BS EN 1114-1:2011

BSI Standards Publication

Plastics and rubber machines — Extruders and extrusion lines

Part 1: Safety requirements for extruders

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National foreword

This British Standard is the UK implementation of EN 1114-1:2011. It supersedes BS EN 1114-1:1997 which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee MCE/3/2, Rubber and plastics machine - Safety.

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

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

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Foreword

This document (EN 1114-1:2011) has been prepared by Technical Committee CEN/TC 145 “Plastics and rubber machines”, the secretariat of which is held by UNI.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by April 2012, and conflicting national standards shall be withdrawn at the latest by April 2012.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN [and/or CENELEC] shall not be held responsible for identifying any or all such patent rights.

This document supersedes EN 1114-1:1996.

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 the relationship with EU Directives, see informative Annex ZA, which is an integral part of this document.

This is the first in a series of standards on the safety of extruders and extrusion lines.

Part 2 deals with die face pelletisers.

Part 3 deals with haul-offs.

NOTE Part 2 (EN 1114-2) was cancelled in 2010.

List of significant technical changes since the last edition:

— partially modified requirements and/or protective measures of extruders, feeding systems and ancillary equipment by taking into account the technological changes in the plastics and rubber industry and the development of the safety technology;

— modified requirements for the safety related parts of the machine control of extruders, feeding systems and ancillary equipment;

— the requirements and/or protective measures concerning the electrical equipment are specified in greater detail;

— addition of a noise test code.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland and the United Kingdom.

Introduction

This document is a type C standard as stated in EN ISO 12100. The machinery concerned and the extent to which hazards, hazardous situations and events are covered are indicated in the scope of this document.

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

1 Scope

This European Standard specifies all significant hazards, hazardous situations and events relevant to all types of screw extruders for plastics and rubber, when they are used as intended and under conditions of misuse which are foreseeable by the manufacturer (see Clause 4).

This European Standard additionally covers the following feeding systems:

— hoppers;

— single roller feed;

— double roller feed;

— crammer feeder;

and the following ancillary equipment which form part of or are attached to the extruder:

— screen changers;

— melt/gear pumps;

— melt pipes and adaptors;

— static mixers;

— extruder head that give initial shape to the extruded material.

NOTE Metering devices are not covered by this standard.

This European Standard does not deal with hazards caused by the processing of materials and which may lead to a risk of fire or release of health hazardous materials.

An extruder conforming to this document is not regarded as a pressure vessel as defined in the Pressure Equipment Directive 97/23/EC.

Extruders usually do not produce explosive atmospheres. Where materials are processed, which may cause an explosive atmosphere, the Directive 94/9/EC on the Equipment intended for use in Potentially Explosive Atmospheres (ATEX) should be applied. Explosion hazards are not dealt with in this document.

This European Standard is not applicable to extruders which are manufactured before the date of its publication as EN.

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+A1:2008, *Safety of machinery — Minimum gaps to avoid crushing of parts of the human body*

EN 574:1996+A1:2008, *Safety of machinery — Two-hand control devices — Functional aspects — Principles for design*

EN 614-1:2006+A1:2009, *Safety of machinery — Ergonomic design principles — Part 1: Terminology and general principles*

EN 953:1997+A1:2009, *Safety of machinery — Guards — General requirements for the design and construction of fixed and movable guards*

EN 1037:1995+A1:2008, *Safety of machinery — Prevention of unexpected start-up*

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

EN 60529:1991, *Degrees of protection provided by enclosures (IP Code) (IEC 60529:1989)*

EN ISO 3744:2010, *Acoustics — Determination of sound power levels and sound energy levels of noise sources using sound pressure — Engineering methods for an essentially free field over a reflecting plane (ISO 3744:2010)*

EN ISO 3746:2010, *Acoustics — Determination of sound power levels and sound energy levels of noise sources using sound pressure — Survey method using an enveloping measurement surface over a reflecting plane (ISO 3746:2010)*

EN ISO 3747:2010, *Acoustics — Determination of sound power levels and sound energy levels of noise sources using sound pressure — Engineering/survey methods for use in situ in a reverberant environment (ISO 3747:2010)*

EN ISO 4413:2010, *Hydraulic fluid power — General rules and safety requirements for systems and their components (ISO 4413:2010)*

EN ISO 4871:2009, *Acoustics — Declaration and verification of noise emission values of machinery and equipment (ISO 4871:1996)*

EN ISO 9614-2:1996, *Acoustics — Determination of sound power levels of noise sources using sound intensity — Part 2: Measurement by scanning (ISO 9614-2:1996)*

EN ISO 11201:2010, *Acoustics — Noise emitted by machinery and equipment — Determination of emission sound pressure levels at a work station and at other specified positions in an essentially free field over a reflecting plane with negligible environmental corrections (ISO 11201:2010)*

EN ISO 11202:2010, *Acoustics — Noise emitted by machinery and equipment — Determination of emission sound pressure levels at a work station and at other specified positions applying approximate environmental corrections (ISO 11202:2010)*

