BS EN 12779:2015

BSI Standards Publication

Safety of woodworking machines — Chip and dust extraction systems with fixed installation — Safety requirements

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National foreword

This British Standard is the UK implementation of EN 12779:2015. It supersedes BS EN 12779:2004+A1:2009 which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee MTE/23, Woodworking machines.

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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Sécurité des machines pour le travail du bois - Installations fixes d'extraction de copeaux et de poussières - Prescriptions de sécurité

Sicherheit von Holzbearbeitungsmaschinen - Ortsfeste Absauganlagen für Holzstaub und Späne - Sicherheitstechnische Anforderungen

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European foreword

This document (EN 12779:2015) has been prepared by Technical Committee CEN/TC 142 “Woodworking machines - Safety”, the secretariat of which is held by UNI.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by May 2016, and conflicting national standards shall be withdrawn at the latest by May 2016.

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 12779:2004+A1:2009.

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

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

The European Standards produced by CEN/TC 142 are particular to woodworking machines and compliment the relevant “A” and “B” standards on the subject of general safety (see Introduction of EN ISO 12100:2010 for a description of A, B and C standards).

NOTE Extraction systems as a whole are not intended to be installed in areas, where the presence of potentially explosive atmosphere needs to be taken into account.

In relation to the previous version of the standard, the following main modifications have been made:

— The scope has been adjusted to meet the fields of application of the standard;

— The requirements for safety related controls have been modified for clarification;

— The requirements for electrical equipment and installations have been modified for clarification;

— The requirements for fire and explosion protection have been modified for clarification;

— The requirements for noise protection have been modified for clarification;

— The requirements for protection against hazardous substances have been modified for clarification;

— The requirements for silos have been modified for clarification;

— A new annex for examples of extraction systems have been added for clarification;

— A new annex for the classification of places where explosive atmosphere may occur have been added for clarification.

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, Former Yugoslav Republic of Macedonia, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta,

Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.

Introduction

This standard has been prepared to be a harmonized standard to provide one means of conforming to the Essential Health and Safety Requirements of the Machinery Directive and associated EFTA Regulations. This document is a type "C" standard as defined in EN ISO 12100:2010.

This document is of relevance, in particular, for the following stakeholder groups representing the market players with regard to machinery safety:

— machine manufacturers (small, medium and large enterprises);

— health and safety bodies (regulators, accident prevention organizations, market surveillance etc.).

Others can be affected by the level of machinery safety achieved with the means of the document by the above-mentioned stakeholder groups:

— machine users/employers (small, medium and large enterprises);

— machine users/employees (e. g. trade unions, organizations for people with special needs);

— service providers, e.g. for maintenance (small, medium and large enterprises);

— consumers (in case of machinery intended for use by consumers).

The above-mentioned stakeholder groups have been given the possibility to participate at the drafting process of this document. The machinery concerned and the extent to which hazards, hazardous situations and events 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 other standards, for machines that have been designed and built in accordance with the provisions of this type C standard.

The requirements of this document are directed to manufacturers and their authorized representatives of chip and dust extraction systems.

This document also includes information to be provided by the manufacturer to the user.

1 Scope

This European Standard deals with the significant hazards, hazardous situations and events relevant for chip and dust extraction systems for fixed installation and for connection with machines for working on solid wood (including hard wood), wood-based materials and wood-like materials, when they are used as intended and under the conditions foreseen by the manufacturer, including reasonably foreseeable misuse.

This European Standard deals also with the technical requirements to minimize the hazards in connection with the temporary storage of wood dust, chips and shavings in a silo, bin or container including charging and discharge systems.

This European standard does not apply to:

a) chip and dust extraction systems with filters installed indoors (covered by prEN 16770);

b) extraction equipment (e.g. extraction hoods, ducts) within a woodworking machine including the outlet to which the extraction system is connected;

c) chip and dust extraction systems designed for K_{ST} values above 200 bar ms^{-1};

d) mechanical conveying systems between filter and storage facility;

e) extraction systems and conveying systems with underpressure below 0,3 bar or overpressure above 0,3 bar;

f) storage devices for pressed wood products (e.g. pellets) and humid shavings.

Requirements for containers are not dealt with in this standard.

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

2 Normative references

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

EN 617:2001+A1:2010, *Continuous handling equipment and systems — Safety and EMC requirements for the equipment for the storage of bulk materials in silos, bunkers, bins and hoppers*

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

EN 1093-7:1998+A1:2008, *Safety of machinery — Evaluation of the emission of airborne hazardous substances — Part 7: Separation efficiency by mass, ducted outlet*

EN 1127-1:2011, *Explosive atmospheres — Explosion prevention and protection — Part 1: Basic concepts and methodology*

EN 1366-1:2014, *Fire resistance tests for service installations — Part 1: Ventilation ducts*

EN 1366-2:2015, *Fire resistance tests for service installations — Part 2: Fire dampers*

EN 1366-7:2004, *Fire resistance tests for service installations — Part 7: Conveyor systems and their closures*

EN 1870-4:2012, *Safety of woodworking machines — Circular sawing machines — Part 4: Multiblade rip sawing machines with manual loading and/or unloading*

EN 1991-4:2006, *Eurocode 1 — Actions on structures — Part 4: Silos and tanks*

EN 12750:2013, *Safety of woodworking machines — Four sided moulding machines*

EN 13463-1:2009, *Non-electrical equipment for use in potentially explosive atmospheres — Part 1: Basic method and requirements*

EN 14373:2005, *Explosion suppression systems*

EN 14460:2006, *Explosion resistant equipment*

EN 14491:2012, *Dust explosion venting protective systems*

EN 14797:2006, *Explosion venting devices*

EN 14986:2007, *Design of fans working in potentially explosive atmospheres*

EN 15089:2009, *Explosion isolation systems*

EN 16009:2011, *Flameless explosion venting devices*

EN 16020:2011, *Explosion diverters*

EN 16447:2014, *Explosion isolation flap valves*

EN 60079-14:2014, *Explosive atmospheres — Part 14: Electrical installations design, selection and erection (IEC 60079-14:2013)*

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

EN 60529:1991,[2)] *Degrees of protection provided by enclosures (IP Code) (IEC 60529:1989)*

EN 62305-1:2011, *Protection against lightning — Part 1: General principles (IEC 62305-1:2010, modified)*

EN ISO 4414:2010, *Pneumatic fluid power — General rules and safety requirements for systems and their components (ISO 4414:2010)*

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

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

1) This document is impacted by the stand-alone amendment EN 60204-1:2006/A1:2009.

2) This document is impacted by the stand-alone amendments EN 60529:1991/A1:2000 and EN 60529:1991/A2:2013, and by the corrigendum EN 60529:1991/corrigendum May 1993.

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

EN ISO 14119:2013, *Safety of machinery — Interlocking devices associated with guards — Principles for design and selection (ISO 14119:2013)*

EN ISO 14122-2:2001,[3] *Safety of machinery — Permanent means of access to machinery — Part 2: Working platforms and walkways (ISO 14122-2:2001)*

EN ISO 14122-3:2001, [4] *Safety of machinery — Permanent means of access to machinery — Part 3: Stairs, stepladders and guard-rails (ISO 14122-3:2001)*

EN ISO 14122-4:2004,[5] *Safety of machinery — Permanent means of access to machinery — Part 4: Fixed ladders (ISO 14122-4:2004)*

3 Terms, definitions, terminology, symbols and units

3.1 Terms and definitions

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

3.1.1
chip and dust extraction system
system used for extraction, conveyance, separation and temporary storage of chips and dust from woodworking

Note 1 to entry: Examples of extraction systems are illustrated in Annex A.

3.1.2
fixed installation
extraction system which is permanently located and installed

3.1.3
chip
<woodworking> particles with a size > 0,5 mm

3.1.4
dust
<woodworking> fine particles with a size ≤ 0,5 mm

3.1.5
shaving
<woodworking> chip with a typical length of above 15 mm and a low thickness compared to other dimensions

3.1.6
extraction ducting
all parts of the ducting between the extraction points and the filter consisting of main and branch and machine connection ducts, gate valves, fire gates and back pressure flap

3) This document is impacted by the stand-alone amendment EN ISO 14122-2:2001/A1:2010.

4) This document is impacted by the stand-alone amendment EN ISO 14122-3:2001/A1:2010.

5) This document is impacted by the stand-alone amendment EN ISO 14122-4:2004/A1:2010.

Note 1 to entry: Back pressure flaps can also be a part of the filter.

3.1.7
main duct
duct to the filter to which branch ducts or connection ducts are connected

3.1.8
separator
device for separation of chips and dust from the conveying air

Note 1 to entry: Filters and cyclones are examples of separators.

3.1.9
silo
fixed installed closed structure for temporary storage of chips and dust, part of a continuous handling system, with a filling height of at least 1,5 m

Note 1 to entry: Silo is usually charged from the top and discharged from the bottom or the side.

Note 2 to entry: See also Figures A.1 and A.2 in Annex A.

3.1.10
supporting fan
additional fan to compensate a high pressure loss

3.1.11
bin
movable equipment with a volume up to 1,0 m^3 for temporary storage of chips and dust

3.1.12
container
movable equipment with a volume over 1,0 m^3 for temporary storage of chips and dust

3.1.13
discharge system
system which continually or intermittently removes chips and dust from separators or silos

3.1.14
conveying system
system to convey chips and dust from one or more separators to other parts of the extraction system or into silo(s)

3.1.15
extraction vacuum
static vacuum in a duct connecting point

3.1.16
air velocity
average velocity of the air inside a duct, calculated or measured over the entire cross section

3.1.17
concurrency factor
ratio in percent between the nominal volume flow rate of the extraction system and the total volume flow rate of all machines connected

3.1.18
crude air part
dust loaded interior of the extraction system including ducting, silo, container, bin, separator etc. from the duct inlet connected to the filter element surface, where the air filtration is performed

3.1.19
clean air part
interior of the extraction system from the filter element surface, where the air filtration is performed, to the air outlet

3.1.20
recirculation air
filtered air reintroduced into the working area

3.1.21
recirculation air duct
duct through which filtered air is reintroduced to the working area

3.1.22
exhaust air
airflow discharged to the atmosphere

[SOURCE: EN 13779:2007, 6.1, Table 2, number 7]

3.1.23
filter
device for the removal of particulate contaminants from the air, consisting of filter housing, inlets and outlets, filter element and cleaning device

[SOURCE: EN 12792:2003, Clause 3, Table 1, n° 168, reference modified – device for removing particulate material from a fluid or gas]

3.1.24
filter element
part of the filter for the removal of chips and dust from the air

3.1.25
cleaning device
device for the reduction of a dust layer on filter elements

Note 1 to entry: The cleaning can be obtained e.g. by vibration, reversed airflow or compressed-air blast.

3.1.26
back pressure flap
flap valve kept open by airflow in normal operation, closed by interruption or reversed airflow

3.1.27
wood based material
material with similar physical characteristics to wood

Note 1 to entry: This includes MDF (Medium Density Fibreboard), OSB ((Oriented Strand Board), plywood, chipboard, fibreboard, and also these materials when they are covered with plastic or light alloy laminates and or edges.

3.2 Terminology

List of corresponding terms in English, French and German is included in Annex B.

