuous casting as to whether the bar is cast without interruption and cut with a flying saw or is stopped after reaching a determined length and is then completely removed from the equipment.

In the non-ferrous metals sector the semi continuous casting process is mainly used.

3.6
metering
monitoring the amount of liquid metal

3.7
breakthrough
refractory lining of the pouring equipment is penetrated by molten metal

3.8
stripping/ejection of castings
removal of the centrifugal casting from the mould after solidification

3.9
self-locking gear
a gearbox meets the requirements for self-locking, if the following test gives evidence: the ladle is bottom-placed and removed from the hook; the hanger is moved to a inclined position at approx. 45 degree . The hanger shall be kept in this position by the gearbox. This requirement for self-locking applies for vibration-less conditions only

3.10
refractories
material being resistant to high temperatures with a high refractoriness under load for the bricking up and lining of pouring equipment and ladles

4 List of hazards

Hazardous situations are those where the risk of being injured through hazardous movements (e. g., squeeze or shear points) or sources of hazard exists (e. g., hazardous materials, conduction and radiation of heat, ejection of molten or very hot metal, explosion, ignition of hydraulic or lubrication fluids, unexpected discharge of molten metal).

A parameter for the level of safety measures to be applied is the risk of accident to be expected, the extent of which depends upon the highest foreseeable degree of severity and effect as well as the probability of an injury, e. g., exposure to risk (frequency of intervention or access or duration of stay in a danger zone). Movable safeguards or facilities with guarding functions in danger zones with fixed cycle intervention or access (e. g., during filling with molten metal or periodical manual cleaning or trouble shooting) require a special degree of safety against unexpected start up or dangerous movements, as well as against hazardous sources and failure of relevant safeguards and control systems.

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

This assessment formed the basis for determining

a) potentially hazardous situations having significant risks;

b) the safety requirements and/or measures which shall be incorporated into the machinery/equipment;

c) any information describing the intended uses which shall be communicated to the user.

The significant hazards and hazardous situations identified are listed in columns 1 and 2 of Clause 5, Table 1.

Before using this document it is important to carry out a risk assessment of the machine in question to check that the machine has the same hazards identified in Clause 5. For hazards not covered by this document the principles contained in EN ISO 12100-1 and EN ISO 12100-2 shall be applied.

5 Safety requirements and/or measures

5.1 General

5.1.1 Machines conforming to this document shall comply with the safety requirements and/or measures set out in this Clause together with those set out in Clause 7. Relevant hazards identified in the risk assessment carried out by the manufacturer but not dealt with in this document shall be reduced by applying the principles of EN ISO 12100-2.

For hazards which are to be reduced by the application of a B document such as, e. g., EN 294, EN 418, EN 563/A1/AC the risk assessment carried out by the manufacturer shall establish the requirements of the B standard which are to be applied. This specific risk assessment shall be part of the general risk assessment of the machine.

5.1.2 Where the means of reducing the risk is by the physical arrangement or positioning of the installed machines, the manufacturer shall include in the Information for use a reference to the reduction means to be provided, and to any limiting value of the requirement, and, if appropriate, to the means of verification.

5.1.3 Where the means of reducing the risk is by a safe system of working, the manufacturer shall include in the Information for use details of the system and of the elements of information required by the operating personnel. This shall include arrangements to run a machine for essential operating reasons or in special mode with safety devices suspended or temporarily modified.

5.1.4 It is recognised that a general hazard exists of exposure to high temperature surfaces which may be touched and which is not practicable to eliminate. The manufacturers information for use shall contain guidance to the user on the preventative measures to be used in connection with contact to hot surfaces and the need to provide the operator(s) with PPE as appropriate.

5.1.5 Access to a danger zone is required for any reason during normal operation, e. g., commissioning, setting up, production, maintenance, decommissioning (see 5.2.3 of EN ISO 12100-2:2003). The safety related control system of the machines and equipment shall be in accordance with the appropriate category given in EN 954-1, at least category 3, except for hydraulic equipment which shall be at least category 1.

If access to machines and equipment specified in this document is required for repairs, the measures outlined in 5.5.4 of EN ISO 12100-2:2003, shall apply, where all movements shall be made safe.

5.1.6 Required guards and enclosures shall be made in such a way that injuries caused by metal eruptions are prevented.

5.1.7 Table 1 is a comprehensive presentation of significant hazards, the safety requirements to reduce risks, and the means of verifying their presence:

— Column 1 identifies the significant hazards;

— Column 2 identifies the situations that give rise to the hazards;

— Column 3 identifies the risk reduction measures to be applied for the significant hazards and hazardous situations. They shall be provided in a cumulative manner if not otherwise stated;

NOTE When implementing safety requirements and/or measures it has to be considered that different hazards may appear at the same time.

— Column 4 identifies the method to be used to demonstrate conformity; the abbreviations V, F, M and D are defined as follows:

V: Visual inspection verifies the required features of the components.

F: A functional check/test verifies that the features provided perform their function in such a way that the requirement is met. If a functional check is necessary, the manufacturer shall give details in the instruction handbook (see 7.3).

M: Measurement verifies that requirements are met, to the specified limits.

D: Drawings and/or calculations verify that the design characteristics of the components provided meet the requirements.

Verification may involve more than one method.

Table 1 — Safety requirements and/or measures

Column 1	Column 2	Column 3	Column 4
Hazard	**Hazardous situation**	**Safety measures according to the mentioned standards AND/OR specific measures**	**Verifi-cation**
5.2 Ladles			
5.2.1 Fire, burns	— Discharge of molten metal or slag due to unexpected tilting in case of: — manual tilting	— Locking device for ladles tilted by hand. — A self-locking gear shall be installed by the manufacturer which is fitted to the forces under operation such that tilting movements are under the control of the operator at all operations. Tilting test shall be carried out with inclined hanger (see 3.9).	D, F (see Clause 6)
	— motorised tilting	— The tilting movement shall be activated only when energised through a hold-to-run control device, placed where its operator has a full and unrestricted view of the ladle and the receiver vessel/container.	F
	— centre of gravity above trunnion axis, e. g., by modification of nominal capacity by the user (e. g., use of smaller linings)	— The manufacturer shall ensure that the centre of gravity is always below the trunnion axis at all operating conditions. He shall advise the user in the Information for use that — any modification shall maintain this condition and — the conditions due to gearing and maximum operating load shall be given.	D
	— Loss of self-locking of gear in case of gear ladles that are tilted by hand.	— Lubricants shall not prevent the self-locking of ladle gears. — Information for use shall include advice that the gear function shall be checked before every shift (see 7.3.1).	

Table 1 *(continued)*

Column 1	Column 2	Column 3	Column 4
Hazard	**Hazardous situation**	**Safety measures according to the mentioned standards AND/OR specific measures**	**Verifi-cation**
	— Insufficient connection between — trunnion and ladle (centre band) — vessel and bottom	— Ladle trunnions shall be inserted concentrically into the centre band and positively fixed by welding (see Annex B, Figure B.1).	V, D
		— Ladle bottoms shall be dished or strengthened with gusset plates (see Annex B, figures B.3, B.4 and B.5).	V, D
		— Using qualified welders and certificated procedures (see EN 287-1, EN 719, EN 729-1).	V, D
	— Worm wheel of the ladle gear without mechanical safety device.	— Safety device shall be fixed by mechanical means, e. g., key and not rely on friction.	V, D
	— Breakage of gear parts.	— Ladle gearing shall be designed to withstand the calculated and foreseen dynamic loads during lifting and transportation.	V, D
		— Information for use shall include advice that impacts to the gear shall be prevented (see 7.3.1).	V
	— Breakthrough of the ladle and unexpected discharge of molten metal.	— Information for use shall include advice that the ladle shall only be used after refractory material has been applied in accordance with the refractory manufacturer's instructions.	V
	— Unexpected discharge from a bottom pouring ladle caused by unintended actuation of the stopper rod equipment.	— The stopper rod equipment (see Annex B, Figure B.2) shall be designed to prevent unintended or accidental actuation, e. g., by a mechanical locking device.	D, F (see Clause 6)
		— Information for use shall include advice about the need to inspect and renew the stopper at necessary intervals.	V, D
5.2.2 Explosion, burns	— Moisture existing in the lining of the ladle.	— Vents shall be provided for certain types of linings. — Information for use shall include a note that the lining shall be heated and the moisture shall be removed in accordance with the refractory manufacturer's instructions (see 7.3.1).	V
	— Bottom pouring ladles	— Information for use should advise the user that pouring zones and ladle filling areas in which bottom pouring ladles are used should have provisions to accommodate molten metal leakage (e. g., sand pits, pit moulds).	