EN ISO 11204:2010, *Acoustics — Noise emitted by machinery and equipment — Determination of emission sound pressure levels at a work station and at other specified positions applying accurate environmental corrections (ISO 11204:2010)*

EN ISO 11688-1:2009, *Acoustics — Recommended practice for the design of low-noise machinery and equipment — Part 1: Planning (ISO/TR 11688-1:1995)*

EN ISO 12100:2010, *Safety of machinery — General principles for design — Risk assessment and risk reduction (ISO 12100:2010)*

EN ISO 13732-1:2008, *Ergonomic of the thermal environment — Methods for the assessment of human responses to contact with surfaces — Part 1: Hot surfaces (ISO 13732-1:2006)*

EN ISO 13849-1:2008, *Safety of machinery —Safety-related parts of control systems — Part 1: General principles for design (ISO 13849-1:2006)*

EN ISO 13850:2008, *Safety of machinery — Emergency stop — Principles for design (ISO 13850:2006)*

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

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

EN ISO 14122-1:2001/A1:2010, *Safety of machinery — Permanent means of access to machinery — Part 1: Choice of fixed means of access between two levels — Amendment 1 (ISO 14122-1:2001/Amd 1:2010)*

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 14122-2:2001/A1:2010, *Safety of machinery — Permanent means of access to machinery — Part 2: Working platforms and walkways — Amendment 1 (ISO 14122-2:2001/Amd 1:2010)*

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)*

EN ISO 14122-3:2001/A1:2010, *Safety of machinery — Permanent means of access to machinery — Part 3: Stairs, stepladders and guard-rails — Amendment 1 (ISO 14122-3:2001/Amd 1:2010)*

EN ISO 14122-4:2004+A1:2010, *Safety of machinery — Permanent means of access to machinery — Part 4: Fixed ladders (ISO 14122-4:2004+Amd 1:2010)*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in EN ISO 12100:2010 and the following apply.

3.1
extruder
machine which conveys materials by means of one or more screws rotating within a barrel and discharges it continuously through the extrusion head

NOTE In doing so, the material can be heated, cooled, consolidated, mixed, plasticised, can undergo chemical reactions, and may be degassed or gas injected. Viewed in the direction of flow of the material the extruder itself ends with the tip of the screw or screws.

3.2
feeding system
equipment which feeds the material into the extruder

3.3
hopper
container for gravity feeding of material into the extruder

3.4
single roller feed
roller used for feeding the extruder, which has an axis parallel to that of the screw

NOTE The screw and the roller counter-rotate and form an in-running nip and thereby improve the regularity of feeding. The device may be driven by the screw or by an independent device.

3.5
double roller feed
two rollers used for feeding the extruder

NOTE The feeding device consists of two rollers arranged in parallel positioned at the feed opening of the extruder.

3.6
crammer feeder
system with a dedicated drive which assists or densifies the flow of materials into the extruder by means of screws or other devices

3.7
main feed opening
opening in the barrel through which for example the granule, sheets, strips, powder or plasticised material pass

3.8
secondary opening
subsidiary opening in the barrel through which for example granulate, powder, liquid, gases or paste (e.g. colour, stabilisers, plasticisers) enters, or gases or vapours are removed

3.9
barrel
housing which surrounds one or more screws

3.10
accessories attached to openings in the extruder barrel
parts or devices for example pins as used for pin extruders, temperature or pressure gauges, vent or degassing chimneys

3.11
melt/gear pump
device which has a dedicated drive used to convey molten material at a defined pressure

3.12
melt pipes and adaptors
parts for connecting accessories for example screen changers, melt pumps and static mixers

3.13
static mixer
device which contains fixed obstacles used to homogenize, cool and heat the material

3.14
screen changer
device containing one or more screens through which molten material flows to remove foreign particles

NOTE The screen or screens are fixed on a carrier and can be moved from an on-line operating position and vice versa.

3.15
extruder head
device that gives shape to the extruded material

4 List of significant hazards

4.1 General

This clause contains all the significant hazards, hazardous situations and events, as far as they are dealt with in this document, identified by risk assessment as significant for this type of machinery and which require action to eliminate or reduce the risk.

NOTE The numbering system of the significant hazards in Subclauses 4.3 to 4.9 corresponds with the numbering system of the safety requirements and/or protective measures in Subclauses 5.3 to 5.9.

4.2 Mechanical hazards

NOTE Table 1 below shows the danger areas and the types of mechanical hazards which may occur and gives reference to the corresponding safety requirements and/or protective measures in 5.2.