3.3 Symbols and units

Following symbols and units are used in this document:

Table 1 — Symbols and units

Parameter	Symbol	Unit
Diameter	d	mm
Height	h	m
Length	l	m
Width	w	m
Volume	V	m^3
Air velocity	v	ms^{-1}
Volume flow rate	q_v	m^3h^{-1}
Pressure	p	Pa
Pressure difference	Δp	Pa
Maximum explosion overpressure	P_{max}	bar
Reduced maximum explosion overpressure	P_{redmax}	bar
Material flow rate	q_m	kg/h
K_{ST} value	K_{ST}	bar ms^{-1}
Minimum ignition energy	MIE	mJ
Minimum ignition temperature	MIT	°C
Lower explosion level	LEL	g m^{-3}

4 List of significant hazards

This clause contains all significant hazards, hazardous situations and events (see EN ISO 12100:2010), identified by risk assessment as significant for the extraction systems as defined in the scope and which require action to eliminate or reduce the risk. This European Standard deals with these significant hazards by defining safety requirements and/or measures or by reference to relevant standards.

These hazards are listed in Table 2 in accordance with EN ISO 12100:2010, Annex B.

If gaseous pollutants occur at the working area, they will be partly removed from the working area by the extraction system for wood dust and chips. But the gaseous pollutants are not separated by the extraction system for dust and chips.

Table 2 — List of significant hazards

No	Type or group	Examples of hazards		Specific Requirements Applicable clauses of this standard	Subclause of EN ISO 12100:2010
		Origin[a]	Potential consequences[b]		
1	**Mechanical hazards**	— height from the ground; — instability; — moving parts; — rotating parts; — rough, slippery surface; — stored energy; — explosion venting (ejection of parts); — gravity (bridges of dust and chips);	— crushing; — drawing-in or trapping; — entanglement; — shearing; — slipping, tripping and falling; — impact; — sinking into wood dust and chips; — being buried under wood dust and chips;	5.3. ff 5.8 ff 5.2.1 5.2.2 5.2.3	6.2.3 a) 6.2.6 6.2.10 6.3.5.2 6.3.5.4
2	**Electrical hazards**	— electrostatic phenomena; — parts which have become live under fault conditions;	— electrocution; — fire; — electric shock;	5.7 ff 5.2.3	6.2.9 6.3.3.2 6.3.5.4 6.4.4 6.4.5
3	**Thermal hazards**	— explosion; — flame; — objects or materials with a high temperature;	— burn; — fire spreading; — pressure shockwave	5.4 ff 5.2.1 5.2.3	6.2.4 b) 6.2.8 c)
4	**Noise hazards**	— exhausting system; — scraping surfaces; — unbalanced rotating parts; — whistling pneumatics; — compressed air;	— discomfort; — permanent hearing loss; — stress; — tinnitus; — tiredness;	5.5	6.2.3 c) 6.2.8 c) 6.3.1 6.3.4.2 6.4.3 6.4.5.1 b) and c)
7	**Material/ substance hazards**	— biological and microbiological (viral or bacterial) agent; — dust; — flammable materials;	— breathing difficulties, suffocation; — cancer; — explosion; — fire; — fire spreading; — poisoning; — sensitization.	5.6 ff 5.2.1	6.2.3 b) 6.2.3 c) 6.2.4 a) 6.3.4.4 6.4.5.1 c) 6.4.5.1 g)
8	**Ergonomic hazards**	— access; — visibility;	— stress; — any other (for example, mechanical, electrical) as a consequence of a human error;	5.3.3 5.8.1 5.8.2 5.8.3	6.2.7 6.2.8 6.2.11.8

No	Type or group	Examples of hazards		Specific Requirements Applicable clauses of this standard	Subclause of EN ISO 12100:2010
		Origin[a]	Potential consequences[b]		
9	**Hazards associated with the environment in which the machine is used**	— lightning; — humidity; — snow; — wind;	— slipping, falling; — fire;	5.3.3 5.4.2.1 5.4.2.2 5.4.2.3	6.2.6 6.4.5.1 b)

[a] A single origin of a hazard can have several potential consequences.

[b] For each type of hazard or group of hazards, some potential consequences can be related to several origins of hazard.

5 Safety requirements and/or measures

5.1 General

The extraction system shall comply with the safety requirements and/or protective measures of this clause. In addition, the system shall be designed in accordance with the principles of EN ISO 12100:2010 for hazards relevant but not significant, and which are not dealt with in this document (e.g. sharp edges).

For guidance in connection with risk reduction by design, see EN ISO 12100:2010, 6.2 and for safeguarding measures, see EN ISO 12100:2010, 6.3.

5.2 Control systems

5.2.1 Safety and reliability of control systems

Control systems shall be designed in compliance with the principles of EN ISO 13849-1:2008.

The following safety-relevant functions shall correspond to a performance level (PL) according to EN ISO 13849-1:2008:

— mode selection PL c (see 5.3.2 and 5.8.3);

— emergency stop PL c (see 5.2.2 and 5.8.3);

— interlocking (shut down and switching procedures) to limit effects of fire and explosions PL c (see 5.4.1);

— monitoring of dust concentration in recirculation air PL b (see 5.6.4.2);

— spark extinguishing system PL c (see 5.4.3.2.1);

— interlocking of charging/discharging system with access openings to silos PL c (see 5.8.3).

Verification: By checking the relevant calculations, drawings and the data of the components used.

5.2.2 Emergency stop

Emergency stop devices shall meet the requirements of EN 60204-1:2006 and EN 60204-1:2006/A1:2009, 9.2.5.4 and 10.7, and EN ISO 13850:2008, and shall be placed on each control panel.

Verification: By visual inspection, checking the relevant documents, e.g. drawings, control logic configuration and functional testing.

5.2.3 Failure of the power supply

Automatic re-starting of the extraction system shall be prevented (as specified in EN 60204-1:2006 and EN 60204-1:2006/A1:2009, 7.5, 3rd paragraph).

Verification: By visual inspection, checking the relevant documents, e.g. drawings, control logic configuration and functional testing.

5.3 Protection against mechanical hazards

5.3.1 Stability of structural parts

All structural parts of the extraction system shall be designed so that they can simultaneously carry the weight of the component itself (e.g. duct, fan, separator and rotary valve) and any foreseeable additional load, e.g. the weight of chips and dust accumulations inside parts of the extraction system intended or unintended, of maintenance personnel (100 kg per person), scaffoldings, snow and extinguishing water. Additionally vibrations, wind load and seismic hazards shall be considered.

Support structures for components with explosion relief facilities shall be designed to be fixed and able to withstand reaction forces resulting from an explosion .

All enclosures and directly connected parts up to the next explosion isolation device or pressure reduction device shall resist the maximum pressure in case of an explosion (see 5.4.3.3).

Verification: By checking the relevant documents and calculations.

5.3.2 Shearing, crushing, drawing-in

Hazards by shearing, crushing or drawing-in by movements of machine parts and equipment shall be prevented by design. Access to dangerous moving parts shall be prevented. This can be achieved by fitting fixed or interlocked movable guards, see EN 953:1997+A1:2009.

NOTE For fans and rotary valves, fixed guards have been proven to be effective.

Fixed guards that shall be demounted by the user, e.g. for maintenance and cleaning purposes, shall be fitted with fixing elements remaining attached to the machine or to the guard when the guard is removed, e.g. unlosable screws. See also 6.3.4 i).

If access for maintenance or other reasons is foreseen to be frequent, i.e. more than once per shift, interlocked movable guards shall be used. If it is possible to reach moving parts before they have stopped, the guard shall be interlocked with guard locking. See EN ISO 14119:2013.

If some parts of the machine shall be able to operate with open movable guards (e.g. for maintenance purposes), a lockable selector, switching between automatic and manual mode shall be fitted on the control panel.

In manual mode, the following requirements shall be met:

— dangerous movements shall only be possible by the use of a hold-to-run control;

— an emergency stop control shall be installed where the hold-to-run control is located;

— the hold-to-run control shall be fitted at a safe distance from the dangerous moving parts, providing a clear view on the dangerous zone.

If this is not possible, a mobile hold-to-run control, combined with a 2-position enable switch with an emergency stop or a 3-position enable switch according to EN 60204-1:2006 and EN 60204-1:2006/A1:2009, 9.2.6.3 can be provided.

The stopping time of the moving parts (after releasing the hold-to-run control) should not exceed 0,5 s.

Movable guards giving access to the dangerous zone that are not within view of the operator from where he is working shall continue to be interlocked as during normal operation.

The performance level according to EN ISO 13849-1:2008 shall be at least PLc.

If it's intended to stop single devices for maintenance purposes during operation of the extraction system, these devices (fans, rotary valves, etc.) shall be fitted with a separate lockable mains disconnecting switch to prevent any unexpected restart.

Verification: By visual inspection, checking the relevant documents and functional testing.

5.3.3 Access to machinery

Stairs, ladders and platforms shall be designed according to EN ISO 14122-2:2001 impacted by EN ISO 14122-2:2001/A1:2010, EN ISO 14122-3:2001 impacted by EN ISO 14122-3:2001/A1:2010, and EN ISO 14122-4:2004 impacted by EN ISO 14122-4:2004/A1:2010.

Platforms, which give access to openings in the silo wall, shall give enough space to open the doors and for safe working. Minimum dimensions for silo platforms are given in Table 7, in 5.8.3 and in Annex E, Table E.2.

Verification: By visual inspection and checking the relevant documents.

5.3.4 Pneumatics

The pneumatic installations shall comply with EN ISO 4414:2010.

Verification: By visual inspection and checking the relevant documents.

5.4 Protection against fire and explosion

5.4.1 Hazards of fire and explosion

5.4.1.1 General

The hazard of fire and explosion cannot be eliminated. The hazard can be generated from external or internal factors. Ignition sources can be introduced into the extraction system. Therefore, adequate protection measures are required.

A fire or an explosion within a filter shall be detected with suitable sensors (e.g. spark detectors, flame detectors, particle counters, gas sensors for fire, pressure sensors or monitoring of the explosion venting devices, etc.).

Once a sensor detects a fire or an explosion, the following actions shall be automatically performed:

— shut down of the chip and dust extraction system;

— diversion from recirculation air to exhaust air;

— activation of a visual and/or audible alarm.

An explosion within a silo shall be detected with suitable sensors (e.g. pressure sensors or monitoring of the explosion venting devices, etc.).

Once a sensor detects an explosion, the following actions shall be automatically performed:

— shut down of the filling and discharge system;

— activation of a visual and/or audible alarm.

The interlockings described above shall fulfil the requirements of PL c, see 5.2.1.

Verification: By visual inspection, checking the relevant documents and functional testing.

5.4.1.2 Parameters for fire and explosion

The fire and explosion characteristics stated below shall be used for the design of the fire and explosion protection measures (see Table 3):

Table 3 — Parameters for wood dust

Parameter	Units	Remarks/Reference
minimum ignition energy (MIE)	60 mJ	
minimum ignition temperature of a dust cloud (MIT dc)	400 °C	
Minimum ignition temperature of a dust layer with reference to a 5 mm layer of dust (MIT dl5)	250 °C	(increased layers of dust reduce the minimum ignition temperature)
combustion class	4/5	
lower explosion limit/level (LEL)	60 g m^{-3}	The particle size distribution in extraction systems is not homogeneous. In literature, a LEL of 30 g m^{-3} for a particle size less than 63 µm can be found. In extraction systems, this value is not representative for the real situation. A LEL of 60 g m^{-3} has therefore been adopted.
maximum explosion overpressure P_{max}	9 bar	
maximum pressure rise K_{ST}	200 bar ms^{-1}	

5.4.1.3 Avoidance of chip and dust accumulation in ducting

Ducting shall be designed in such a way that accumulation of chip and dust does not occur.