Table 1 *(continued)*

Column 1	Column 2	Column 3	Column 4
Hazard	**Hazardous situation**	**Safety measures according to the mentioned standards AND/OR specific measures**	**Verifi-cation**
5.2.3 Impact, burns	— Unexpected upset of hanger or ladle.	— Ladles shall be provided with devices to prevent ladle turning during transport and filling, e. g., by a locking pin or mechanical latch. NOTE Hazards due to ladles directly lifted by cranes or casting machines are not covered by this document.	V, D
	— Hoisted ladle falling caused by break, tear out and wear of parts of the ladle and hanger.	— The manufacturer shall design the hoist-ladle such that at a minimum there is no permanent deformation with stress of 20,000 cycles at 2x the intended max. operating load. — If necessary protection of hanger against radiant heat shall be provided, e. g., by a heat shield (see Annex B, Figure B.1). — The manufacturer and welders shall be certified for welding conditions on this equipment (see EN 287-1, EN 719 and EN 729-1). — Welding that requires special treatment shall be done prior to the final heat treatment if appropriate. — Information for use shall provide instructions that — before each use there shall be visual inspections for apparent deficiencies such as missing parts, corrosion, deformation and points of visible overheating of the material and in particular the self-locking of the gear and — at regular intervals there shall be inspections of all stressed components of the assembly by qualified personnel for — cracks, wear, corrosion, deformation, distortion, — missing parts, — points of visible overheating and — loss of self-locking of the gear. Stressed components are: — hangers and hanger connections, supporting arms of hanger, tilt gear parts and supporting parts of the ladle exposed to radiation or direct heat; — hanger connections and gear fittings stressed by mechanical vibrations during transport;	D V, D

Table 1 *(continued)*

Column 1	Column 2	Column 3	Column 4
Hazard	**Hazardous situation**	**Safety measures according to the mentioned standards AND/OR specific measures**	**Verifi-cation**
		— strengthening bands of ladle walls and bottom that may be weakened by corrosion and — trunnions. — Detection for cracks shall be performed by a proven non-destructive test method, e. g., magnetic particle inspection process, ultrasonic or equivalent methods. The results of the tests shall be recorded.	M
5.2.4 Burns, impact	— Transport by industrial truck (not on public highway). — Ladles slipping from the forks of an industrial truck.	— If the ladle is intended to be transported by industrial truck it shall be fitted with the means for lifting by industrial truck and the manufacturer shall include information in the Information for use suitable industrial truck facilities and methods of operation.	V, D
5.2.5 Burns, fumes	— If liquid metal is treated with magnesium there is a risk of spattering and/or delayed reactions.	— The space for treatment ladles shall be enclosed during treatment to prevent spattering of liquid metal. — Information for use shall include information — to provide means to remove toxic or reaction fumes and — how to protect area open to personnel against spattering of liquid metal, e. g., by shields and — to provide PPE.	V, D
5.3 Pouring equipment			
NOTE Hazards and safety requirements of plant and equipment for liquid phase treatment are given in prEN 746-6:1994.			
5.3.1 Lack of stability	— Unintended tilting during tilting or in a tilt stop position due to any cause.	— Provide by design: — hold-to-run control device. The tilting movement shall be activated only when energised through a hold-to-run control device, placed where its operator has a full and unrestricted view of the ladle and the receiver vessel/container and — controlled non-return valves or directional valves (directly attached at the hydraulic cylinder) which turn off independently in case of pressure drop or — mechanically operated jacks (by hand, hydraulics, spring or gravity) and — device for manual re-tilting and — control system to provide means due to malfunction (see 5.3.12)	D D D
5.3.2 Crushing, shearing	— During tilting or movement of equipment.	— Design safety distances, grids, guards, trip devices	V, D

Table 1 *(continued)*

Column 1	Column 2	Column 3	Column 4
Hazard	**Hazardous situation**	**Safety measures according to the mentioned standards AND/OR specific measures**	**Verifi-cation**
5.3.3 Burns	— Metal eruptions caused by:		
	— excess pressure in the vessel or metal level below the minimum heel level required to maintain the siphon effect or	— Pressure limitation and display for minimum heel level of the vessel (see Annex B, Figure B.6)	V, D
		— Fixed guards (see EN 953)	V, D
	— damaged siphon refractories losing the siphon effect or	— Covers or lids on filling gate and pouring spout and	V, D
	— cracks in the refractories.	— Protective walls and roofing over operators desk. — Information for use shall provide — information about PPE, warning signs (see EN 61310-1; -2) and fault alarms. — instructions that equipment shall only be used in accordance with the refractory manufacturers' instructions (see 7.3.2).	V, D
	— cooling water coming into contact with liquid metal; — leakage of liquid metal into moist furnace pit;	— Monitoring (preferably automatic) of refractory lining in case of electric heated pouring equipment; — Protection of cooling pipes and hoses and	D V, D
	— use of equipment with refractory lining not fully dried.	— Where applicable, any furnace pit has to be designed such that water can flow off freely in case of damaged pipes and hoses and that no ground water can enter (see 7.3.2); — Information for use shall include a note that the lining shall be heated and the moisture shall be removed in accordance with the refractory manufacturer's instructions (see 7.3.2). — Information for use shall indicate the need for PPE (see 7.3.2).	V, D
	— Overfilling of the pouring equipment causes flow out of molten metal.	— Provide means such as automatic pressure relief if maximum permissible level in the pouring spout or pressure limit value inside or the pouring equipment has been exceeded.	V, D
		— Design to include provisions to re-tilt the pouring equipment to the neutral position, if necessary by manual means or auxiliary means.	V, D
5.3.4 Fire or explo-sions or burns	— If burner flame extinguishes the fuel may enter the vessel and suddenly ignite.	— See 5.2.6, 5.3.6 and 5.4.6 of EN 746-2:1997.	
	— Ejection of molten material from the vessel.	— Design of equipment to prevent uncon-trolled release of treatment gases.	D

Table 1 *(continued)*

Column 1	Column 2	Column 3	Column 4
Hazard	**Hazardous situation**	**Safety measures according to the mentioned standards AND/OR specific measures**	**Verification**
		— Information for use shall contain instructions on training of personnel (see 7.3.2) and shall indicate the need for personal protective clothing (see 7.3.1).	
	— When producing spheroidal graphite cast iron, magnesium vapour ignites in air when it discharges.	— Guard close to the pipes and valves where flammable gases could escape from the equipment.	V, D
	— Uncontrolled release and ignition of hydraulic fluids.	— Pipework and hoses for hydraulic fluids shall be protected against mechanical and thermal damage by the use of covers, shielding etc. and fixing means such as ducts and channels and — Hydraulic equipment shall be suitable for use with fire resistant hydraulic fluids (see ISO 7745 and Annex A). — Information for use shall include advice, that hydraulic fluids which contain poly-chlorinated bi phenyls (P.C.B.) and poly-chlorinated tri phenyls (P.C.T.) shall not be used (see 7.3.1).	V, D
5.3.5 Burns and scalds	— When there is cooling water failure, formation of vapour in cooling pipes and hoses can cause explosion danger.	— Provide standby emergency cooling in case there is cooling water failure. NOTE This provision should be made by agreement between the manufacturer and the user.	D
5.3.6 Explosions	— When there is a generation of explosive dusts or gases in a confined space, heat caused by, e. g., welding or hot gases can create an explosion when escaping, or a furnace door is opened.	— Design of equipment to prevent these generations. — Provide explosion reliefs where applicable. — Information for use shall indicate the need for a control procedure to prevent this situation, e. g., work permits for danger zones for preventative maintenance (see 7.3.3) or repairs.	D D
5.3.7 Thermal radiation	— Burns by contact or close proximity to hot parts during, e. g., — deslagging; — changing the stopper rod, or metal level control electrode; — pouring spout replacement; — maintenance; — opening the slag door; — opening the cover; — inductor replacement.	— Information for use shall indicate the need for: — Protective screens; — Warning signs (see EN 60310-1; -2); — Wearing personal protective clothing when potentially exposed and — Protection of operators work place, if applicable.	