Table 1 — Mechanical hazards and danger areas

	Crushing	Shearing	Cutting and severing	Drawing-in or trapping	Ejection of parts of machinery	Splashing of material	Corresponding requirements in Clause 5.2
Rotating parts of the drive and power transmission machinery	X	X	X	X	X		5.2.1
Rotation of screw(s)	X	X	X	X			5.2.2, 5.2.3, 5.2.4
Moving parts of the feeding system	X	X	X	X			5.2.4.2, 5.2.4.3, 5.2.4.4
Overpressure in the barrel					X	X	5.2.3.2, 5.2.5
Accessible moving parts of the screen changer	X	X	X	X		X	5.2.6
Accessible moving parts of the drive of the melt/gear pump	X	X	X	X			5.2.7
Overpressure in melt/gear pump					X	X	5.2.5, 5.2.7
Overpressure in melt pipes and adaptors					X	X	5.2.5, 5.2.8
Overpressure in static mixer					X	X	5.2.5, 5.2.9
Dangerous movement of the extruder head and/or its parts	X	X	X	X			5.2.10
Extruder itself when moved or moving	X						5.2.11

4.3 Hazards due to electrical energy

— Electrical shock or burns due for example to direct or indirect contact with live parts;

— electrical shock due to electrostatic phenomena.

4.4 Thermal hazards

— Burns,

— scalds,

due to contact with hot machine parts, hot extruded product, hot gases or hot liquids.

4.5 Hazards generated by noise

— Hearing loss:

— interference with speech communication;

— interference with the perception of acoustic signals, due to high noise levels.

4.6 Hazards resulting from materials and substances processed, used and/or exhausted by the machinery

Contact with, or inhalation of, materials, fumes or gases escaping from the openings.

4.7 Fire hazards

Ignition due to:

— contact with flammable materials;

— leakage from hydraulic lines onto hot surfaces.

4.8 Hazards due to falling from height

Injury due to falling from high level working places.

4.9 Hazards due to unsuitable ergonomics

5 Safety requirements and/or protective measures

5.1 General

Machinery shall comply with the safety requirements and/or protective measures of this clause.

In addition, the machine shall be designed according to the principles of EN ISO 12100 for relevant but not significant hazards which are not dealt with by this document.

5.2 Mechanical hazards

5.2.1 Drive and power transmission

The drive shafts and couplings between the motor and reduction gear and transmission belts shall be protected by fixed guards in accordance with EN 953:1997+A1:2009. For safety distances of EN ISO 13857:2008, Tables 2, 3 and/or 4 apply.

5.2.2 Screw shaft

If the end of the screw shaft is not enclosed by a housing, it shall be protected by fixed guards in accordance with EN 953:1997+A1:2009. For safety distances of EN ISO 13857:2008, Tables 2, 3 and/or 4 apply.

5.2.3 Openings in the barrel

5.2.3.1 Main feed opening – with or without a feeding system

The main feed opening shall be protected:

— by design, taking into account the safety distances in accordance with EN ISO 13857:2008, Tables 2, 3 and/or 4; or

— by the presence of a fixed or interlocked feeding system, for example hoppers or crammer feed systems. The safety related parts of the control system implementing the interlocking function shall be in accordance with EN ISO 13849-1:2008, PL_r =c.

5.2.3.2 Secondary openings

Secondary openings not under pressure shall be protected in accordance with 5.2.3.1.

Secondary openings which are pressurised shall be protected in accordance with 5.2.3.3.

5.2.3.3 Openings for the attachment of accessories

Openings for the attachment of accessories shall be protected by the presence of the accessories or by using fixed plugs; see also 7.2 b).

5.2.4 Feeding system

5.2.4.1 Hopper

Access to dangerous movement shall be prevented by design, taking into consideration the safety distances in accordance with EN ISO 13857:2008, Tables 2, 3 and/or 4.

If the hopper is provided with a door or movable cover which permits access to the dangerous movements, that door or cover, shall be provided with an interlocking device as defined in EN ISO 12100:2010, 3.28.1. The safety related parts of the control system implementing the interlocking function shall be in accordance with EN ISO 13849-1:2008, PL_r =c.

5.2.4.2 Single roller feed

The intake area of the single roller feed shall be protected:

— by design, taking into account the safety distances in accordance with EN ISO 13857:2008, Tables 2, 3 and/or 4; or

— by a fixed hopper or another fixed guard in accordance with EN 953:1997+A1:2009.

If the single roller feed is opened, the movement of the screw(s) and the roller shall be stopped by an interlocking device as defined in EN ISO 12100:2010, 3.28.1. The safety related parts of the control system implementing the interlocking function shall be in accordance with EN ISO 13849-1:2008, PL_r =c.

If the opening and closing of the feed roller is motorised, the danger points shall be protected:

— by an interlocking guard in accordance with EN 953:1997+A1:2009. The safety related parts of the control system implementing the interlocking function shall be in accordance with EN ISO 13849-1:2008, PL_r =c; or

— by a hold-to-run control device as defined in EN ISO 12100:2010, 3.28.3, which is positioned so that the danger area is visible to the operator and at a sufficient distance to prevent the operator being endangered by the opening and closing of the roller housing. The safety related parts of the control system implementing the hold-to-run control function shall be in accordance with EN ISO 13849-1:2008, PL_r =c.