The conveying air velocity in all parts of the ducting shall be sufficient to avoid accumulation of chip and dust in the ducts.

Duct connections, inspection doors, dampers, gate valves, fire-gates, etc. integrated in ducting shall not hinder continuous material transportation.

NOTE The minimum conveying air velocity depends on the material load, the moisture content, the particle size of the chip and dust. Table 4 shows minimum conveying air velocities of chip and dust with a moisture content ≤ 15 %.

Table 4 — Minimum conveying air velocity of wood waste with a moisture content ≤ 15 %

Minimum conveying air velocity	dust	chips	shavings
low material load < 50 g m^{-3}	12 ms^{-1}	15 ms^{-1}	18 ms^{-1}
high material load < 150 g m^{-3}	15 ms^{-1}	18 ms^{-1}	21 ms^{-1}
conveying system	18 ms^{-1}	22 ms^{-1}	25 ms^{-1}

Verification: By visual inspection, checking the relevant documents, measuring the air velocities and functional testing.

5.4.2 Fire protection and prevention

5.4.2.1 General

The spreading of fire (heat radiation and flame transmission) from the filter to adjacent equipment and objects shall be avoided. The spreading of fire and smoke through ducting connected to the filter (extraction ducting, recirculation air ducting, conveying system) shall be avoided.

With regard to fire protection requirements, national rules and regulations should be adhered to in agreement with the customer.

5.4.2.2 Measures against fire spreading

Filter shall be located outdoors.

Ducts connected to the filter (extraction ducts, recirculation air ducts, conveying system) shall be equipped with devices to stop the spreading of fire and smoke.

Extraction ducts and recirculation air ducts shall either:

a) not pass through a fire wall; or

b) be equipped with fire gates according to EN 1366-7:2004 (extraction ducts) and fire dampers according to EN 1366-2:2015 (recirculation air ducts) of an appropriate class of fire rating; or

c) be insulated in accordance with the requirements of EN 1366-1:2014 in the corresponding fire zones.

Verification: By visual inspection, by checking of the corresponding drawings and by requesting a declaration of compliance from the manufacturer of the components.

5.4.2.3 Measures against fire damage

All filters, silos and any other closed storage devices with a storage volume of > 1 m^3 shall, as a minimum, have a fixed fire suppression system installed with a fire hose coupling according to local standards. The coupling shall be at a height of 0,4 m to 0,8 m above ground and safely and easily accessible for connection with a fire hose.

The fire suppression system shall comply with the following requirements:

a) Water nozzles shall be placed so that the entire cross section is reached by the water and the required water flow of 5,0 l/m^2min is ensured. The area protected by one nozzle shall not exceed 12 m^2. The distance between nozzles shall not exceed 4 m and the distance between nozzles and filter housing shall not exceed 2 m. Instructions by the manufacturer of the nozzles shall be considered;

b) automatically activated sprinkler systems shall also have a manual activation.

The manufacturer of the extraction system shall specify the required water pressure for the fire suppression system and the water consumption at the specified pressure (see 6.3.1 i).

The fire suppression system limits the fire and reduces the hazard, e.g. by cooling the housing and binding the dust. In order to extinguish the fire in the filter completely, the remaining material should be brought out of the filter or the silo. Hereby hazard of fire is present due to possible re-ignition by unextinguished material.

Verification: By visual inspection of the extraction system and checking of the relevant drawings.

5.4.3 Explosion

5.4.3.1 Ignition sources

An assessment of the ignition source shall be performed for the extraction system. According to EN 1127-1:2011, the efficiency of the following ignition sources shall be analysed (see Table 5):

Table 5 — Potential types of ignition sources

	Ignition sources	Existing	Effective
1	Hot surfaces	present under certain conditions:	
		— foreign objects carried over into the system which blocks or overcharge moving parts, e.g. discharge screw conveyor	Yes
		— welding-, grinding- and metal cutting activities during maintenance work	Yes
		— bearings	Yes
2	Flames and hot gases, including hot particles	existing, if hot flue gases enter the silo from the combustion equipment	Yes
		existing, if flames or hot particles occur at the connection point and are introduced	Yes
3	Mechanically generated sparks	on principle possible with fans, high speed parts of the extraction system	Yes
		mechanical discharge systems	No, mechanical discharge systems are usually running at low speed (<1 ms^{-1})
		impact and friction sparks caused by metal parts carried over into the system	Sparks from single impacts are in general not effective, if the impact energy is below 20 Nm (see EN 13463–1:2009, 6.4.2.2.5, Table 8). EXAMPLE With an air velocity of 20 ms^{-1}, a metal part with a weight less than 100 g could not cause an impact spark with enough energy ($E = 0,5 * m * v^2$).
4	Electrical equipment and electrical installation	electrical equipment in hazardous areas	Yes

	Ignition sources	Existing	Effective
5	Static electricity		
		spark discharge (occurs with inadequate earthing) of conductive parts	Yes (depending on the size of the components without earthing)
		brush or corona discharge	No (non-incentive for dusts with minimum ignition energy > 3 mJ)
		— propagating brush discharge (occurs in principle e.g. with pneumatic conveying of dusts and bulk material in non-conductive ducts or conductive ducts with non-conductive coatings or liners of high dielectric strength)	Yes (shall be avoided by - using conductive materials or non-conductive material of low dielectric strength; the breakdown voltage through the insulating wall or layer shall be less than 4 kV - thickness of the non-conductive surface more than 9 mm or surface charge density < $2{,}5 \times 10^{-4}$ C/m^2)
		— cone discharge (occurs in principle with filling of silos or large containers with charged highly non-conductive bulk materials)	No (not to be expected if bulk material with a volume resistivity < 10^{10} Ωm is handled)
6	Lightning	gnition source, if a lightning protective system according to EN 62305–1:2011 is installed	Yes, in case a lightning protective system does not exist
7	Exothermal reaction	possible temperature rise due to decomposition of chips and dust	Yes, hazard of self-ignition
		glowing nests carried over into the system	Yes

5.4.3.2 Prevention of hazards due to ignition sources

5.4.3.2.1 Ignition sources carried over into the system

If the extraction system is connected to woodworking machines with a higher probability of generating ignition sources like sparks, glowing nests or other hot particles, a spark extinguishing system shall be installed in the extraction duct from these machines to the filter.

The spark extinguishing system shall fulfil the requirements of PL c, see 5.2.1.

NOTE The use of spark extinguishing systems does not replace constructive measures according to 5.4.3.3.

Machines with a higher probability of generating ignition sources could be for instance, depending on their application and material processed:

— wide belt sanding machines ;

— multiblade rip sawing machines (EN 1870-4:2012);

— high speed four-sided moulding machines (machines excluded EN 12750:2013).

Verification: By visual inspection of the extraction system and checking of the list of machinery connected to it and the relevant drawings.

5.4.3.2.2 Mechanically generated hot surfaces

To avoid temperature rise caused by friction, velocity of discharge systems shall be lower than 1 ms^{-1}. The risk of hot surfaces caused by bearings shall be minimized by either placing the bearings away from the dust loaded part of the system or other measures.

Verification: By visual inspection, checking the relevant drawings and calculations as well as the declaration of compliance from the manufacturer of the equipment.

5.4.3.2.3 Mechanically generated sparks

Where, due to their function, parts made of metal, could cause sparks, this hazard shall be avoided by constructive measures/design (e.g. limited velocity, material combination). Fans shall comply with the requirements of EN 14986:2007, if an explosive atmosphere is conveyed.

To avoid sparks, relative movements of discharge systems in the crude air part shall run with velocities lower than 1 ms^{-1}.

Verification: By visual inspection, checking the relevant drawings and calculations as well as the declaration of compliance from the manufacturer of the equipment.

5.4.3.2.4 Electrical equipment and electrical installation in hazardous areas

The category of equipment shall be in accordance with EN 1127-1:2011 depending on the probability of occurrence of a hazardous explosive atmosphere. Installation of electrical equipment shall be in accordance with EN 60079-14:2014.

NOTE Hazardous areas are classified in terms of zones on the basis of frequency and duration of the occurrence of an explosive atmosphere, see Annex C.

Verification: By visual inspection, checking the relevant documents as well as the declaration of compliance from the manufacturer of the equipment.

5.4.3.2.5 Static electricity

All conductive parts of the extraction systems shall be earthed. The complete system shall have no potential difference between its individual parts and all the extraction hoods of the connected machines. Ducting shall be made of conductive material and shall not be coated or lined with electrostatic chargeable material.

Conductive support cages and support rings for filtering elements shall be earthed in order to divert any charge to ground potential. For small conductive parts with a capacity ≤ 10 pF, e.g. tension belts for filter hoses, earthing is not necessary.

NOTE Conductive or antistatic filtering media are not required for wood dust because the minimum ignition energy of combustible dusts is > 3 mJ.

All flexible hoses shall be flame retardant. They shall also be made of antistatic material or able to lead charge to earth potential via a metallic spiral. Both ends of this spiral shall be earthed.

Verification: By visual inspection, checking the relevant drawings and the information of the equipment manufacturer.

5.4.3.2.6 Lightning

Extraction systems in need of protection against the effects of lightning shall be fitted with a lightning protective system according to EN 62305-1:2011.

Verification: By visual inspection, checking the relevant drawings and the information of the equipment manufacturer.

5.4.3.3 Constructive measures against impact of explosions

To limit the effects of an explosion, filter, silos and any other closed storage devices with a storage volume of > 1 m^3 shall be equipped with adequate constructive explosion protective devices according to EN 1127-1:2011, 6.5. Such measures are described in the following standards:

— Explosion venting devices, EN 14797:2006;

— Dust explosion venting protective systems, EN 14491:2012;

— Flameless explosion venting devices, EN 16009:2011;

— Explosion isolation systems, EN 15089:2009;

— Explosion suppression systems, EN 14373:2005;

— Explosion resistant equipment, EN 14460:2006;

— Explosion diverters, EN 16020:2011;

— Explosion isolation flap valves, EN 16447:2014.

The pressure wave and the flame front expelled from explosion venting elements shall vent to a safe place (e.g. outdoor atmosphere and away from work areas and gangways with open access).

If it is not possible to vent to a safe place, flameless explosion venting devices, explosion suppression systems or pressure resistant equipment shall be applied.

All crude air inlets, all clean air outlets and all material inlets and outlets shall be protected against flame and pressure propagation.

Alternatively to individual type-tested explosion protective measures and consideration of interactions of individual measures, an adequate reduction of explosion effects can be achieved by the following measures:

a) by a third party certification. The operating conditions of the filter system as well as interaction of the different applied safety measures (e.g. explosion venting and back pressure flap) shall be considered and the effectiveness of the applied protective measures shall be proven; or

b) by the following design which has been established for filters with calculated crude air loads ≤ 50 % of the LEL in the extraction ducting.