Table 1 *(continued)*

Column 1	Column 2	Column 3	Column 4
Hazard	**Hazardous situation**	**Safety measures according to the mentioned standards AND/OR specific measures**	**Verification**
5.3.8 Light radiation	— Glare causing: — disorientation; — defective vision.	— Design of equipment to prevent this condition. — Information for use shall indicate the need for: — Warning notices in danger zones (see EN 60310-1; -2); — Using antiglare glasses where applicable (see 7.3.2).	V
5.3.9 Inhalation, ingestion of harmful dusts and fumes	— Deliberate or accidental use of potentially harmful operational process materials, e. g., chloride, fluoride, cadmium, lead, nickel.	— Adequate exhaust ventilation shall be provided, or operating manual shall include the need for its provision and maintenance (see 7.3.2, EN 626-1:1994 and EN 626-2).	V, D
5.3.10 Crushing, shearing, cutting or severing, entanglement, drawing, trapping, impact, friction, or burns	— Intended or unintended actuation of machine movements. — Unexpected movements or failure of the normal retaining or drive system whether mechanical, electrical, hydraulic or pneumatic. — Cooling water failure	— According to EN 1037 and EN 954-1 the control system shall ensure that automatic restart is prevented and re-actuation of the start control is always required to initiate powered movement following, e. g., any change of mode, selection of optional function, a system re-set, guard interlock interruption, restoration of adequate pressure or voltage or correction of a system failing.	D
5.3.11 Electrical shock	— Direct contact or indirect contact with live parts.	— See 10.1, 10.2, 10.3, 10.4, 11 and 12 of EN 60519-1:1993	D
	— Heat radiation or excessive temperature causes failure of electric isolation. — Inadequate connections and conductors. — Adjacent metallic parts under the effect of induced currents	— See 13 of EN 60519-1:1993	
5.3.12 Malfunction	— Impossibility of stopping the tilting in the best possible condition	— Emergency stop device(s) in accordance with EN 418. — Stop category 1 (9.2.2 of EN 60204-1:1997) shall be provided for the tilting movement of a pouring vessel to prevent flow-out of molten metal in tilting position. — Emergency switching off device: Push-button operated switches shall be used (see 10.8.2 of EN 60204-1:1997).	
5.3.13 Electrical shock, fire	— Electrostatic discharge	— 6.2 and 7.2.6 of CENELEC R044-001,1999	
5.4 Centrifugal casting machines			
5.4.1 Crushing, impact	— Stripping/ejection of castings.	— Design of the machine: — Control panel shall be remote from danger zone;	D

Table 1 *(continued)*

Column 1	Column 2	Column 3	Column 4
Hazard	**Hazardous situation**	**Safety measures according to the mentioned standards AND/OR specific measures**	**Verification**
		— Provision of interlocking guards with guard locking conforming to EN 1088 (see Annex B, Figure B.7).	V, D
	— Disintegration of parts of the die due to centrifugal force, e. g., die-lockings.	— Strength of the die and die-locking. — Information for use shall provide instructions of intended use, e. g., — speed limits (rpm) corresponding to the strength of the die and — pressure limits.	D
	— Uncontrolled over-speed of the drive (electronic controlled)	— Limiting of the speed (rpm) by proximity switches.	D
	— Mechanical rail guided cross transport of castings.	— Design equipment to prevent trapping of persons so that movements of the equipment do not cause danger.	D
	— Dies moving along pouring spouts and approaching end stops.	— Provide safety distances by location of parts, according EN 349.	V, D, M
	— Ejection or falling of the die from the bearing rollers.	— Design to prevent ejection or falling of die (see Annex B, Figure B.8), e. g. — fixed guides; — restraining pieces.	D
5.4.2 Burns, impact, crushing	— Machine integrated controlled tilting of the ladle, manually initiated.	— The tilting movement shall be activated only when energised through a hold-to-run control device, placed where its operator has a full and unrestricted view of the ladle and the receiver vessel/container.	D
5.4.3 Burns	— Discharge of molten metal due to — disintegration of parts (see also 5.4.1); — unintended loosening of die-lockings during rotation of the die; — unintended machine stop	— Centrifugally applied die-lockings shall be designed to prevent them loosening during casting operation. Die-lockings that are actuated pneumatically, hydraulically or electro-mechanically shall be designed in such a way that unlocking cannot occur before the solidification of the liquid metal. — The emergency stop device for the die rotation movement (see 5.4.9) shall correspond to 9.2.2 of EN 60204-1:1997, category 1, and EN 418.	D D, F (see Clause 6)
	— Shifting of movable and slewable pouring spouts.	— It shall be possible to fix pouring spouts positively prior to start of casting operation, e. g., by locking clamps.	V, D, F (see Clause 6)
	— Ejecting metal during rotation of the die.	— Coverings to protect against burns caused by ejection of molten metal shall be included and conformed to fixed guard (see 5.3.2.1 of EN ISO 12100-2:2003 and EN 953) with an inserted movable guard (see 5.3.2.3 of EN ISO 12100-2:2003, EN 953 and EN 1088).	V, D

Table 1 *(continued)*

Column 1	Column 2	Column 3	Column 4
Hazard	**Hazardous situation**	**Safety measures according to the mentioned standards AND/OR specific measures**	**Verification**
5.4.4 Fire, burns	— Uncontrolled release and ignition of hydraulic fluids	— Pipework and hoses for hydraulic fluids shall be protected against mechanical and thermal damage by the use of covers, shielding etc. and fixing means such as ducts and channels and — Hydraulic equipment shall be suitable for use with fire resistant hydraulic fluids (see ISO 7745 and Annex A) and — Information for use shall include advice, that hydraulic fluids which contain poly-chlorinated bi phenyls (P.C.B.) and poly-chlorinated tri phenyls (P.C.T.) shall not be used (see 7.3.1).	D
5.4.5 Noise	— Noise during operation.	— Noise reduction by design according EN ISO 11688-1 directly at source by, e. g., minimising acceleration masses, reducing rotational speed and on the transmission path by, e. g., acoustic enclosures, screens. The criterion for assessing the efficiency of the noise reduction measures are the actual noise emission values from the machine in relation to other machines of the same family and not the nature of the reduction measures themselves. — Information for use shall provide information regarding the use of PPE.	M
5.4.6 Crushing, shearing, cutting or severing, entanglement, drawing, trapping, impact, friction, or burns	— Intended or unintended actuation of machine movements. — Unexpected movements or failure of the normal retaining or drive system whether mechanical, electrical, hydraulic or pneumatic.	— The control system shall ensure that automatic restart is prevented and re-actuation of the start control is always required to initiate powered movement following, e. g., any change of mode, selection of optional function, a system re-set, guard interlock interruption, restoration of adequate pressure or voltage or correction of a system failing, according to EN 1037 and EN 954-1	D
5.4.7 Electrical shock	— Direct contact or indirect contact with live parts: — general	— 6.2.2, 6.2.5, 6.3.2, 6.3.3 and 6.4 of EN 60204-1:1997 shall be applied. — Warning signs (see 17.2 of EN 60204-1: 1997 and EN 61310) shall be provided at casings/enclosures which — have no supply disconnecting/ isolating device and/or — are not a control station and — are not a single device with its own enclosure (e. g., position switch).	D