If it is necessary for certain operations to rotate the screw(s) or the feed roller with the feed system open, a two hand control device in accordance with EN 574:1996+A1:2008, type II shall be provided if they are not protected by design. This two hand control device shall be located in the immediate vicinity of the feed roller. Fixed guards in accordance with EN 953:1997+A1:2009 or equivalent protective devices shall be fitted where this is necessary to prevent the access of a second person to the danger area.

The single roller feed shall be provided with an emergency stop in accordance with EN ISO 13850:2008, stop category '0' or stop category '1' so that movement of the extruder screw and feed roller can be stopped.

5.2.4.3 Double roller feed

The intake area of the double roller feed shall be protected:

— by design, taking into account the safety distances in accordance with EN ISO 13857:2008, Tables 2, 3 and/or 4; or

— by a fixed hopper or a fixed guard in accordance with EN 953:1997+A1:2009.

If the double roller feed is opened, for example by swinging away the feed hopper, the movement of the rollers shall be stopped by an interlocking device as defined in EN ISO 12100:2010, 3.28.1. The safety related parts of the control system implementing the interlocking function shall be in accordance with EN ISO 13849-1:2008, PL_r =c.

If it is necessary for certain operations (e.g. in laboratories) to rotate the rollers with the feeding system open a two hand control device in accordance with EN 574:1996+A1:2008, type II shall be provided. This two hand control device shall be positioned in the immediate vicinity of the rollers. Fixed guards in accordance with EN 953:1997+A1:2009 or equivalent protective devices shall be fitted where this is necessary to prevent access of a second person to the danger area.

If the double roller feed can be swivelled away or dismantled, the opening shall be safeguarded in accordance with 5.2.3.1.

The double roller feed shall be provided with an emergency stop in accordance with EN ISO 13850:2008, stop category '0' or stop category '1' so that movement of the extruder screw and the feed rollers can be stopped.

5.2.4.4 Crammer feeder

Danger areas of crammer feeders shall be protected:

— by design; or

— by fixed guards in accordance with EN 953:1997+A1:2009; or

— by interlocking guards in accordance with EN 953:1997+A1:2009. The safety related parts of the control system implementing the interlocking function shall be in accordance with EN ISO 13849-1:2008, PL_r =c.

In all these cases the safety distances shall be in accordance with EN ISO 13857:2008, Tables 2, 3 and/or 4.

5.2.5 Excess pressure protection

The extruder and the parts subject to excess pressure shall be protected against exceeding the maximum admissible internal pressure indicated by the manufacturer by one or more of the following measures:

— safety breaking points;

— bursting discs;

— expanding bolts;

— pressure sensing system in accordance with EN ISO 13849-1:2008, PL_r =c which, where a limit value is reached, switches off all the pressure generating elements via the control system;

— position sensing system in accordance with EN ISO 13849-1:2008, PL_r =c for the recording of the backward displacement of an overhanging positioned extruder screw(s) which, where a limit value is reached, switches off all the pressure generating elements via the control system.

Number and position of such elements or systems shall be defined according to the composition of the extruder or the extrusion line.

An alarm shall be provided in case of fault or failure of the specific control system intended for the reduction of dangerous overpressure.

NOTE 1 Each excess pressure protective measure listed above can protect different parts of the extrusion line.

NOTE 2 EN ISO 13849-1:2008, Table 4 shows the relationship between performance level (PL) and safety integrity level (SIL).

Possible ejection of material or parts used for the means of over pressure protection (e.g. safety breaking points, bursting discs, expanding bolts) shall be directed safely, e.g. downwards or deflected safely by design for example by the use of deflector panels.

See also 7.2 d).

5.2.6 Screen changer

5.2.6.1 General

Screen changers shall be protected against hazardous movement and against splashing from hot extruded material.

NOTE See also 7.2 e).

5.2.6.2 Automatic screen changer

Automatic screen changers shall be protected by interlocking guards in accordance with EN 953:1997+A1:2009. The safety related parts of the control system implementing the interlocking function shall be in accordance with EN ISO 13849-1:2008, PL_r =c.

5.2.6.3 Manual screen changer

Manual screen changers are to be protected by design in such a way that in case of an unintended splashing of material it will be diverted safely, for example, by using deflector panels. The safety distances shall be in accordance with EN ISO 13857:2008, Tables 2, 3 and/or 4.

5.2.7 Melt/gear pump

Melt/gear pumps shall be protected against hazards arising from rotating parts of the drive by fixed guards in accordance with EN 953:1997+A1:2009 by taking into consideration the safety distances of EN ISO 13857:2008, Tables 2, 3 and/or 4 and against exceeding the maximum admissible internal pressure as defined by the manufacturer in accordance with 5.2.5.

5.2.8 Melt pipes and adaptors

Melt pipes and adaptors shall be designed to withstand maximum internal pressures as generated by the application in accordance with 5.2.5.