   Explosion venting:

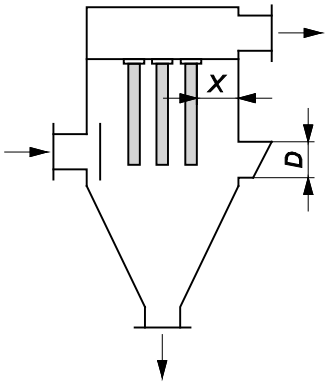
   1) all explosion venting devices located in the crude air part,

   2) explosion venting devices, tested as autonomous safety systems according to ATEX Directive 94/9/EC (according to EN 14797:2006),

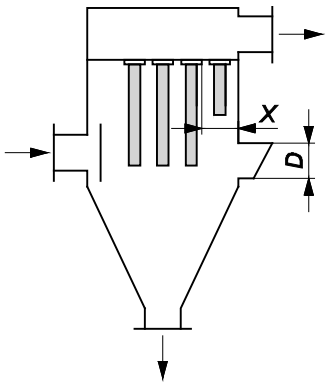
3) dimensioning of the explosion venting areas with a reduced explosion pressure of ≤ 200 mbar in accordance with EN 14491:2012 and based on the dust characteristics given in Table 3 of this standard,

4) prevent blocking of venting devices according to EN 14491:2012 (inside and outside the venting device). Walls or baffles preassembled outside the venting devices cause higher explosion pressures in the filter. This shall be considered in the design,

5) maintain free passage area between the first arrays of the filter elements and the venting device according to EN 14491:2012. When filter elements (partly) block the venting devices, the filter elements in front of these devices shall be removed completely or shortened, so that they do not extend below the top of the venting device: In addition, bars should be installed to refrain the filter elements from obstructing the venting process. The distance *X* between the first array of the filter elements and the venting device (see Figure 1) shall be such, that the passage area directly in front of the venting device at least equals that of the venting device;



a) filter bags removed



b) filter bags shortened

Key

X distance between the first arrays of filter elements and the venting device

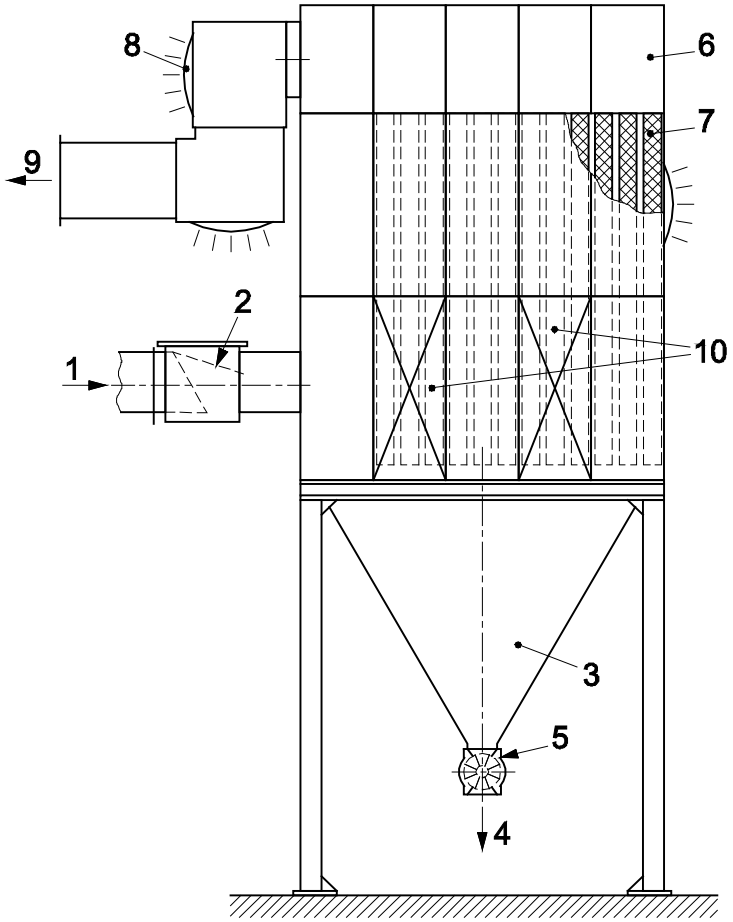
D diameter of venting device

Figure 1 — Filter elements in front of the venting device

c) Flame and pressure propagation:

1) back pressure flap installed outside the filter-housing, see Figure 2, according to the following requirements:

i) installation close to the filter,



Key

1 crude air inlet
2 back pressure flap
3 crude air part
4 material discharge
5 rotary valve
6 clean air part
7 filter media
8 explosion venting device
9 recirculation air
10 explosion venting devices

Figure 2 — Special filter unit design – Example

ii) design:

— pressure resistance ≥ P_{redmax} of the filter housing,

— blade design with the centre of gravity in closed position offset to the axis of rotation to ensure self-activated closure,

— tightness: leakage at closed position less than 1 % of its nominal volume flow rate with a pressure of P_{redmax},

— made of steel,

— designed to avoid chip and dust accumulation,

— accessibility for maintenance, for maintenance procedures see 6.3;

2) recirculation air ducts equipped with a 2 × 90°- or 180°-bend with integrated explosion venting elements - first bend mounted less than 2 m from the filter housing,

3) If a conveying system, silo or container is connected to a filter, the material discharge shall be equipped with a pressure shock resistant and flame-arresting rotary valve, tested as autonomous safety system (in accordance with Directive 94/9/EC) according to EN 15089:2009.

d) Pressure resistance

Pressure shock resistance according to the calculated P_{redmax} for the following items:

— filter housing,

— back pressure flap,

— duct from back pressure flap to the filter housing,

— duct from the filter housing to the venting devices in the recirculation air duct,

— rotary valve for the discharge system.

Verification: By visual inspection, checking the relevant drawings, calculations, test reports and declaration of conformity from the manufacturer of the components.

5.5 Protection against noise

Extraction systems shall be 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.

NOTE 1 The main noise sources and measures to reduce noise of chip and dust extraction systems are described in Annex D.

NOTE 2 EN ISO 11688-1:2009 gives general technical information on widely recognized technical rules and means for the design and construction of low-noise machinery.

NOTE 3 EN ISO 11688-2:2000 gives useful information on noise generation mechanisms in machinery, plants and systems.

Verification: By checking the noise declaration.

5.6 Protection against hazardous substances

5.6.1 Dust emissions

Extraction systems shall be designed and constructed to avoid leakage. Ducting placed inside the working area should operate at pressures below atmospheric pressure.

It shall be possible to remove chip bins with a minimum of dust release and to empty them out, e.g. by using inserted bags. The maximum useable volume of the chip bins shall be indicated by a mark and the filling level shall be visible without removing the chip bins or bags.

Bags for chip bins in vacuum plants shall be protected against suction by the fan, e.g. by means of pressure compensation ducts. If a pressure compensation duct is connected to the clean air part of the filter, contamination by dust shall be prevented, e.g. by using filter elements installed in the pressure compensation facilities which possess at the least the same filter class as the main filter elements.

The usable volume of individual chip bins shall not be larger than 165 l, or these bins shall be equipped with auxiliary equipment such as sling ropes or belt drives in order to enable the lifting of the chip bags with the aid of mechanical facilities such as cranes or manipulators.

Verification: By visual inspection of the extraction system and checking the relevant drawings.

5.6.2 Performance requirements

The extraction system shall be designed and constructed taking account of:

1) number and type of machines to be connected to the extraction system;

2) extraction performance data for each machine (see Table 6);

3) concurrency factor of machines in use (minimum, average and maximum);

4) machine floor plan and layout from the workshop or production site.

Table 6 — Necessary extraction performance data for each machine

No.	Parameter	Symbol	Unit
1	Position of the connection point		
2	Movement flexibility of the connection point	$M_{x/y/z}$	[mm]
3	Diameter of the connection point	d	[mm]
4	Vacuum pressure at the connection point	P	[Pa]
5	Air velocity or volume flow rate	v q_v	[ms^{-1}] [m^3h^{-1}]
6	Average material flow rate	q_m	[kg/h]
7	Maximum material flow rate	q_m max	[kg/h]
NOTE Data to be provided by the user.			

The design and construction of the extraction system shall enable that all machines operating under the specified working conditions will have as a minimum the indicated volume flow rate.

Gate valves for disconnecting a single woodworking machine or other extraction connection points shall operate automatically. Manual gate valves may be used for disconnection of single woodworking machines with a small volume flow rate related to the total volume flow rate.

Even with a part of the gate valves closed, the minimum required air velocity for material transport shall be guaranteed in all used sections of the ducting.

NOTE This can be reached for example with bypass-systems or injection of air.

The volume flow rate shall be measured at the machine connection points for the worst case combination. The measurements shall be documented.

All filters shall be equipped with automatic cleaning devices for filter media.

Verification: By checking the relevant drawings and by calculation based on measurements and/or technical specifications.

5.6.3 Performance indication

The extraction system shall be fitted with equipment for the permanent monitoring of the volume flow rate. The monitoring can be ensured for example by the following measures:

— indicator at each main duct to demonstrate that the specified extraction requirement (e.g. vacuum) is achieved;

— comparison of the fan power with the extraction points in use;

— pressure difference measurement over the filter elements.

The monitoring system shall activate an output signal and acoustic or visual alarms when the performance is out of range.

Verification: By visual inspection, measurement of the air velocity in the ducts and checking of the measurement reports at hand.

5.6.4 Reintroduction of dust

5.6.4.1 Recirculation air

When recirculation air is used (depending on national regulation) the following requirements shall be fulfilled:

— the residual dust content in the recirculation air shall not exceed 0,1 mg m^{-3} and the measurement shall be made in accordance with the requirements of EN 1093-7:1998+A1:2008. In difference to the referenced standard, the measurement is conducted in the recirculation air duct and not in a measuring room. The measurement shall be carried out at maximum volume flow rate;

— the dust content in the recirculation air shall be monitored continuously (e.g. by tribo sensor, optical sensors or pilot filter);

— the design of the extraction system shall provide means for diverting from recirculation air to exhaust air.

If there are hazards of biological or microbiological (viral or bacterial) agents, the design of the extraction system shall not allow recirculation air.

NOTE Limitations of dust emissions from the extraction system to the outdoor atmosphere are not part of this standard.

Verification: By visual inspection of the extraction system, measurement of the residual dust content in the recirculation air or by checking of the measurement reports. It is possible to use measurement reports from comparable extraction systems (i.e. same type and same material of filter elements, same cleaning system, similar filtering area load, similar filter pressure drop during operation); for the purpose of comparability, it's recommended to use the measurement procedure described in Annex F.

5.6.4.2 Monitoring devices

Monitoring devices for the residual dust content shall meet the following requirements:

— a warning signal (visual and/or acoustic alarm) shall be activated when the residual dust content is elevated. The triggering level for this signal shall be between 0,1 mg m^{-3} and 0,3 mg m^{-3};

— when the residual dust content exceeds 0,3 mg m^{-3}, a system malfunction alarm shall be given and either the recirculation air shall be diverted automatically to exhaust air or the extraction system shall be shut down automatically;

— when the air velocity in the recirculation air duct is variable, the monitoring device shall give adequate signals in the operational range of air velocity in the recirculation air duct.

Monitoring devices shall fulfil the requirements of PL b, see 5.2.1.

Verification: By checking the measurement reports and the sensor signals.

5.7 Protection against electrical hazards

With the exception of 6.3, the requirements of EN 60204-1:2006 and EN 60204-1:2006/A1:2009 apply unless stated otherwise in this document.

See EN 60204-1:2006 and EN 60204-1:2006/A1:2009, 6.2 for the requirements regarding prevention of electric shock due to direct contact, and EN 60204-1:2006 and EN 60204-1:2006/A1:2009, Clause 7 for the requirements regarding protection against short circuits (feeder circuit excluded) and overloading.

The protection against electric shock due to indirect contact should be ensured by automatic isolation of the electrical power supply of the machine by the operation of a protective device installed by the user in the line powering the machine (see the information provided by the manufacturer in the instruction handbook, 6.3 w)). The protection against electric shock due to indirect contact shall be ensured by the user, e.g. by automatic isolation of the electrical power supply of the machine by the operation of a protective device installed in the line powering the machine (see information provided by the manufacturer in the instruction handbook 6.3.2 c)).