Table 1 *(continued)*

Column 1	Column 2	Column 3	Column 4
Hazard	**Hazardous situation**	**Safety measures according to the mentioned standards AND/OR specific measures**	**Verifi-cation**
	— supply disconnecting/ isolating device (power off)	— A disconnector in accordance with 5.3.2.b of EN 60204-1:1997 or a circuit-breaker in accordance with 5.3.2.c of EN 60204-1:1997 shall be provided.	V, D
5.4.8 Malfunction	— Malfunction of position switches, interlocking guards, switching devices, trip devices and covered electrical devices (enclosures) due to ambient influences, e. g., dust, increased temperature (caused by liquid metal), radiation, spillage, accidental ground of control circuits.	— Emergency stop device in accordance with EN 418 as well as stop category 1 (9.2.2 of EN 60204-1:1997) shall be provided. — Interlocking guards and trip devices shall be equipped with position switches in accordance with 10.1.4 of EN 60204-1:1997. — Interlocking guards and trip devices as well as switching devices, covered electrical devices (see 12.4 of EN 60204-1:1997) shall be protected against ambient influences by — design (e. g., enclosures withstanding mechanical and thermal stresses, (heat) shields), — degree of protection, see EN 60529 and 12.3 of EN 60204-1:1997. Minimum requirement is IP 2X or IP XXB. Where the top surface of an enclosure is easily accessible, IP 4X or IP XXD. Ventilated enclosures with air cleaning, IP 32. If protection against dust is necessary, IP 65.	
5.4.9 Impossibility of stopping the machine in the best possible conditions.	— Malfunction of the machine	— Emergency stop device(s) in accordance with EN 418 and — Stop category 1 (9.2.2 of EN 60204-1:1997) shall be provided for the rotational move-ment of the die and the interlocking of the die locking before solidification of the liquid metal. — Emergency switching off device: Push-button operated switches shall be used (see 10.8.2 of EN 60204-1:1997).	
5.5 Continuous and semi continuous casting machines for non-ferrous metals			
5.5.1 Crushing and shearing	— Approach of ladle to tundish or mould.	— The design shall conform to EN 349 or have installed acoustical and/or optical warning devices.	V, D, F (see Clause 6)
5.5.2 Burns	— Caused by leaking and eruption of molten metal during operation and malfunction.	— The pouring equipment (see 5.3) shall be designed in such a manner that liquid metal can be evacuated into areas specifically defined for this purpose. — Information for use shall include advice that escape ways shall have at least two different directions of escape.	D

Table 1 *(continued)*

Column 1	Column 2	Column 3	Column 4
Hazard	**Hazardous situation**	**Safety measures according to the mentioned standards AND/OR specific measures**	**Verifi-cation**
		— Information for use shall indicate the need for wearing personal protective clothing (see 7.3.1).	
	— Ejection or discharge of molten metal, e. g., exothermic reaction of aluminium caused by contact with corroded parts of the tundish or mould.	— In case of semi continuous casting of aluminium and aluminium alloys the walls of the casting pit and all equipment surfaces that may be struck by molten metal shall be properly coated and maintained with a protective layer of inorganic material (see 7.3.2) e. g., two-component epoxy coating or by use of stainless steel.	V, D
	— Moisture under the surface of the molten metal causing eruptions.	— Design of machine to limit cooling spray pressure until metal surface is solidified. — Information for use shall indicate to — use dry operating tools; — use dry casting powder (see 7.3.2) and — dry the mould and, if applicable, pre-heat the mould.	D
	— Overflow, overfilling	— Overrun conditions for the reception vessel (e. g., tundish) shall be defined.	V, D
	— Lining failures, metal leakages or breakouts from ladle or tundish.	— A means shall be provided to receive total amount of material in the feeding system. — Information for use shall indicate the need to protect metal overrun areas by guards (according to 5.3.2 of EN ISO 12100-2: 2003).	D
	— Ejection of molten products caused by uncontrolled spillage of fluids on the liquid metal bath.	— Design of pipes and cooling systems (e. g., couplings, flexible pipes) of the casting equipment in such a way as to minimise the spillage risk (see 4.10 of EN ISO 12100-2: 2003).	D
	— Eruption when flow of molten metal is disturbed.	— Alarm system shall be fitted to detect disturbance of automatic operation. — Controls and shutoff devices shall be provided in easily accessible places and shall be clearly marked.	V, D, F (see Clause 6)
	— Eruption or explosion caused when temperature of molten metal and/or casting speed are outside set tolerances before or during casting.	— Design of automatically operated equipment shall make provisions for visual and/or acoustical alarm in case of exceeding set tolerances. — For automated operation the design shall provide an automatic shutdown of the pouring operation when any process irregularity exceeds a pre-set limit.	V, D, F (see Clause 6)

Table 1 *(continued)*

Column 1	Column 2	Column 3	Column 4
Hazard	**Hazardous situation**	**Safety measures according to the mentioned standards AND/OR specific measures**	**Verifi-cation**
	— Eruption caused by failure of water flow.	— Emergency (cooling) water shall be available where necessary to terminate a cast safely (see 7.3.1). The machine shall incorporate visual and/or acoustical alarms to signal loss of cooling water.	D
		— Information for use shall include advice on the supply conditions for an emergency supply of cooling water such as flow rate and absence of particles which may clog orifices (see 7.3.1).	
5.5.3 Burns or scalds	— Leakage of molten metal into accessible casting pits.	— Design of the casting pit shall be such that the leaking metal is collected safely and	D
		— Doors shall be locked to prevent opening whilst casting metal and	
		— Manual opening from inside in direction of escape shall always be possible, e. g., by the use of panic handles.	V, D, F (see Clause 6)
	— Uncontrolled leakage of water onto molten metal due to overheated mould.	— The cooling water system (that is used to cool the mould and provide spraying) shall be designed so that water cannot flow into areas around the casting equipment where spattering of molten metal is possible.	D
		— The design shall ensure that all water flows away from the mould, e. g., by provision of — roof type covers and/or — aprons.	D
		— Any water leakage shall be evacuated into defined areas which take account of the volume concerned.	V, D
		— The cooling of the mould shall be designed in such a way that it discourages overheating and encourages the formation of a solidified metal skin of sufficient thickness to prevent breakout.	V, D
		— Equipment shall include means to monitor the cooling water flow rate, pressure and input and output temperatures on both sides of the mould.	V, D
		— All of the monitoring instrumentation shall control: a) Warning: When any user preset warning is given by acoustic and/or visual means, the operator shall make adjustments and b) Automatic shutdown: When any further user pre-set limit is exceeded, the metal flow shall be automatically stopped.	V, D

Table 1 *(continued)*

Column 1	Column 2	Column 3	Column 4
Hazard	**Hazardous situation**	**Safety measures according to the mentioned standards AND/OR specific measures**	**Verifi-cation**
		— Information for use shall provide information for maintenance and servicing of hydraulic and water cooling system (sealing, sedimentation, clogging, see 7.3.3) as well as the need to monitor water hardness (see 7.3.1).	V, D
		— The manufacturer shall make provisions such that an emergency power supply can be used to — shutdown automatic operation in a controlled manner by e. g., reliable mechanically actuated and operated stopping of metal flow from the ladle or tundish and maintain — pouring ladle transport; — tundish movement; — mould cooling (see 7.3.2).	V, D
	— Insufficient water level can lead to insufficient cooling causing leakage of metal.	— The water level in the casting pit shall be continuously monitored to ensure that it is between a high and low level limit.	V, D
5.5.4 Harmful fumes	— Possible inhalation of dangerous noxious or toxic fumes, dusts or gases.	— Information for use shall advice the user to: — install an exhaust system where appropriate and — provide personal protective equipment for use in emergency situations (see EN 626-1:1994 and EN 626-2). NOTE When using CO_2 for cooling the casting the exhaust system shall be designed to maintain an adequate oxygen content of air in the pit.	V, D
5.5.5 Falling from height	— Falls can occur at large plant when working above ground or furnace pits, e. g., during setting-up or maintenance.	— When manufacturer provides access platforms etc. they shall be adequate to safeguarded against falls (see EN ISO 14122-1, EN ISO 14122-2, EN ISO 14122-3 and prEN ISO 14122-4).	V, D
5.5.6 Noise	— Noise during operation	— The machine shall be designed so that risks from airborne noise emission are reduced by particular applying measures at source to control noise (see EN ISO 11688-1). The success of the applied noise reduction measures is assessed on the basis of the actual noise emission values in relation to other machines of the same family.	M
5.5.7 Electrical shock	— Direct contact or indirect contact with live parts: — general	— 6.2.2, 6.2.5, 6.3.2, 6.3.3 and 6.4 of EN 60204-1:1997 shall be applied.	D