5.2.9 Static mixer

Static mixers shall be protected against exceeding the maximum internal pressure as defined by the manufacturer in accordance with 5.2.5.

5.2.10 Extruder head

Extruder heads and/or its parts shall be protected against mechanical hazards due to dangerous movements, if existing:

— by design taking into account the safety distances in accordance with EN ISO 13857:2008, Table 2 for reaching over protective structures; or

— by fixed guards in accordance with EN 953:1997+A1:2009; or

— by interlocking guards in accordance with EN 953:1997+A1:2009. The safety related parts of the control system implementing the interlocking function shall be in accordance with EN ISO 13849-1:2008, PL_r =c.

If access is necessary to areas subject to dangerous movements, the dangerous movements may only be initiated by:

— a two-hand control device in accordance with EN 574:1996+A1:2008, type III which shall be located in the immediate vicinity of the extruder head to give the operator a clear view of the danger area; or

— a hold-to-run control device as defined in EN ISO 12100:2010, 3.28.3, located at a minimum distance of 2 m from the danger area. The safety related parts of the control system implementing the hold-to-run control function shall be in accordance with EN ISO 13849-1:2008, PL_r =b.

Fixed guards or equivalent protective devices shall be fitted where this is necessary to prevent the access of a second person to the danger area. The parts of the extruder head shall be capable of being secured when open in order to prevent any dangerous movement caused by gravity-fall or a malfunction of the hydraulic, pneumatic or electric control circuits.

5.2.11 Power operated horizontal movement of the complete machine or parts of it

If the machine is so designed that the operator cannot see all parts of the complete machine, an automatically operated acoustic and/or optical signalling device shall be provided giving warning of imminent movement of the machine.

To prevent crushing of the feet the carriage wheels shall be provided with fixed guards in accordance with EN 953:1997+A1:2009 taking into account the maximum safety distance of 15 mm specified in EN ISO 13857:2008, Table 7.

Where the maximum speed of movement of the machine exceeds 100 mm/s, a sensitive protective equipment (trip device) as defined in EN ISO 12100:2010, 3.28.5 shall be provided in the direction of movement to

ensure that the machine stops safely taking into account the overrun. If this sensitive protective equipment (trip device) cannot be fitted to the moving part, a hold-to-run control device as defined in EN ISO 12100:2010, 3.28.3 shall be provided allowing only movement of the machine at a maximum speed of 100 mm/s. The safety related parts of the control system implementing the interlocking function and the hold-to-run-control function shall be in accordance with EN ISO 13849-1:2008, PL_r =c.

Unintended movement of the machine shall be prevented. This can be achieved for example by a braking system. To prevent unintended start-up see EN 1037:1995+A1:2008.

If the machine is fitted with an operating platform on which an operator can stand, the workplace shall be arranged in accordance with EN 349:1993+A1:2008 in such a way as to preclude any crushing hazards caused by fixed or movable adjacent parts. If these safety distances cannot be achieved the movement of the carriage shall be prevented by the use of a sensitive protective equipment (trip device) as defined in EN ISO 12100:2010, 3.28.5.

NOTE See also 7.2 f).

5.3 Electrical energy

5.3.1 General

The electrical equipment shall be in accordance with EN 60204-1:2006 with the exception of connection and junction boxes in the area of the heating zones, where protection to IP 3X of EN 60529:1991 is sufficient. This deviates from EN 60204-1:2006, 11.3. In addition, the specific requirements given in 5.3.2 to 5.3.4 apply.

Specification for emergency stop and the stop categories to be chosen are given in 5.2.4.2, 5.2.4.3 and 5.10.

5.3.2 Supply disconnecting (isolating) device

The supply disconnecting devices shall be in accordance with EN 60204-1:2006, 5.3.2 and 5.3.3.

5.3.3 Protection against direct contact

Protection against direct contact shall be in accordance with EN 60204-1:2006, 6.2.

5.3.4 Protection against indirect contact

Protection against indirect contact shall be in accordance with EN 60204-1:2006, 6.3.

5.3.5 Electrostatic phenomena

The areas of the machine where an unwanted build-up of electrostatic charge is foreseeable shall be equipped with protective anti-static equipment. For guidance see CLC/TR 50404:2003.

5.4 Thermal hazards

5.4.1 Hot machine parts

Hot machine parts, except for those which cannot be covered for operational or process reasons, e.g. extruder heads, shall be protected against accidental contact by using insulating material or impeding devices in accordance with EN ISO 12100:2010, 3.29; for temperature limit values see EN ISO 13732-1:2008. Warning signs shall be provided on or close to uncovered hot machine parts; see 7.1 a). Information and recommendation about the wearing of personal protective equipment shall be given in the instruction manual; see 7.2 g).

5.4.2 Hot extruded products, hot gases and hot liquids

Warning signs shall be provided on or close to uncovered openings to warn about hot extruded products, hot gases and hot liquids; see 7.1 b). Information and recommendation about the wearing of personal protective equipment shall be given in the instruction manual; see 7.2 h).