The protection against short circuits of the feeder circuit shall be ensured by the user (see information provided by the manufacturer in the instruction handbook, 6.3.2 d)).

The degree of protection of all electric components outside of enclosure(s) and the enclosure(s) for electrical components itself/themselves shall be at least IP 54 in accordance with the requirements of EN 60529:1991, EN 60529:1991/A1:2000 and EN 60529:1991/A2:2013.

Live parts in electrical enclosures shall not be accessible in accordance with EN 60204-1:2006 and EN 60204-1:2006/A1:2009, 6.2.2. Fire risk is not present where power circuits are protected against over current in accordance with EN 60204-1:2006 and EN 60204-1:2006/A1:2009, 7.2.3.

In accordance with EN 60204-1:2006 and EN 60204-1:2006/A1:2009, 18.1 the test 1 for the continuity of the protective bonding circuit and with EN 60204-1:2006 and EN 60204-1:2006/A1:2009, 18.6 the functional test apply.

Verification: By checking the relevant drawings and/or circuit diagrams, inspection of the machine and relevant tests. In accordance with EN 60204-1:2006 and EN 60204-1:2006/A1:2009, 18.2 the test 1 for the continuity of the protective bonding circuit and with EN 60204-1:2006 and EN 60204-1:2006/A1:2009, 18.6 the functional test apply.

NOTE For electrical components characteristics information from the electrical components suppliers can be useful.

5.8 Additional requirements for silos

5.8.1 Requirements for design and construction

The design of the silo shall be such that disturbances of the material flow are avoided:

— The storage space shall not contain any installations that can hinder the flow of material.

— Interior walls of the silo should be smooth, concrete walls at least raw (Cat. D3 according to EN 1991-4:2006, Table 4.1) and free from ledges, corners and protruding parts.

— The bottom of the silo shall be constructed in such a way that the risk of bridging and plugging is minimized.

— The cross section of a silo shall be either constant or decrease with the height of the silo.

— If material is not removed regularly under normal operating conditions, facilities shall be provided for the circulation of the material stored.

— For silos with a L/D ratio greater than 2,5 and/or intended for the storage of material with a moisture content > 15 %, additional measures shall be provided to ensure the flow of material, e.g. compressed air cannons or continuous circulation of stored material.

— It shall be possible to check the filling level of the silo from outside.

Verification: By visual inspection and checking the relevant drawings.

5.8.2 Discharge system

Silos shall be equipped with an automatic mechanical discharge system. This shall cover the entire cross section of the silo.

The discharge system shall be capable of emptying the silo even in the case of an emergency (e.g. fire). If the discharge system is connected to other equipment (e. g combustion system, press system), a bypass shall be provided.

To empty a silo in the event of the failure of the discharge system, openings shall be provided for the mounting of emergency discharge system.

As an alternative to the requirements stated in the two paragraphs above, a corresponding number of additional access doors shall be provided for silos with a cross section up to 45 m^2 (for details, see normative Annex E).

Verification: By visual inspection and checking the relevant drawings and calculations.

5.8.3 Openings for silos

Openings shall be guarded against unauthorized access (see Figure 3). It shall not be possible to open such guards (doors or hatches) without a tool or a key. Silo access openings (doors) shall be interlocked with the charging and discharge system as well as with compressed air cannons, if fitted.

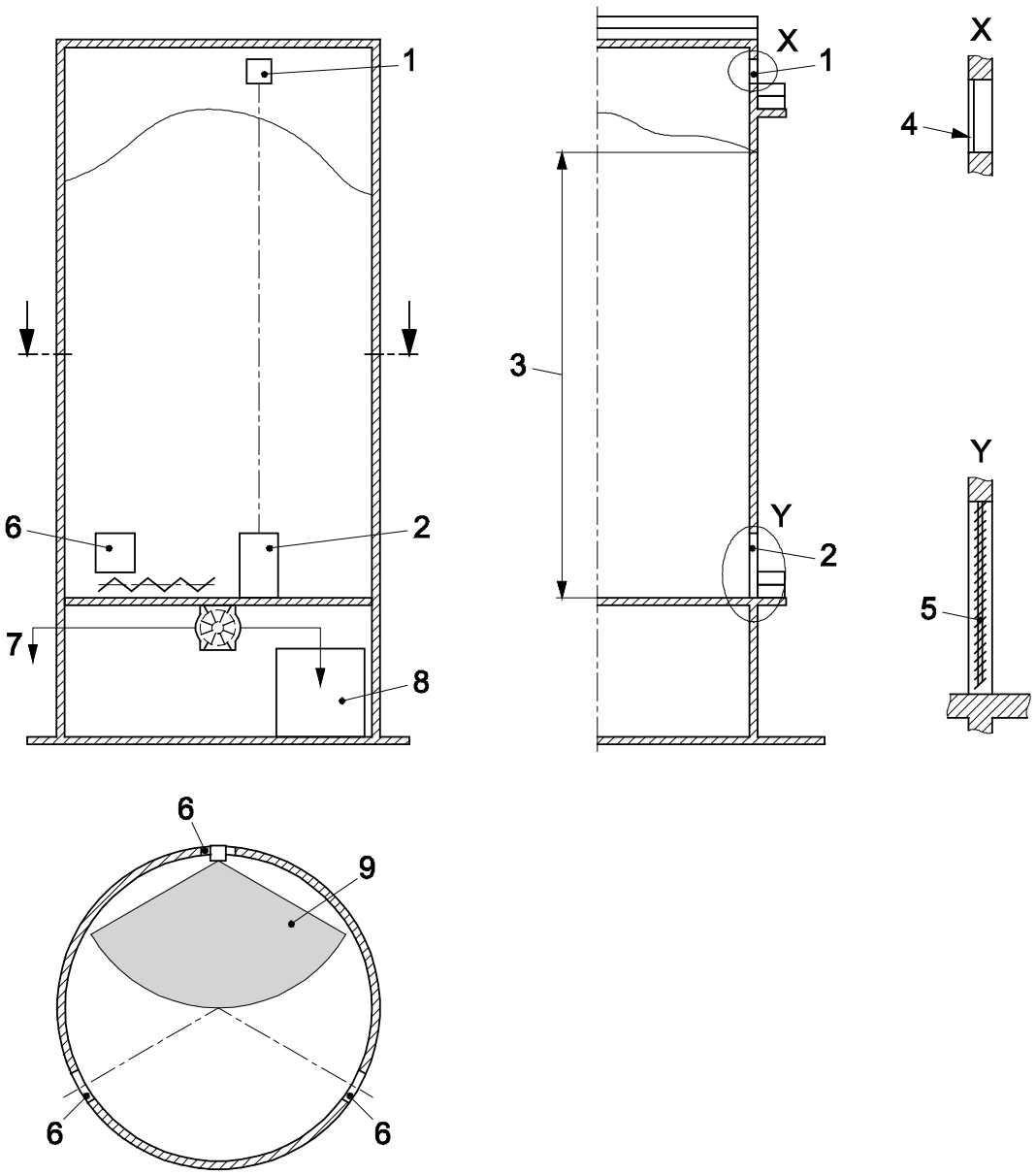
The safety related parts of the control system for interlocking shall achieve at least PL c (see also 5.2.1).

Level control openings shall be designed so that it is impossible for the operator to enter the silo through them (e.g. by its size or by installed bars).

Openings located on top of the silo shall be safeguarded by bars in the openings to prevent personnel from falling into the silo.

If bars are used, the vent area of the opening will be reduced. This should be taken into account in the design of the explosion venting device.

Ladders shall be secured against use of unauthorized persons (see EN ISO 14122-4:2004 impacted by EN ISO 14122-4:2004/A1:2010).



Key

1 opening for level control

2 access opening (door): maintenance at the discharge equipment

3 maximum filling height

4 bars to avoid entrance

5 boards in the door openings

6 opening for the mounting of an emergency discharge equipment to empty the silo in case of a break-down of the built-in discharge equipment (3 openings, angle 120°)

7 emptying the silo in case of a fire and overfilling with the discharge equipment

8 combustion system

9 working radius of emergency emptying system

Figure 3 — Silo openings and discharge system

The openings for entrance and emergency discharge system shall not be located under ground-level and shall be accessible also for the mounting of the emergency discharge system from the outside. The area in front of these openings shall be accessible by means of transportation.

Openings shall be designed with minimum dimensions according to Table 7. For silos according to Annex E the dimensions according to Table E.2 shall be used.

At least one control opening shall be provided above the maximum filling height.

Additional openings shall be provided, to remove from the outside material bridges, adhesions, etc. present inside the silo.

For this purpose, one or more openings may be provided in the silo ceiling to insert a mechanical system to remove such bridges, adhesions, etc. Dimensions and number of the necessary openings are depending on the requirements of the manufacturer of this system.

To protect personnel when emptying the silo by hand, boards shall be installed in the door openings. The boards shall cover the full door opening and shall be removable one-by-1 starting from the bottom upwards, see Figure 3 and Figure E.1 in Annex E.

To protect personnel when cleaning the silo, boards shall be installed in the openings. These boards shall cover the whole opening and shall be removable.

Table 7 — Minimum size openings in silo walls and platforms which give access to these openings

	Minimum opening size		Minimum platform size	
	height *h* [m]	width *w* [m]	height *h* [m]	depth *d* [m]
Access opening (door)	1,8 [a]	0,90 – 1,10 [b]	The platform shall be so large that hatches/doors can be opened by 180° (platforms for two side use) and 90° (platforms for single side use). The distance between edges of flaps/doors to all fixed installations shall be at least 20 cm.	
Level control opening	0,6	0,6		
Opening for mounting an emergency discharge system	[c]	[c]		

[a] With a doorsill of maximum 10 cm.

[b] 0,90 m (up to 7,5 m silo diameter) and 1,10 m width (more than 7,5 m silo-diameter).

[c] The dimension of the opening and the position in the silo wall for mounting an emergency discharge system shall be according to the requirements of the manufacturer of the emergency discharge system.

For maintenance purposes, it shall be possible to run the automatic discharge system with the door(s) in the open position. A mode selector and a hold-to-run control and an emergency stop control in accordance with 5.3.2 shall be provided.

Verification: By visual inspection, functional testing and checking the relevant drawings

6 Information for use

6.1 General

The information for use shall comply with EN ISO 12100:2010, 6.4, especially with 6.4.4 “Marking” and 6.4.5 “Instruction handbook”.

6.2 Marking

The marking of the extraction systems shall include the following information:

a) business name and address of the machine manufacturer and, where if applicable, of his authorized representative;

b) designation of machinery;

c) designation of series or type;

d) serial number;

e) year of construction, that is the year in which the manufacturing process is completed;

f) maximum design volume flow rate for the extraction system;

g) the following signs shall be fixed as pictograms at all access points:

Table 8 — Pictograms at access points

Warning signs	Prohibiting signs	Mandatory signs
Explosive atmosphere	Access prohibited to unauthorized personnel (restricted access area)	Wear respirator
	Fire, naked flames and smoking prohibited	

Verification: By visual inspection of the extraction system.

6.3 Instruction handbook

6.3.1 General

The manufacturer shall supply an instruction handbook for every chip and dust extraction system.