Table 1 *(continued)*

Column 1	Column 2	Column 3	Column 4
Hazard	**Hazardous situation**	**Safety measures according to the mentioned standards AND/OR specific measures**	**Verification**
	— supply disconnecting/ isolating device	— Warning signs (see 17.2 of EN 60204-1: 1997 and EN 61310) shall be provided at casings/ enclosures which — have no supply disconnecting/ isolating device and/or — are not a control station and — are not a single device with its own enclosure (e. g., position switch). — A disconnector in accordance with 5.3.2.b of EN 60204-1:1997 or a circuit-breaker in accordance with 5.3.2.c of EN 60204-1:1997 shall be provided.	V, D
5.5.8 Malfunction	— Malfunction of position switches, interlocking guards, switching devices, trip devices and covered electrical devices (enclosures) due to ambient influences, e. g., dust, increased temperature (caused by liquid metal), radiation, spillage, accidental ground of control circuits	— Emergency stop device in accordance with EN 418 as well as stop category 1 (9.2.2 of EN 60204-1:1997) shall be provided. — Interlocking guards and trip devices shall be equipped with position switches in accordance with 10.1.4 of EN 60204-1:1997. — Interlocking guards and trip devices as well as switching devices, covered electrical devices (see 12.4 of EN 60204-1:1997) shall be protected against ambient influences by — design (e. g., enclosures withstanding mechanical and thermal stresses, (heat) shields), — degree of protection, see EN 60529 and 12.3 of EN 60204-1:1997. Minimum requirement is IP 2X or IP XXB. Where the top surface of an enclosure is easily accessible, IP 4X or IP XXD. Ventilated enclosures with air cleaning, IP 32. If protection against dust is necessary, IP 65.	
5.5.9 Impossibility of stopping the machine in the best possible conditions	— Malfunction of the machine	— Emergency stop device in accordance with EN 418 as well as stop category 1 (9.2.2 of EN 60204-1:1997) shall be provided. — Emergency switching off device: Push-button operated switches shall be used (see 10.8.2 of EN 60204-1:1997).	
5.5.10 Fire or explosions or burns	— If burner flame extinguishes the fuel may enter the vessel and suddenly ignite.	— See 5.2.6, 5.3.6 and 5.4.6 of EN 746-2:1997.	
	— Ejection of molten material from the vessel.	— Design of equipment to prevent uncontrolled release of pressuring gases.	D

Table 1 *(concluded)*

Column 1	Column 2	Column 3	Column 4
Hazard	**Hazardous situation**	**Safety measures according to the mentioned standards AND/OR specific measures**	**Verification**
	— Uncontrolled release and ignition of hydraulic fluids.	— Pipework and hoses for hydraulic fluids shall be protected against mechanical and thermal damage by the use of covers, shielding etc. and fixing means such as ducts and channels and — Hydraulic equipment shall be suitable for use with fire resistant hydraulic fluids (see ISO 7745 and Annex A) and — Information for use shall include advice, that hydraulic fluids which contain poly-chlorinated bi phenyls (P.C.B.) and poly-chlorinated tri phenyls (P.C.T.) shall not be used (see 7.3.1).	V, D

6 Verification of the safety requirements and/or measures

The verification of the safety requirements detailed in Clause 5 shall be carried out using the verification methods also shown in Clause 5. The verification of the safety requirements regarding noise shall be carried out by measurement and declaration of dual number noise emission values according to EN 1265 and EN ISO 4871. Where functional testing is involved the method of test shall be as defined by the manufacturer recognising independently described test procedures where these are appropriate. For example,

— testing of electrical safety shall be in accordance with the relevant Clauses of EN 60204-1.

— flammability of hydraulic fluids shall be proved by proven laboratory methods such as that described in Annex A.

— any tests on weld strength/suitability shall be confirmed by compliance with the test criteria detailed in the chosen non-destructive testing method used to conduct the test.

Verification shall take place after completion of manufacture of the machine or after commissioning. If partial disassembly is necessary, e. g., to gain access, it shall not affect the function being verified. Safety devices put out of action for verification shall be restored before verification is considered to be completed.

Tests involving danger to the safety of persons or equipment shall be carefully compiled, agreed and carried out under the guidance of an expert in the matters.

7 Information for use

7.1 Marking

A durable, legible and permanent plate containing at least the following information, where applicable, shall be applied to the equipment at a clearly visible point:

— name and address of the manufacturer;

— designation of series or type;

— mandatory marking[1)] ;

— serial number/machine number, if any;

— year of manufacture;

— designed for which type of metal.

Additionally on ladles only

— Nominal capacity with new lining (depending on the type of metal), also weight of empty ladle without lining.

The colour of a plate shall stand out from the background to which it is applied. The wording shall be easily legible from a safe distance.

7.2 Technical data and description of safety

The operating manual shall provide information concerning the avoidance of hazards and emissions like hazardous noises, vibration, radiation, gases and dusts.

Furthermore it shall provide information concerning safety devices and safety measures for intended use, transport, assembling, disassembling (e. g., protection against turning over, against falling of elevated parts), malfunction of programmable electronic systems, temperature, fire or explosive atmospheres, meaning of warning indicators, and give advice on clearances necessary for the safe operation of equipment.

7.3 Instruction Handbook

7.3.1 Manual

The manufacturer shall supply a manual with operating instructions for every machine. These instructions shall be accompanied by diagrams, drawing and leaflets, as appropriate, and shall in particular contain the following details (see 6.5 of EN ISO 12100-2:2003):

— rating plate details;

— type of equipment;

— safety and regulating equipment;

— nominal capacity;

— startup, operation and shutdown, maintenance and repair of safe systems;

— limitations as to its use;

— action in the event of faults or irregularities and abnormal conditions;

— references for preventing hazardous conditions;

— definitions of danger zones, where applicable;

— personal protective equipment for the hazards listed in Clause 5;

— declared noise emission values of the machine according to EN 1265;

— appliance of fire resistant hydraulic fluids;

1) For machines and their related products intended to be put on the market in EEA, CE marking as defined in the European applicable directive(s), e.g., Machinery, Low Voltage, Explosive Atmosphere, Gas appliances

— intervals for inspection, renew of spare and/or wear parts, where applicable;

— specify warning notices, where applicable;

— specify the users need to provide adequate working platforms, where appropriate;

— specify the users need to use appropriate lifting devices.

7.3.2 Training of the operative personnel

The manufacturer shall inform the user that the personnel operating the equipment or plant shall be well trained in the operation, and in the dangers associated with the process.

7.3.3 Maintenance Manual

A maintenance manual shall be provided. It shall contain instructions for testing to be carried out, also instructions for maintenance and repair work inclusive the protective measures against hazards mentioned in Clause 5.

It shall also emphasise those maintenance activities that require special knowledge or qualification, and it shall provide lists of spare parts with the designation of these spare parts, according to the information given in the construction plan and the circuit diagrams.

Annex A
(informative)

Methods of testing flammability of hydraulic fluids

A.1 General

In the absence of an accepted standard on the testing of flammability the method described in this Annex may be used.

A.2 Example 1 (German Technical Supervision Company TÜV)

A.2.1 Principle

A test of the hydraulic fluid is made on the surface of an aluminium bath. The time between the feeding of the hydraulic fluid and its ignition is determined.

A.2.2 Procedure

An aluminium bath at 800°C is held in a standard apparatus. The hydraulic fluid which is to be tested is fed in a full spurt on to the bath. The ignition of the fluid effects a temperature rise which is measured above from the bath.

The full procedure to ascertain the ignition delay is described in a German draft of the Technical Supervision Company TÜV.