5.5 Noise

5.5.1 General

Machinery shall be so designed and constructed that risks resulting from the emission of airborne noise are reduced to the lowest level, taking account of technical progress and the availability of means of reducing noise, in particular at source. Useful guidance is given in EN ISO 11688-1:2009.

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

5.5.2 Noise reduction at source by design

Particular attention should be given to the following major sources of noise:

— motor drives;

— power transmission systems;

— pneumatic systems;

— pressure relieving/exhaust systems;

— ventilation systems;

— hydraulic pumps;

— control valves;

— pipelines.

The following measures may, for example, be taken for noise reduction:

— designs which reduce noise;

— enclosures;

— silencers;

— low noise emission pumps;

— damping;

— anti-vibration mountings.

5.5.3 Information connected with noise hazards

See 7.2 i) and Annex A.

5.6 Materials and substances processed, used and/or exhausted by the machinery

The extruder shall be designed to allow an exhaust ventilation system to be connected to it; see 7.2 j).

5.7 Fire hazards

Fire hazards due to overheating of materials shall be limited by heating system temperature monitoring and control.

Hydraulic systems and components shall be in accordance with EN ISO 4413:2010.

Recommendation shall be given in the instruction manual that the machine is to be kept clean; see 7.2 m).

5.8 High level working places

Designated access and working positions on the machine shall be designed in accordance with 6.3.5.6 of EN ISO 12100:2010 and with EN ISO 14122-1:2001 and EN ISO 14122-1:2001/A1:2010, EN ISO 14122-2:2001 and EN ISO 14122-2:2001/A1:2010, EN ISO 14122-3:2001 and EN ISO 14122-3:2001/A1:2010, and and EN ISO 14122-4:2004+A1:2010. Guard-rails shall however be installed only when the height of the possible fall exceeds 1 m.

5.9 Ergonomics

Machine operator working area shall be designed and constructed in accordance with ergonomic requirements, described in EN 614-1:2006+A1:2008; see 7.2 n).

5.10 Emergency stop

Emergency stop shall be in accordance with EN ISO 13850:2008, stop category '0' or '1'. At least one emergency stop actuator shall be provided at the control panel, and where necessary according to the risk assessment, at further positions.

All dangerous movements shall be stopped when emergency stop is activated. It is however not mandatory to stop the circulation of heat transport fluids in cooling systems, exhaust systems and heating systems.

Specific requirements for emergency stop are also given in 5.2.4.2 and 5.2.4.3.

6 Verification of conformity with safety requirements and/or protective measures

Type tests shall be used to verify the safety requirements and/or protective measures in accordance with Table 2 below.

"Functional testing" includes verifying the function and efficiency of the guards and protective devices on the basis of descriptions given in the information for use, safety related plans and circuit diagrams, the requirements given in Clause 5 of this standard and the other quoted standards.

"Design validation" means verifying that the design meets the safety specifications of this European standard.

Table 2 — Verification methods

Subclause	Verification Method			
	Visual inspection	Functional Testing	Measurement	Design Validation
5.2.1	X		X	
5.2.2	X		X	
5.2.3.1	X	X	X	X
5.2.3.2	X	X	X	X
5.2.3.3	X			X
5.2.4.1	X	X	X	X
5.2.4.2	X	X	X	X
5.2.4.3	X	X	X	X
5.2.4.4	X	X	X	X
5.2.5	X	X		X
5.2.6.2	X	X		X
5.2.6.3	X		X	X
5.2.7	X	X	X	X
5.2.8	X	X		X
5.2.9	X	X		X

Table 2 — Verification methods *(concluded)*

Subclause	Verification Method			
	Visual inspection	Functional Testing	Measurement	Design Validation
5.2.10	X	X	X	X
5.2.11	X	X	X	X
5.3	X	X	X	X
5.4	X		X	X
5.5	X		X	X
5.6	X			X
5.7	X	X		X
5.8	X		X	X
5.9	X			X
5.10	X	X	X	X

7 Information for use

7.1 Minimum marking on the machine

The extruder must be marked visibly, legibly and indelibly with the following minimum particulars:

— business name and full address of the manufacturer and, where applicable, his authorised representative,

— designation of the machinery,

— CE Marking,

— designation of series or type,

— serial number, if any,

— year of construction, that is the year in which the manufacturing process is completed.

See also EN ISO 12100:2010, 6.4.4.

In addition, indications shall be marked in case of the following hazards:

a) hot machine parts if their surface temperature exceeds the limit values in EN ISO 13732-1:2008 and if they cannot be protected against inadvertent contact by means of insulating material or additional guards;

b) hot extruded products, hot gases and hot liquids on or close to uncovered openings;

c) hot materials which can be released at certain locations e.g. at screen changers, shear heads and extruder heads.

If required such indications must also include additional information about commissioning, operation, maintenance, cleaning and the requirements to wear personal protective equipment, for instance during screen changing operations, etc.