The instruction handbook shall include at least the following:

a) detailed description of the extraction system and safety systems:

   1) explosion venting systems,

   2) explosion isolation devices,

   3) spark detection and extinguishing systems,

   4) residual dust content monitoring systems in the recirculation air,

   5) performance indicators;

b) intended use, information about the relevant explosion parameters of dust taken as a basis for the design of the extraction system and the resultant restrictions for the material machined on the woodworking machines connected to it (see Table 3);

c) reasonably foreseeable misuse (e.g. connect extraction system to metal working machines);

d) information: if wood material contaminated with biological or microbiological (viral or bacterial) agents is processed, the clean air shall not be recirculated into the working area;

e) noise emission values (see 6.3.7);

f) information that the extraction system shall be included into the users explosion protection, fire protection and prevention documents;

g) information on the purpose of explosion venting systems, that the venting shall not be affected by any obstructions and that the danger zone shall be kept free from personnel and flammable material because flame and pressure effects outside the filter and/or silos and flying debris shall be expected;

h) information on de-commissioning, dismantling and safe disposal (see EN ISO 12100:2010, 6.4.5.1 f));

i) information about residual dust content in the recirculation air;

j) information on the operating method to be followed in the event of accident or breakdown, e.g.:

   1) the required water pressure for the fire suppression system and the water consumption at the specified pressure;

   2) filter leakage.

Verification: By checking of the instruction handbook.

6.3.2 Information related to installation

The information related to installation shall contain the following:

a) references and instructions for installation (e.g. foundation plans, required space);

b) references and instructions for transport;

c) information on how to provide protection against electric shock due to indirect contact in the machine by a device for automatic disconnection of the power supply to be installed by the user in the line powering the machine (RCD);

d) information on how to provide protection against short circuits of the feeder circuit.

Verification: By checking the instruction handbook.

6.3.3 Information related to operation

The information related to operation shall contain the following:

a) instructions for safe operation (e.g. start, system re-start after breakdown, stop, mode selection) with regard to explosion/fire risks and hazardous dust loads;

b) warnings against all residual risks;

c) requirements for the training of personnel and reference, that the extraction systems shall be operated only by trained personnel under the intended operating conditions;

d) at switching off the connected woodworking machines, accumulations shall be avoided by ensuring a sufficient overrun time of the extraction system.

Verification: By checking the instruction handbook.

6.3.4 Information related to maintenance

The information related to maintenance shall contain the following:

a) the nature and frequency of maintenance tasks to be carried out;

b) training necessary for maintenance personnel;

c) a specification of maintenance operations which can be carried out by users (operators, etc.);

d) drawings and diagrams enabling maintenance personnel to carry out their task rationally;

e) a list of access points for maintenance;

f) most common failures, their causes and procedures to resolve them;

g) a description of the safe working practices to be used during maintenance or system re-start after breakdown with regard to the explosion/fire risks (especially hot works) and hazardous dust loads;

h) information on the safe procedures for maintenance work in the crude air part of the filter include information that

   1) all persons involved shall be instructed regarding the safety procedures including escape/rescue procedures;

   2) one person shall oversee/supervise the work;

   3) suitable tools shall be used, including personal protection equipment;

   4) it is strictly forbidden to step under material bridges.

i) description of fixed guards which could be removed by the user for maintenance and cleaning purposes. (guards to be dismounted only by the manufacturer or personal charged by the manufacturer are excluded);

j) the identification data of the spare parts to be changed by the user, when these affect the health and safety of operators (parts to be changed only by the manufacturer or personal charged by the manufacturer are excluded).

Verification: By checking the instruction handbook.

6.3.5 Information related to silos

Subclauses 6.3.1 to 6.3.4 are applicable for silos. The information related to silos shall additionally contain the following:

a) Information to avoid disturbances in the material flow (e.g. bridging):

   1) characteristics of the material suitable for the storage;

   2) the frequency and the amount of material removal (depends on the material composition, moisture, etc.).

b) Procedures how to resolve disturbances safely in case of formation of material walls and material bridges inside a silo;

c) The emergency emptying of a silo. Emergency cases are:

   1) the silo being overfilled;

   2) fault at the discharge system;

   3) fire / explosion in the silo.

d) Information on the safe procedures for emptying the silo:

   1) all persons involved shall be instructed regarding the safety procedures including escape/rescue procedures and the use of special tools;

   2) one person shall oversee/supervise the work;

   3) suitable tools to be used shall be described, including personal protection equipment;

   4) it is strictly forbidden to stand on piles of material or to step under material bridges.

e) Procedure how to enter the silo:

   1) emptying the silo;

   2) before entering the silo, the presence of carbon monoxide (CO) and carbon dioxide (CO_2) shall be measured;

   3) ventilation of the silo (natural / technical);

f) Procedures for maintenance of the discharge system.

Verification: By checking the instruction handbook.

6.3.6 Fire fighting

The information related to fire-fighting shall contain the following:

In case of fire:

a) alert fire brigade;

b) stop feeding material ;

c) do not open the filter and silo openings;

d) evacuate the area.

It is recommended to inform the local fire brigade about the specific hazards of the extraction system and to organize regular training sessions with the local fire brigade

Verification: By checking the instruction handbook.

6.3.7 Noise declaration

The instruction handbook shall provide the following information:

— The A-weighted sound pressure levels measured at a distance of 1 m and at a height of 1,6 m from the surface of fans and other parts of the extraction system, that may cause noise emissions with more than 70 dB(A) (e.g. filter with cleaning system by compressed air). In the case that the fan(s)

is/are on the clean air side A-weighted sound pressure levels measured below the outlets of the recirculation air ducts at a height of 1,6 m. The highest value for each component measured shall be stated;

— associated measurement uncertainty (K_{pa} = 4 dB);

— operating conditions during testing;

— the standard used for the measurement.

Where the sound pressure level does not exceed 70 dB(A), this fact shall be indicated.

The noise declaration shall be accompanied by the following statement:

The figures quoted are emission levels and are not necessarily working levels. While there is a correlation between the emission and exposure levels, this cannot be used reliably to determine whether or not further precautions are required. Factors that influence the actual level of exposure of the work-force include the characteristics of the work room, the other sources of noise, etc., i.e. the number of machines and other adjacent processes. Also the permissible exposure level can vary from country to country. This information, however, will enable the user of the machine to make a better evaluation of the hazard and risk.

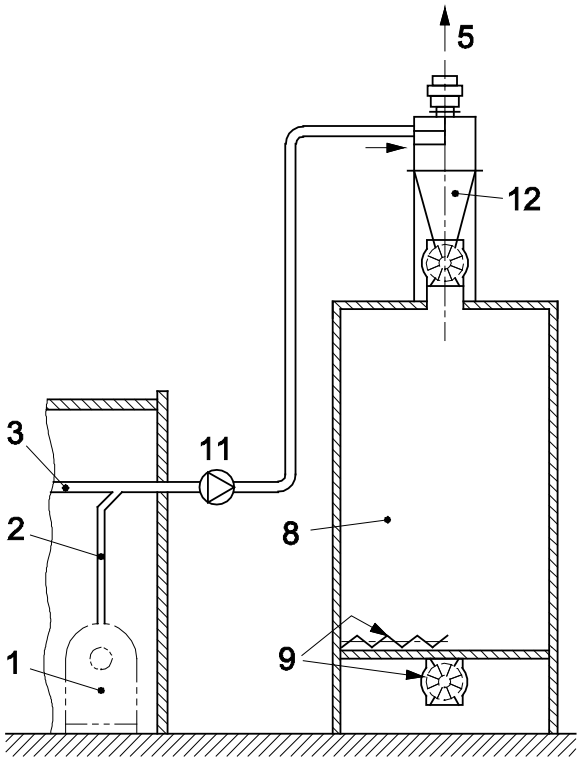
Verification: By checking the instruction handbook.

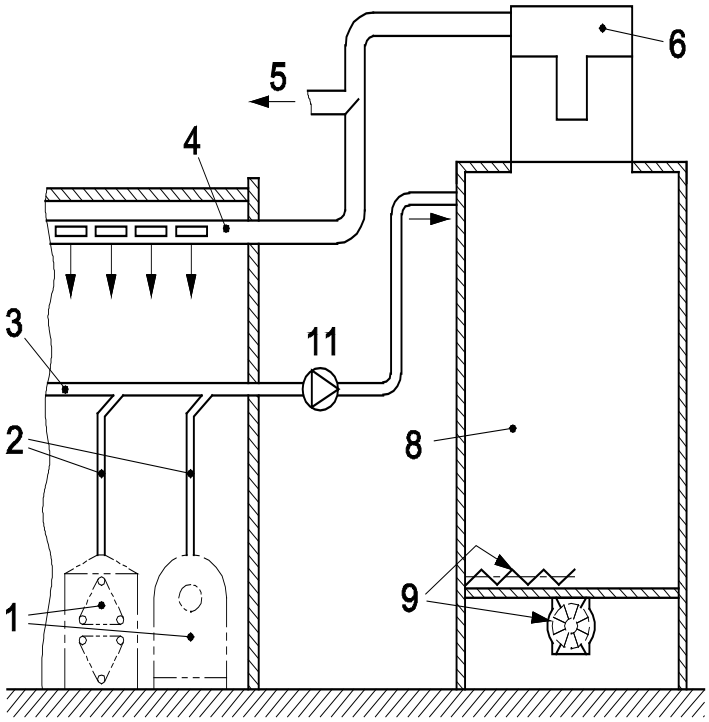
Annex A
(informative)

Examples of extraction systems

A.1 Explanation to figures

The following Figures (A.1 to A.11) are simplified examples, e.g. explosion measures are not displayed.



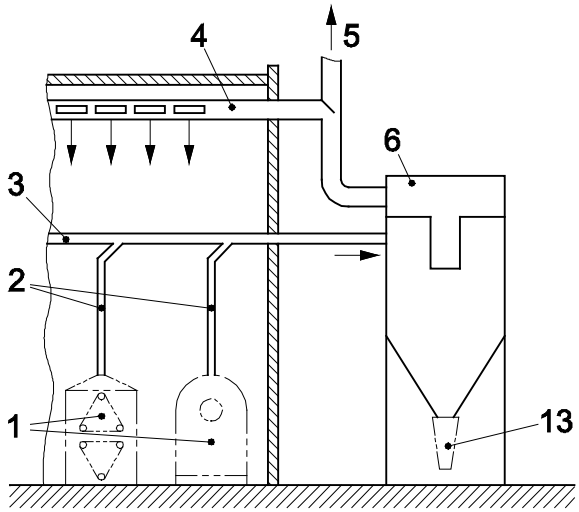


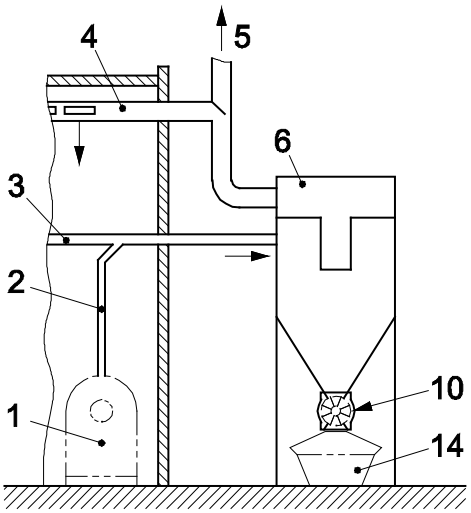
Key

1 woodworking machine (dotted lines indicate: out of scope)
2 machine connection duct
3 main duct
4 recirculation air duct
5 exhaust air
6 filter
7 conveying system
8 silo
9 silo discharge system
10 filter discharge system
11 main fan
12 cyclone
13 bin
14 container
15 press
16 elevator and screw conveyor
17 silo charge system
18 chain conveyor
19 pneumatic conveying system