A.2.3 Evaluation

The time taken to ignite is characteristic of the flammability of the hydraulic fluid. If, for unused fluid, the time between the charging of the hydraulic fluid to ignition is at least 20 s then it can be classed as "low flammable".

A.2.4 Source of supply:

Rheinisch-Westfälischer TÜV
Steubenstrasse 53

D-45138 Essen

Report No.: Bau/Vrn, 14. Mai 1986

A.3 Example 2 (7th Luxembourg report)

A.3.1 Test of the sprayed spurt

A.3.1.1 Principle

An acetylene/oxygen flame is directed to a spurt of the fluid to be tested sprayed under pressure. The effect of the flame to the spurt shall be observed.

A.3.1.2 Procedure

The fluid shall be sprayed at a pressure of 70 bar and the temperature of 65°C after having passed a nozzle with defined dimensions. The sprayed spurt is directed to a metal screen with a height of 100 cm and a breadth of

75 cm positioned 175 cm from the nozzle. Attempt to ignite the sprayed spurt by a defined acetylene/oxygen flame beginning from the nozzle mouth up to a distance of 120 cm from the nozzle.

A.3.1.3 Evaluation

The value 1 is given if the spurt does not ignite. If it ignites but the flame does not reach the metal screen, the value of 2 is given. Ignition up to the metal screen is given the value 3.

The fluid shall be classed as "low flammable", when value 2 is not exceeded in five successive tests.

A.3.2 Determination of the flame propagation within the mixture of coal dust and fluid

A.3.2.1 Principle

The propagation of a fire in a mixture of coal dust and fluid caused by ignition with a propane flame is to be determined.

A.3.2.2 Procedure

The mixture is made from 75 g of a defined coal dust and 37,5 cm^3 fluid. A sample of this mixture is formed into strips with a length of 150 mm, a breadth of 20 mm and a thickness of 4 mm and put on a metal plate. The plate at its beginning is to be heated with a defined propane burner flame up to 1 000°C and held for five minutes. After removal of the burner the degree of flame propagation and the time up to its extinguishing is determined.

A.3.2.3 Evaluation

The flame may not propagate the point of action of the flame of the propane burner more than negligible. The arithmetic mean value of the propagation zone found by 20 single tests shall not exceed 10 cm. Additionally 25 % of the single test values shall be below 13 cm.

A.3.3 Source of supply

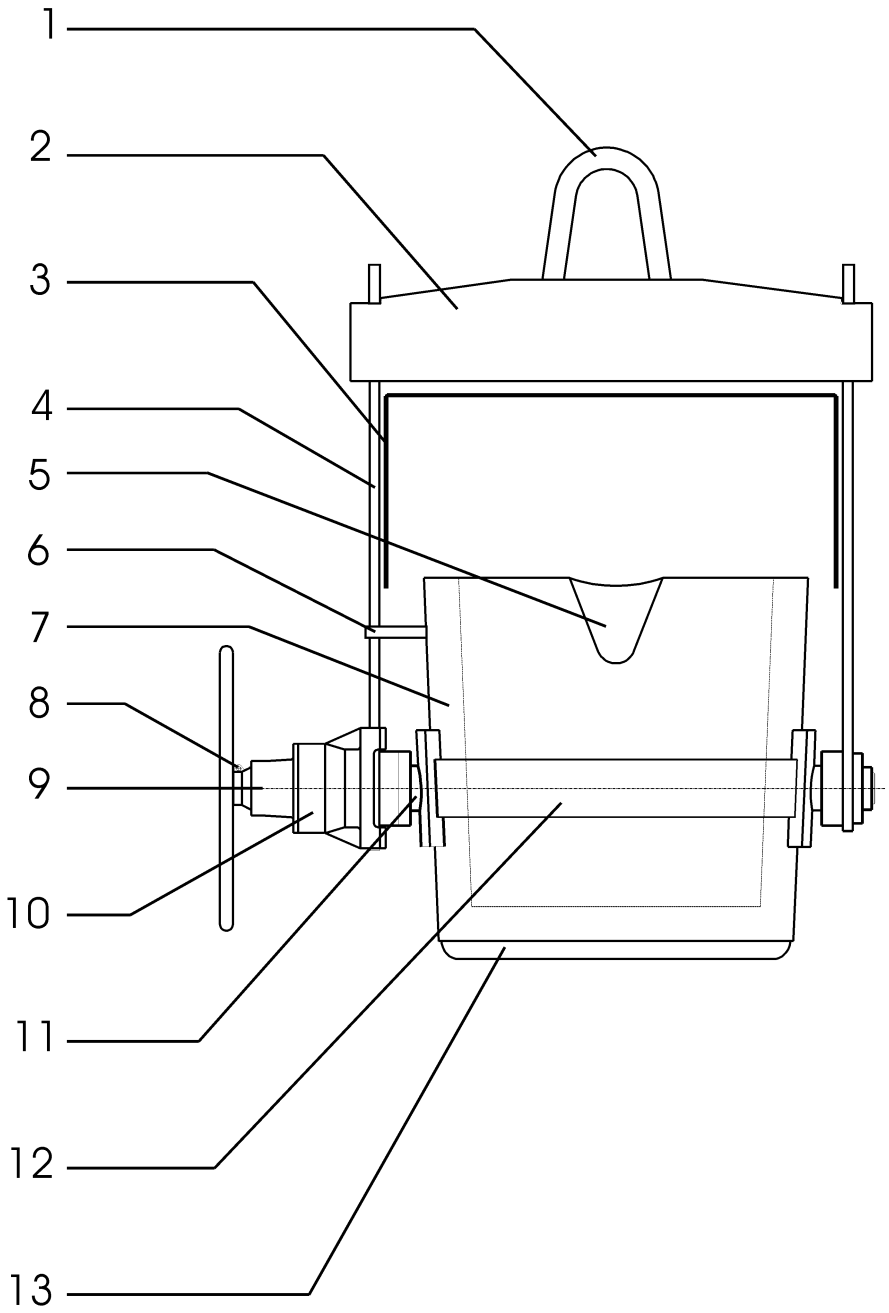
The briefly described methods are stated in the "7th report regarding demand and test of hardly flammable hydraulic fluids for hydrostatic and hydrokinetic power transmission and controls" issued by the Commission of the European Community (Standing Committee for Occupational Safety and Health in the coal mining industries and in other mineral producing industries):

Commission of European Community, General Board 5 E
Bâtiment Jean Monnet - Place Kirchberg
L-2920 Luxembourg

The 7th Luxembourg report, doc-no.: 2786/9/80 DK

Annex B
(informative)