7.2 Instruction manual

Instruction manuals shall be drafted in accordance with EN ISO 12100:2010, 6.4.5.

Each machine shall be accompanied by an instruction manual which includes the minimum information as in 7.1, in addition to the fundamental instructions in accordance with EN ISO 12100:2010, 6.4.5.1.

In addition, the instruction manual shall include:

a) indications about the various operations carried out at the openings of the extruder barrel, e.g. instructions for the operators, wearing of personal protection devices, warning against residual risks, etc.;

b) indications to the user that openings for accessories etc. shall be protected either by the accessory itself or by the fixed plugs provided;

c) indications about permissible internal pressures of extruder and ancillary equipment for example, melt ducts, static mixers, screen changers, shear head and extruder head;

d) indications that the user shall not open the machine while it is under pressure;

e) indications about the protective measures to be taken during screen changing, e. g. the use of personal protective equipment, etc.;

f) indications about movement of the entire machine:

    1) indications about the spaces needed between the moving parts of the machine and parts of the building or other machines to ensure that no one can be crushed between them (see EN 349:1993+A1:2008);

    2) indications, for example by the posting of prohibition signs, not to step up on the moving machine;

g) instructions about safety measures to be taken against accidental contact with hot machine parts or hot materials if the surface temperature exceeds the limit values in EN ISO 13732-1:2008;

h) instructions about safety measures to be taken against accidental contact with hot extruded products, hot gases and hot liquids, for example, wearing of personal protective equipment such as protection gloves or protection goggles;

i) the following information concerning noise:

    1) a noise emission declaration according to A.6;

2) if applicable, information on possible noise enclosures, screens or silencers fitted to the machinery, etc;

3) if applicable, recommendations to use cabins and/or operating and maintenance modes with reduced noise emission, specification about installation and assembly for reducing noise, e.g. vibration dampers;

4) if applicable, recommendation to use personal hearing protection;

j) where it is known that gases, fumes and dust, hazardous to health can be released, the manufacturer shall recommend the use of exhaust ventilation systems and provide instructions about the locations and connections on the machine;

k) for maintenance operations on the degassing equipment, the manufacturer shall inform the user that during unscrewing of the degassing dome or of the connection lines (depending on the materials used), hazards due to release of vapours or gases which are hazardous to health can exist, as well as hazards due to contact with health hazardous condensate being released from the lines. For such operations, protective measures shall be mentioned, for example the use of specially trained personnel, the wearing of protective gloves and glasses, etc.;

l) in particular cases the risks of explosion shall be indicated, e.g. where pentane is used as a blowing agent;

m) recommendation that the machine is to be kept clean to prevent fire hazards where overheated material may release;

n) information and recommendation how to operate the machine in order to reduce or to prevent discomfort, fatigue and physical and psychological stress.

Annex A
(normative)

Noise test code

A.1 Introduction

This noise test code specifies all the information necessary to carry out efficiently and under standardised conditions the determination, declaration and verification of the airborne noise emission values of extruders.

The determination of these quantities is necessary for:

— manufacturers to declare the noise emitted,

— comparing the noise emitted by machines in the family concerned,

— purposes of noise control at the source at the design stage.

It specifies the noise measurement methods and operating and mounting conditions for the test.

The use of this noise test code ensures the reproducibility of the measurements and the comparability of the airborne noise emission values within specified limits determined by the grade of accuracy of the basic measurement method used. Noise measurement methods allowed by this noise test code are engineering (grade 2) methods. If this is technically not possible survey (grade 3) methods may be used stating the justification for the use of such a method.

A.2 Determination of the A-weighted emission sound pressure level at the workstation

The determination of the A-weighted emission sound pressure level shall be carried out using one of the standards EN ISO 11201:2010 with grade 2 of accuracy, EN ISO 11202:2010 with grade 2 of accuracy or EN ISO 11204:2010 with grade 2 of accuracy. For all extruders microphone positions shall be located at 1 m from the contour of the machine and at a height of 1,60 m. The highest value measured shall be recorded, reported and declared. There shall be at least four microphone positions, one on each side of the machine.

For extruders which are manually loaded and unloaded by an operator the determination of the A-weighted emission sound pressure level shall be carried out at all designated operators' positions defined by the manufacturer in the instruction handbook using one of the standards EN ISO 11201:2010 with grade 2 of accuracy or EN ISO 11204:2010 with grade 2 of accuracy.

If it is not possible to use an engineering method (grade 2 of accuracy), a survey method (e.g. EN ISO 11202:2010 with grade 3 of accuracy) may be used stating the justification for the use of such a method.

A.3 Determination of the A-weighted sound power level

The determination of the A-weighted sound power level shall be carried out using one of the standards EN ISO 3744:2010, EN ISO 3747:2010 with grade 2 or EN ISO 9614-2:1996 with grade 2.