Figure A.1 — Extraction system with cyclone

Figure A.2 — Extraction system with silo filter





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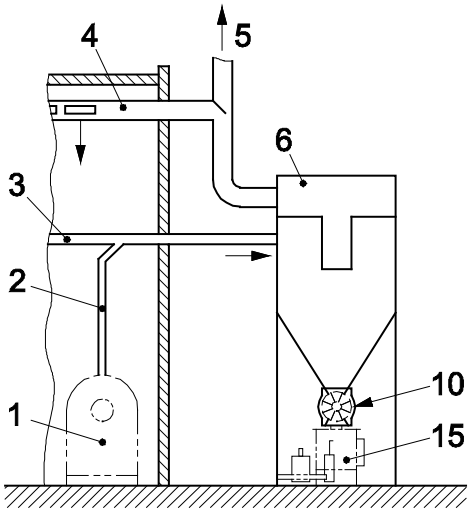
11 main fan
12 cyclone
13 bin
14 container
15 press
16 elevator and screw conveyor
17 silo charge system
18 chain conveyor
19 pneumatic conveying system

Figure A.3 — Extraction system with filter and storage facility without conveying system — Bin as part of the filter

Figure A.4 — Extraction system with filter and storage facility without conveying system — Container



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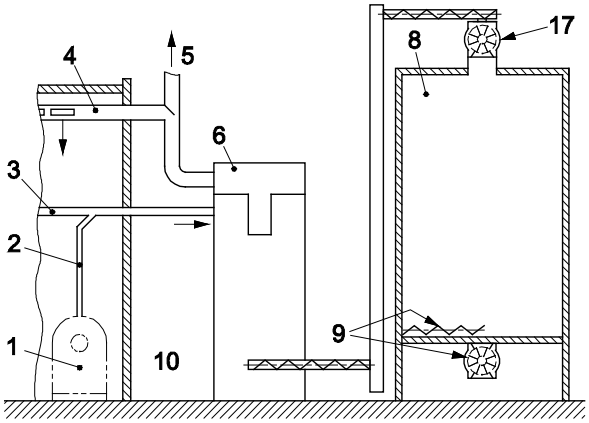
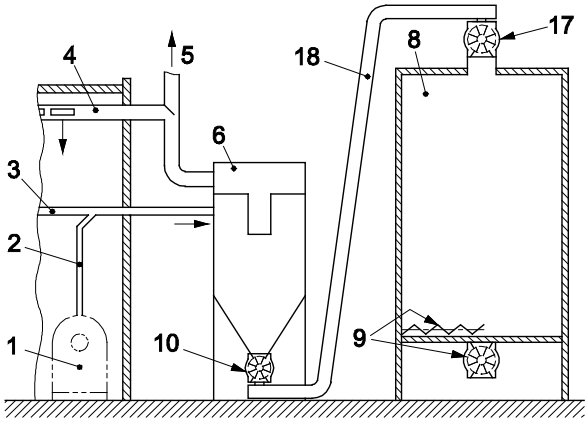
12 cyclone
13 bin
14 container
15 press
16 elevator and screw conveyor
17 silo charge system
18 chain conveyor
19 pneumatic conveying system

Figure A.5 — Extraction system with filter and storage facility without conveying system — Press





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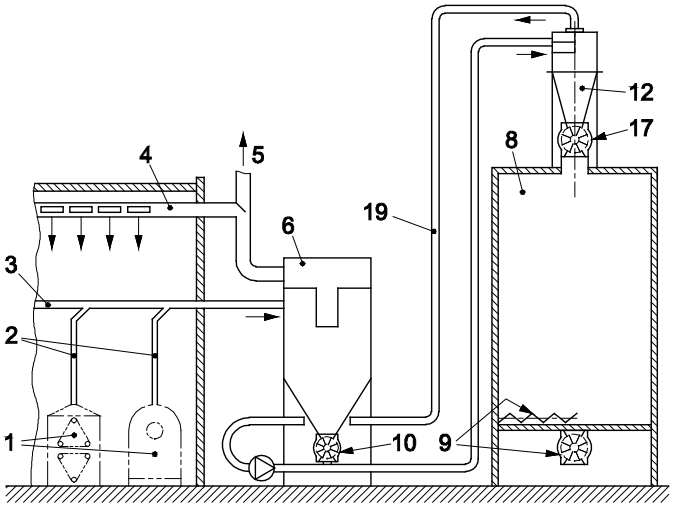
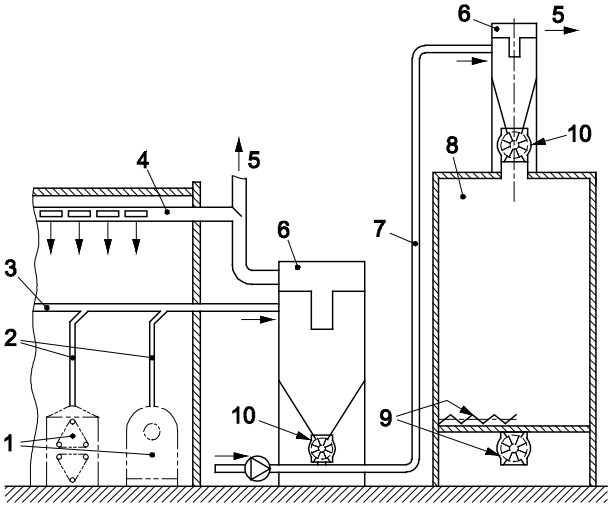
12 cyclone
13 bin
14 container
15 press
16 elevator and screw conveyor
17 silo charge system
18 chain conveyor
19 pneumatic conveying system

Figure A.6 — Extraction system with filter and storage facility with mechanical conveying system — Elevator and screw conveyor

Figure A.7 — Extraction system with filter and storage facility with mechanical conveying system — Chain conveyor





Key

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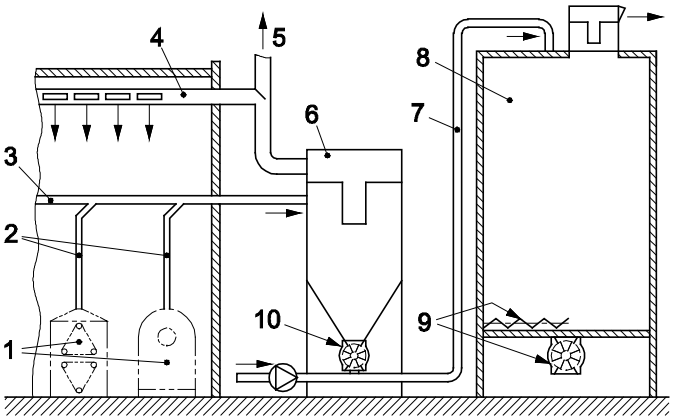
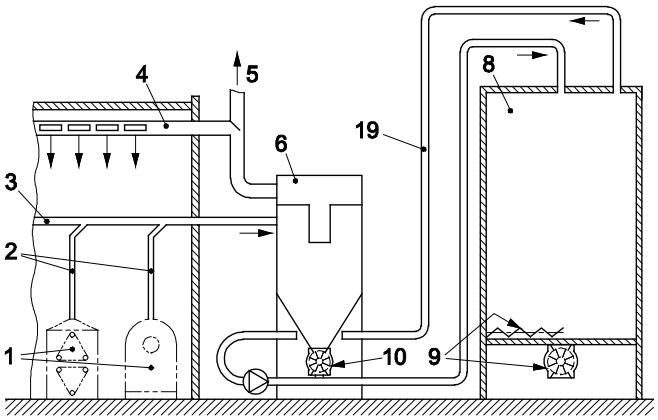
10 filter discharge system
11 main fan
12 cyclone
13 bin
14 container
15 press
16 elevator and screw conveyor
17 silo charge system
18 chain conveyor
19 pneumatic conveying system

Figure A.8 — Extraction system with filter and storage facility with pneumatic conveying system — circulation system with cyclone and rotary valve — silo at atmospheric pressure

Figure A.9 — Extraction system with filter and storage facility with pneumatic conveying system —system with silo filter and rotary valve — silo at atmospheric pressure





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10 filter discharge system
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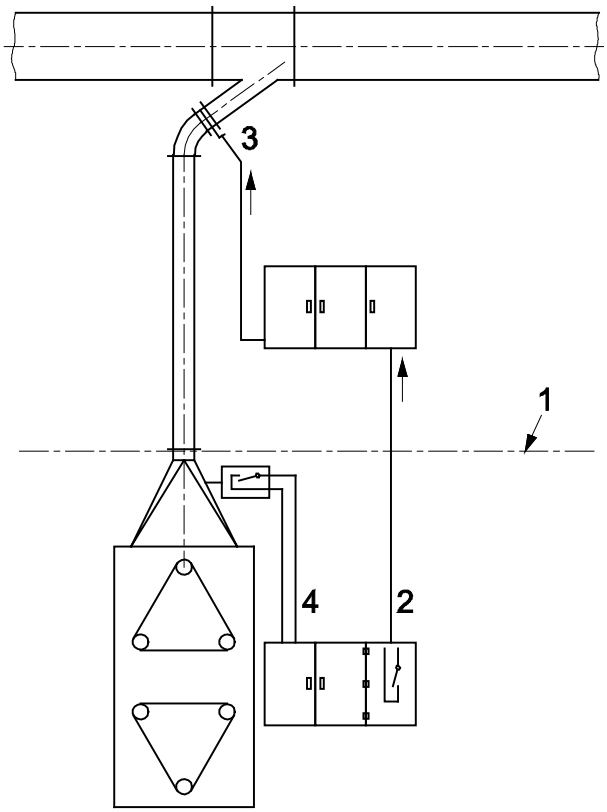
12 cyclone
13 bin
14 container
15 press
16 elevator and screw conveyor
17 silo charge system
18 chain conveyor
19 pneumatic conveying system

Figure A.10 — Extraction system with filter and storage facility with pneumatic conveying system — system blowing directly into the silo with top-mounted filter

Figure A.11 — Extraction system with filter and storage facility with pneumatic conveying system — circulation system blowing directly into the silo

A.2 Interface to woodworking machinery

The extraction systems should have an interface for an external start/stop signal that starts and stops the extraction system automatically (see Figure A.12). If a woodworking machine requires a monitoring system for the volume flow rate, this monitoring system is not part of the extraction system.



Key

1 interface between extraction system and woodworking machine

2 input for external start of extraction system

3 gate valve

4 airflow monitoring system for internal interlocking of a woodworking machine

Figure A.12 — Interface to woodworking machinery

Annex B
(informative)

Table with corresponding terms in English, French and German

This annex is common for English, French and German versions of this standard. The terminology provided is only applicable within the field of application of this standard.