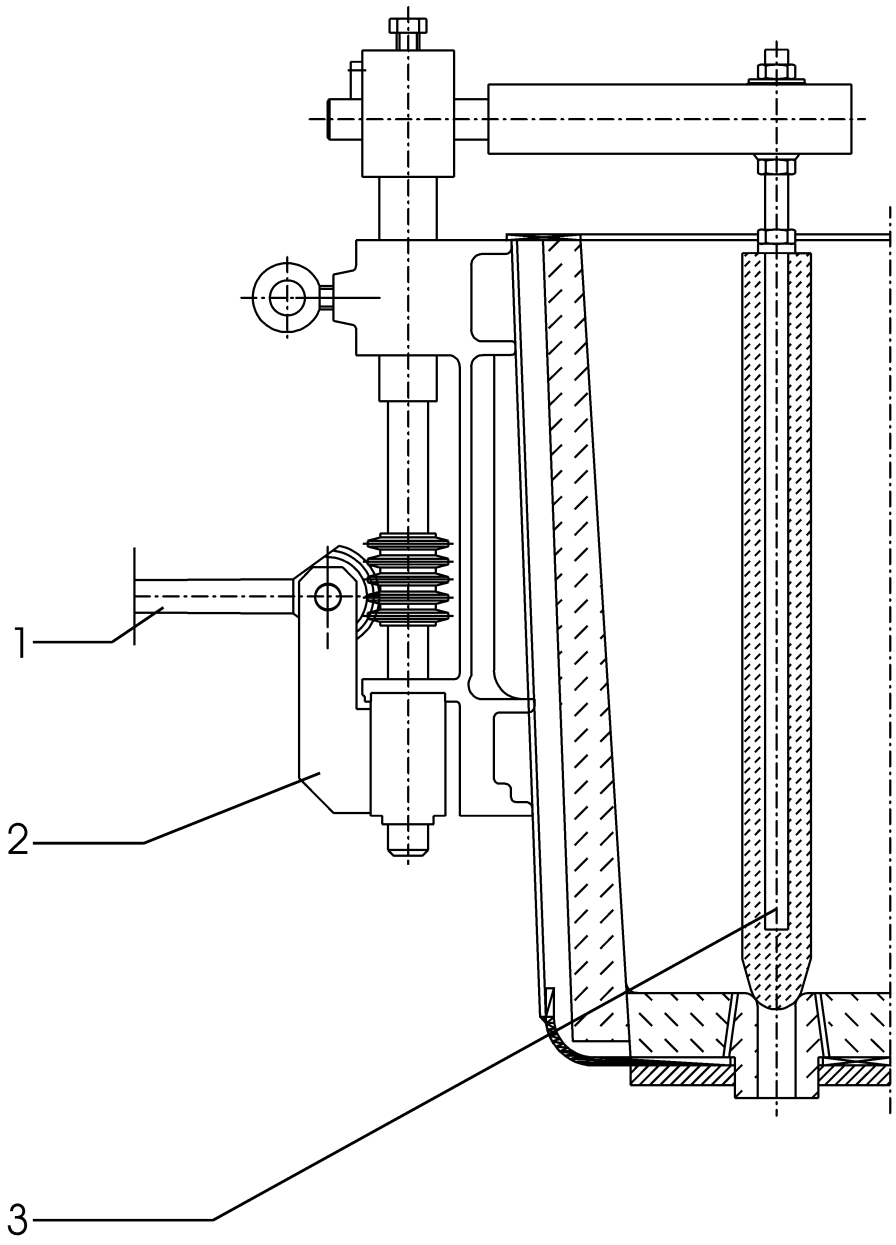
Examples for typical designs



Key

1	Lifting shackle	8	Safety latch
2	Cross members	9	Centre line of trunnion
3	Heat shield	10	Self locking gear box
4	Side members	11	Trunnion
5	Spout	12	Centre band
6	Anti tilting device	13	Ladle bottom
7	Refractory lining		

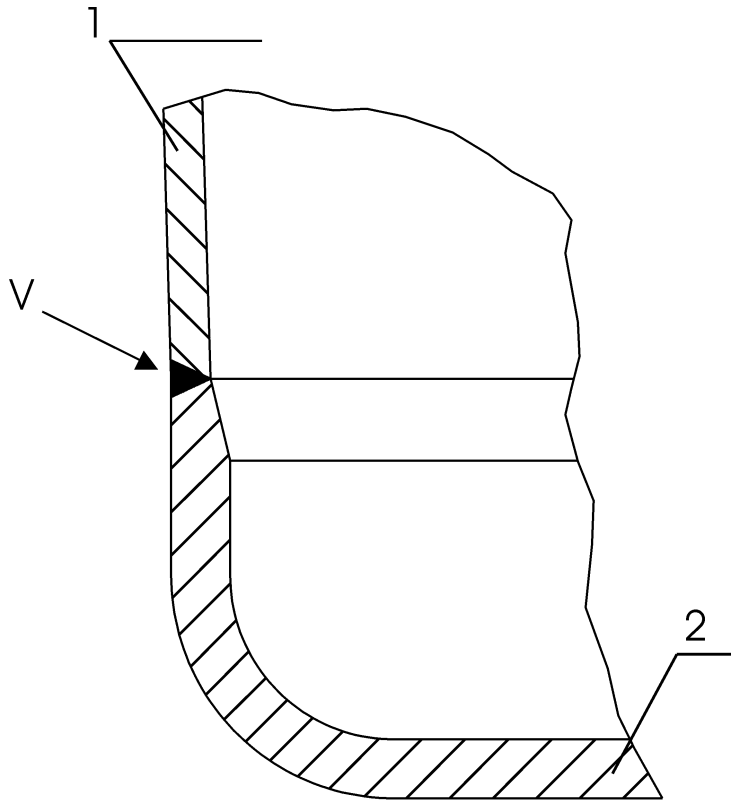
Figure B.1 — Crane ladle for manual tilting. Safety measures according to 5.2.1 and 5.2.3



Key

1 Operating lever
2 Swivel bracket
3 Stopper rod

Figure B.2 — Ladle with stopper device (section)

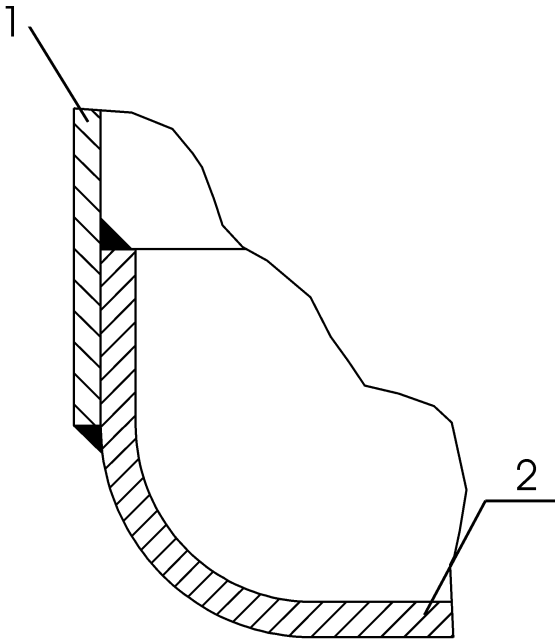


Key

1 Ladle pan cladding-plate

2 Dished bottom plate

Figure B.3 — Dished bottom plate, V-butt welded



Key

1 Ladle pan cladding-plate

2 Dished bottom plate

Figure B.4 — Dished bottom plate, overlapped welded

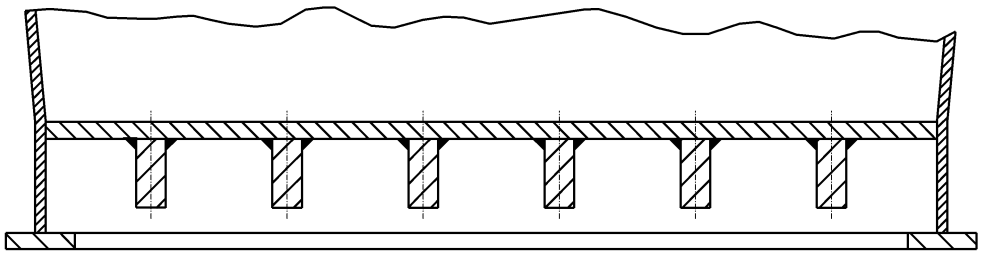
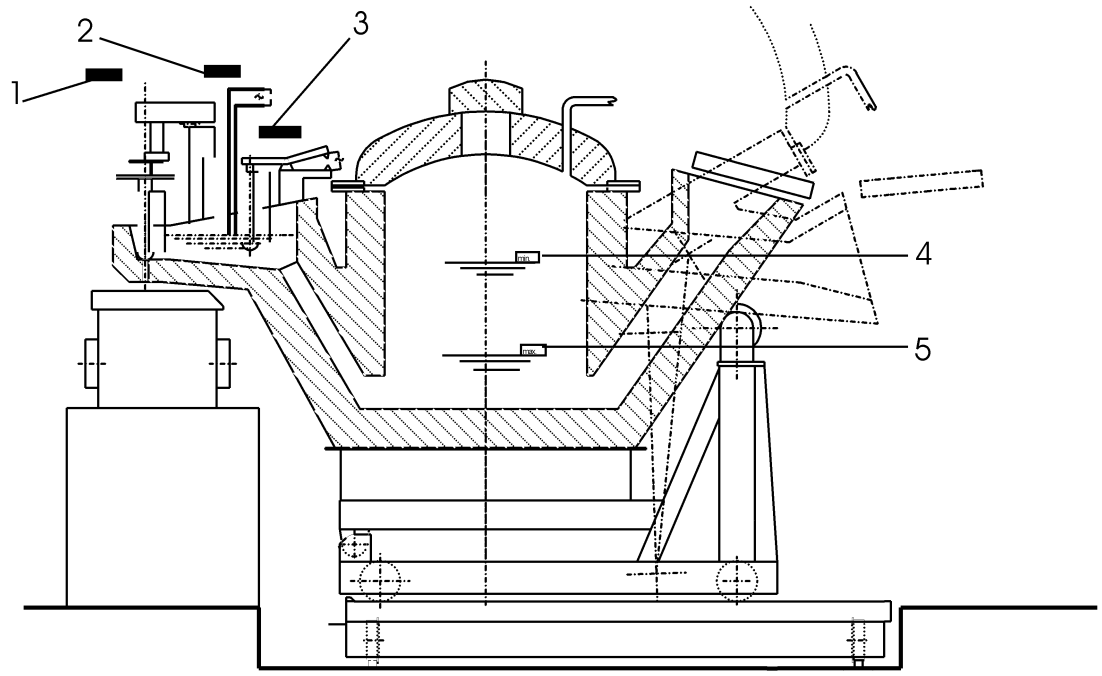