If it is not possible to use an engineering method (grade 2 of accuracy), a survey method (e.g. EN ISO 3746:2010 or EN ISO 3747:2010 with grade 3) may be used stating the justification for the use of such a method.

When EN ISO 3744:2010 or EN ISO 3746:2010 is used the measurement surface shall be a parallelepiped and the measurement distance shall be 1 m.

A.4 Mounting and operating conditions

The machine shall be mounted and operated as specified/recommended by the manufacturer in the instruction manual.

NOTE 1 Extruders are put onto the market also as separate machines for individual and also for multiple applications, which cannot be specified precisely in advance. Therefore, the measurements may vary and are carried out with or without material as well as with or without ancillary equipment or other machines or devices of a complete extrusion line.

Noise emission measurement shall be made by the manufacturer in collaboration with the user. Under different operating conditions the noise level can differ and may by higher.

NOTE 2 In general, extruders can only be operated under real conditions at the user's premises, i.e. to run the extruder with the intended material. Noise emission of extruders without material is not representative. It is therefore recommended that manufacturers start gathering noise emission data on extruders operated with material. This data can be obtained from measurements carried out by manufacturers at users' premises on new extruders after installation or during commissioning. From this data, manufacturers will progressively become able:

— to assess the effectiveness of the noise control measures they implement at the design stage;

— to inform users about noise emission values that can be expected.

A.5 Information to be recorded and reported

A.5.1 General

The information to be recorded and reported shall include all the data required by the basic standards used i.e. precise identification of the machine under test, acoustic environment, instrumentation, presence and position(s) of the operator(s) if any. If there is any deviation to this test code this shall be recorded, reported and declared.

The operating conditions of the machine during measurement and the methods that have been used for the measurement shall be indicated.

At least the data specified in A.5.2 to A.5.5 shall be recorded and reported.

A.5.2 General data

— Type, serial number if any, year of manufacture of the machine;

— date of test, location, person in charge; and

— ambient temperature.

A.5.3 Mounting and operating conditions

Mounting and operating conditions during noise measurement:

— parameters of the drive system;

— percentage of maximum torque;

— speed of the screw(s) in revolutions per minute;

— material throughput in kilograms per hour;

— type of conveyed and discharged material;

— list of ancillary equipment in operation during measurement;

— list of upstream or downstream machines or devices in operation during measurement.

A.5.4 Standards

Measurement standard(s) used.

A.5.5 Noise data

— Location of measurement positions;

— determined noise emission values and associated uncertainty.

A.6 Declaration and verification of noise emission values

The noise declaration shall be a dual-number declaration as defined in EN ISO 4871:2009, i.e. the measured value and the measurement uncertainty shall be indicated separately. It shall include the following:

— the A-weighted emission sound pressure level at workstations, where this exceeds 70 dB(A); where this level does not exceed 70 dB(A), this fact must be indicated; and

— the A-weighted sound power level emitted by the machinery, where the A-weighted emission sound pressure level at workstations exceeds 80 dB(A).

The noise declaration shall mention explicitly that noise emission values have been obtained according to this noise test code. It shall indicate which basic measurement standards have been used and give details of the mounting and operating conditions of the machine during the determination of its noise emission. The noise declaration shall clearly indicate deviation(s) from this noise test code and/or from the basic standards used if any.

If undertaken the verification of declared values shall be conducted according to EN ISO 4871:2009 by using the same mounting and operating conditions as those used for the initial determination of noise emission values.

NOTE EN ISO 4871:2009 gives a methodology for declaring and verifying noise emission values. No technical data on noise emission are presently available to estimate the standard deviation of reproducibility for extruders. Therefore the values of the standard deviation of reproducibility stated in the basic noise emission standards may be regarded as interim upper boundaries and used for the determination of the uncertainty K when preparing the noise declaration. Investigations requiring a joint effort of manufacturers are necessary to determine a possible lower value of the standard deviation of reproducibility which will result in a lower value of the uncertainty K. Results of such investigations will be reflected in a future version of this standard.

Annex ZA
(informative)

Relationship between this European Standard and the Essential Requirements of EU Directive 2006/42/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 a means of conforming to Essential Requirements of the New Approach Directive 2006/42/EC on machinery.

Once this standard is cited in the Official Journal of the European Union 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, *except the Essential Requirement 1.5.7 (explosion)*, 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

[1] EN ISO 11688-2:2000, *Acoustics — Recommended practice for the design of low-noise machinery and equipment — Part 2: Introduction to the physics of low-noise design (ISO/TR 11688-2:1998)*

[2] CLC/TR 50404:2003*, Electrostatics — Code of practice for the avoidance of hazards due to static electricity*

[3] Directive 94/9/EC of the European Parliament and the Council of 23 March 1994 on the approximation of the laws of the Member States concerning equipment and protective systems intended for use in potentially explosive atmospheres

[4] Directive 97/23/EC of the European Parliament and of the Council of 29 May 1997 on the approximation of the laws of the Member States concerning pressure equipment

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