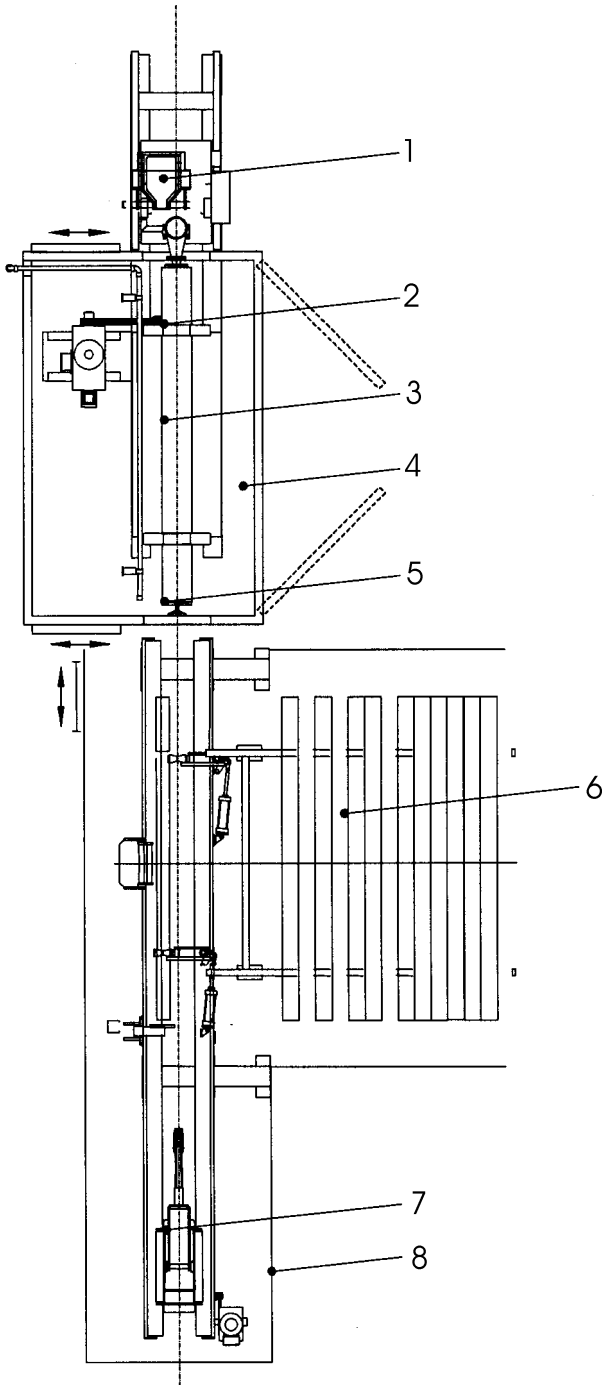
Figure B.5 — Flat ladle bottom with reinforcing ribs



Key

1	Stopper control	4	min. pressure/max. filling
2	Pouring spout level monitoring	5	max. pressure/min. filling
3	Float control		

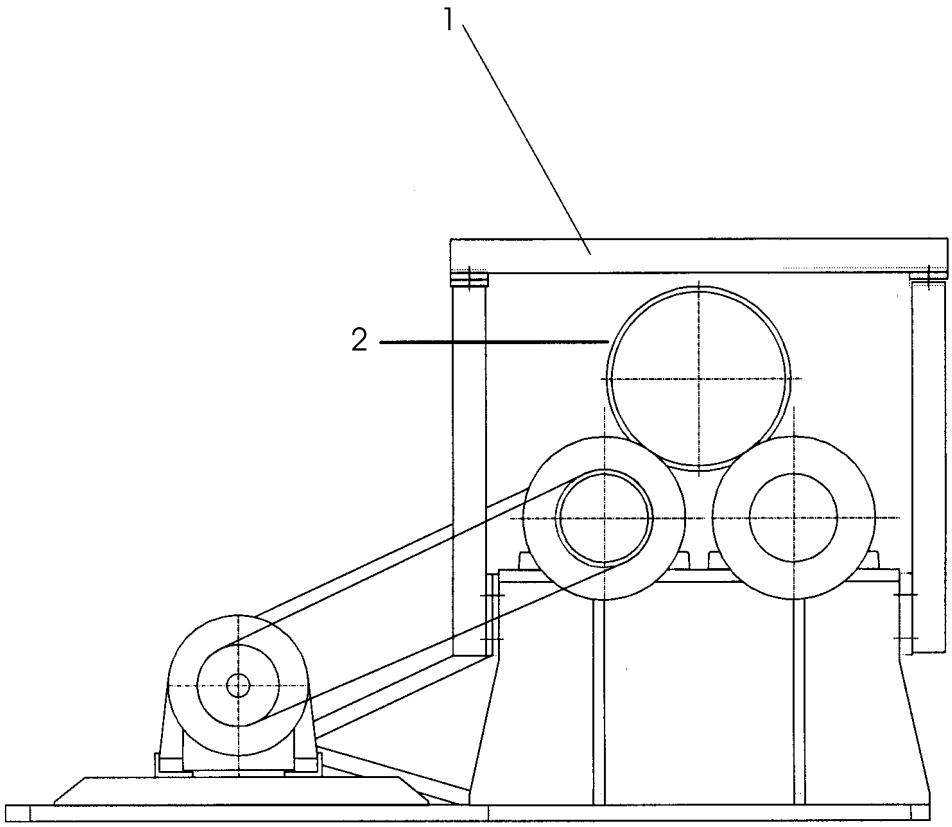
Figure B.6 — Pouring equipment with pressure discharge according to 5.3.3. Limitation of max. pressure with min. filling degree



Key

1	Pouring station	5	Die closing device
2	Driving motor	6	Cross transport
3	Die	7	Extracting station
4	Sound protection	8	Protective fence

Figure B.7 — Centrifugal casting machine. Safety measures according to 5.4



Key

1 Restraining device
2 Die

Figure B.8 — Centrifugal casting machine (section). Safety measures according to 5.4

Annex ZA
(informative)

Relationship between this European Standard and the Essential Requirements of EU Directive 98/37/EC

This European Standard has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association to provide one means of conforming to Essential Requirements of the New Approach Directive Machinery 98/37/EC, amended by 98/79/EC.

Once this standard is cited in the Official Journal of the European Communities under that Directive and has been implemented as a national standard in at least one Member State, compliance with the normative clauses of this standard confers, within the limits of the scope of this standard, a presumption of conformity with the relevant Essential Requirements of that Directive 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.

Bibliography

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

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[6] EN 719:1994, *Welding coordination — Tasks and responsibilities.*

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[9] EN 12464-1:2002, *Light and lighting — Lighting of work places — Part 1: Indoor work places.*

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