Table B.1 — Corresponding terms

ENGLISH	FRENCH	GERMAN
Accumulation	Accumulation	Ablagerung
Air filtration	Filtration de l'air	Luftfilterung
Air velocity	Vitesse de l'air	Luftgeschwindigkeit
Back pressure flap	Clapet anti-retour	Rückschlagklappe
Bend	Coude	Bogen, Krümmer, Umlenkung
Bin	Bac de réception	Sammelbehälter
Chain conveyor	Convoyeur à chaîne	Kettenförderer
Chain trough conveyor	Convoyeur à chaîne en auge	Trogketten- und Kratzförderer
Chips	Copeaux	Späne
Chip and dust extraction system for woodworking	Système d'extraction des copeaux et poussières pour le travail du bois	Absauganlage für Holzstaub und Späne
Clean air	Air propre	Reinluft
Clean air part	Partie en air propre	Reinluftbereich
Cleaning device	Dispositif de nettoyage	Abreinigungseinrichtung
Compressed-air blast	Nettoyage par air comprimé	Druckluftabreinigung
Concurrency factor	Facteur de simultanéité	Gleichzeitigkeitsfaktor
Connecting point	Raccord	Anschlussstelle
Container	Conteneur	Container
Control system	Système de commande	Steuerung
Conveying air	Air de convoyage	Transportluft
Conveying air velocity	Vitesse de l'air de convoyage	Transportluftgeschwindigkeit
Conveying system	Système de convoyage	Transportsystem
Crude air part	Partie en air brut	Rohluftbereich
Cyclone	Cyclone	Zyklon
Discharge	Décharge (électrique) Déchargement (matériau)	Entladung (elektr.) Austrag (Material)

ENGLISH	FRENCH	GERMAN
Discharge system	Système de déchargement	Austragssystem
Duct	Conduit	Kanal/Rohrleitung
Ducting	Réseau de conduits	Kanalsystem/ Rohrleitungssystem
Dust	Poussières	Staub
Dust load	Charge de concentration en poussière	Staubbeladung
Dust loaded part	Partie chargée en poussières	staubbeladener Teil
Earth potential	Potentiel de la terre	Erdpotential
Emergency stop	Arrêt d'urgence	Not-Halt
Exhaust air	Air rejeté	Fortluft
Explosion isolation	Isolement d'explosion	Entkopplung
Explosion venting	Event d'explosion	Druckentlastung
Explosion venting devices	Dispositifs d'évent d'explosion	Druckentlastungseinrichtung
Extraction ducting	Réseau de conduits d'extraction	Absaugrohrleitungs-System
Extraction hood	Buse de captage	Absaughaube
Extraction system	Système d'extraction	Absauganlage
Extraction vacuum	Dépression d'extraction	Absaugunterdruck
Fan	Ventilateur	Ventilator
Fan wheel	Pale du ventilateur	Ventilatorlaufrad
Filter	Filtre	Filter/Filtereinheit
Filter area load	Charge de la surface de filtre	Filterflächenbelastung
Filter element	Elément filtrant	Filterelement
Fire damper	Clapet coupe-feu	Brandschutzklappe
Fire fighting	Lutte contre l'incendie	Brandbekämpfung
Fire gate	Volet coupe-feu	Feuerschutzabschluss
Fire suppression system	Système de lutte incendie	Brandunterdrückungssystem/ Sprinklersystem
Fire zone	Zone inflammable	Brandabschnitt
Fixed guard	Protecteur fixe	Feststehende trennende Schutzeinrichtung
Fixed installation	Installation fixe	Ortsfeste Anlage
Flammable	Inflammable	feuergefährlich
Flexible hose	Tuyaux flexibles	Flexibler Schlauch
Gate valve	Vanne	Absperrschieber

ENGLISH	FRENCH	GERMAN
Grate	Grille	Rost
Ignition source	Source d'inflammation	Zündquellen
Indicator	Indicateur	Anzeige
Inspection door	Porte d'inspection	Wartungsöffnung
Leakage	Fuite	Leckage
Lower explosion level	Limite inférieure d'explosion	untere Explosionsgrenze
Main duct	Conduit principal	Hauptleitung
Material flow	Débit de matière	Materialfluss
Maximum explosion overpressure	Pression maximale d'explosion	maximaler Explosionsüberdruck
Minimum ignition energy	L'énergie minimale d'inflammation	Mindestzündenergie
Minimum ignition temperature	Température minimale d'inflammation	Mindestzündtemperatur
Performance indication	Indication de performance	Leistungsanzeige
Pilot filter	Filtre pilote	Polizeifilter
Poking	Tringlage	Stockern
Poking opening	Ouverture de tringlage	Stockeröffnung
Potential difference	Différence de potentiel	Spannungsunterschiede
Pressure	Pression	Druck
Pressure difference	Pression différentielle	Druckdifferenz
Pressure loss	Perte de charge	Druckabfall
Pressure wave	Onde de pression	Druckwelle
Residual dust content	Teneur résiduelle en poussières	Reststaubgehalt
Recirculation air	Air recyclé	Rückluft
Recirculation air duct	Conduit d'air recyclé	Rückluftkanal
Reversed airflow	Nettoyage contre-courant	Spülluft
Rotary valve	Distributeur rotatif	Zellenradschleuse
Screw conveyor	Convoyeur à vis	Schneckenförderer
Separator	Séparateur	Abscheider
Shavings	Plaquette	Hackschnitzel
Silo	Silo	Silo
Silo discharge system	Système de déchargement du silo	Siloaustragssystem
Silo filling system	Système de remplissage du silo	Silobefüllungssystem oder Silobeschickungssystem
Sound pressure level	Niveau de pression	Schalldruckpegel

ENGLISH	FRENCH	GERMAN
	acoustique	
Spark	Etincelle	Funken
Spark detection	Détection d'étincelle	Funkenerkennung
Spark extinguishing system	Système d'extinction d'étincelles	Funkenlöschanlage
Static electricity	Electricité statique	Statische Elektrizität
Storage facility	Installation de stockage	Sammeleinrichtung
Supporting fan	Ventilateur additionnel	Stützventilator
Verification	Vérification	Prüfung
Vibration	Secouage mécanique	Rüttelung
Volume flow rate	Débit volumique	Luftvolumenstrom
Wood dust	Poussières de bois	Holzstaub
Wood waste	Déchets de bois	Holzabfall
Woodworking machine	Machines à bois	Holzbearbeitungsmaschine

Annex C
(informative)

Classification of places where explosive atmospheres may occur (according to Directive 1999/92/EC)

Hazardous places are classified in terms of zones on the basis of the frequency and duration of the occurrence of an explosive atmosphere (see Table C.1).

Table C.1 — Examples for the classification inside of chip and dust extraction systems according to EN 60079–10–2:2009

Component	Zone	Remarks
ducting between woodworking machine and filter	21	Exception with high dust concentration e.g. wide band grinding machines with high volume of chip removal (e.g. heavy calibration work)
	22	if dust depositions in the ducts are not definitely excluded
	not explosive (n.e).	in all other cases, if no dust deposition occurs
crude air part of the filter	20	filter where the cleaning intervals dominate temporally (more than 50 % of the operating hours)
	21	filter where the cleaning intervals do not dominate temporally (occasionally, discontinuous)
clean air part of the filter	n.e.	In case of recirculation air, residual dust monitoring required. Frequent checks shall be performed in systems without a residual dust monitoring
recirculation air duct between filter and working area – clean air part	n.e.	Residual dust monitoring required.
cyclones	21 22 n.e.	depending on the material which shall be conveyed (particle size distribution, moisture, type of wood) obey different concentrations inside the cyclone: lower in the middle part, higher close to the walls
material conveying system with pneumatic transport, e.g. between filter system and silo	20 21	depending on the material which shall be conveyed and the dust concentration
elevators	20 21	If dust-like materials are conveyed (particle size < 0,5 mm), e.g. wood flour Dust and chip mixture with a low percentage of dust

Component	Zone	Remarks
chain trough conveyor	21	loading/unloading area
	22	other places
silo	20	For continuous filling or temporally dominated filling
	21	For discontinuous or occasional filling

— Zone 20 is a place in which an explosive atmosphere in the form of a cloud of combustible dust in air is present continuously, or for long periods or frequently.

— Zone 21 is a place in which an explosive atmosphere in the form of a cloud of combustible dust in air is likely to occur in normal operation occasionally.

— Zone 22 is a place in which an explosive atmosphere in the form of a cloud of combustible dust in air is not likely to occur in normal operation but, if it does occur, will persist for a short period only.

Zone 22 also contains areas in which layers, deposits and heaps of combustible dust that might be dispersed to an explosive atmosphere occur.

Annex D
(informative)

Noise reduction at the design stage

D.1 Noise sources

The main sources of airborne noise for chip and dust extraction systems are:

a) leakage in the ducting system;

b) fans;

c) filter cleaning system;

d) other moving parts of the extraction system, e.g. chain trough conveyor;

e) collision between interior walls of the extraction system and large wood chips during their conveyance;

f) squeezing of chips between the interior walls of the extraction system and moving parts (e.g. between the screw itself and the wall of the screw conveyor;

g) conveying velocity in the ducting system.

D.2 Measures to reduce noise

Measures that can be introduced to reduce noise emission are:

a) to have smooth inner sides of the extraction system and no abrupt changes of air flow direction;

b) to avoid parts where the extraction air velocity is high;

c) to minimize leakage especially where the static pressure/vacuum is higher than 500 Pa;

d) to make the fan wheel with low out of balance forces and to use a fan design that itself has low noise emission;

e) vibration dampers for fans;

f) sound insolation between fan and ducting;

g) where possible to make the distance between moving parts and the walls large enough so that squeezing of chips rarely occurs;

h) to install air noise silencers in the extraction system;

i) to install sound insulation in the outer walls of the extraction system (eventually also at adjacent parts) at known noise source positions;

j) to have ducting bends with a large bend radius (1,5 x D or more wherever possible);

k) wherever possible to reduce the conveying air velocity;

l) enclosure of valves for pneumatic cleaning systems.

D.3 Impact from chips and dust

Noise emission information for the extraction system in this standard is given without taking into account the noise resulting from the impact of chips and dust being conveyed with the ducting system walls.

The thereby caused sound level depends on several parameters (e.g. size and weight of chips, conveying air velocity and ducting design). The impact between the chips and dust being conveyed and the ducting system can add up to 10 dB extra, and in some cases more, to the noise emission measured without chips and dust being conveyed in the ducting system.

The noise impact from chips and dust can be reduced by:

a) pre-separation of any larger wood pieces;

b) process change from (e.g. from sawing to moulding) to reduce wood piece size;

c) sound insulation of the duct bend;

d) using duct bends with a large bending radius.

Annex E
(normative)

Silos with a cross section up to 45 m²

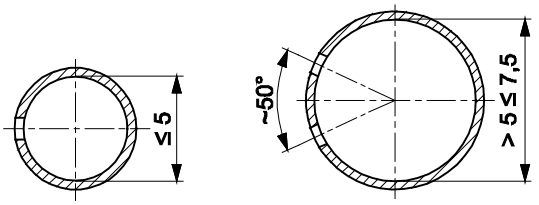
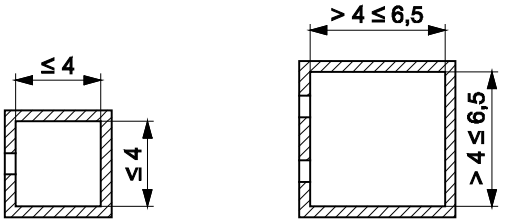
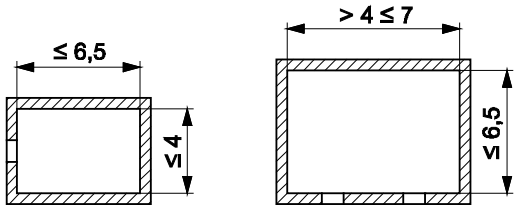
To empty a silo in the event of the failure of the discharge system from the outside, additional access doors (with minimum dimensions of 2,0 m x 1,2 m) shall be provided.

The number and position of these additional access doors depend on the shape of the silo (see Table E.1)

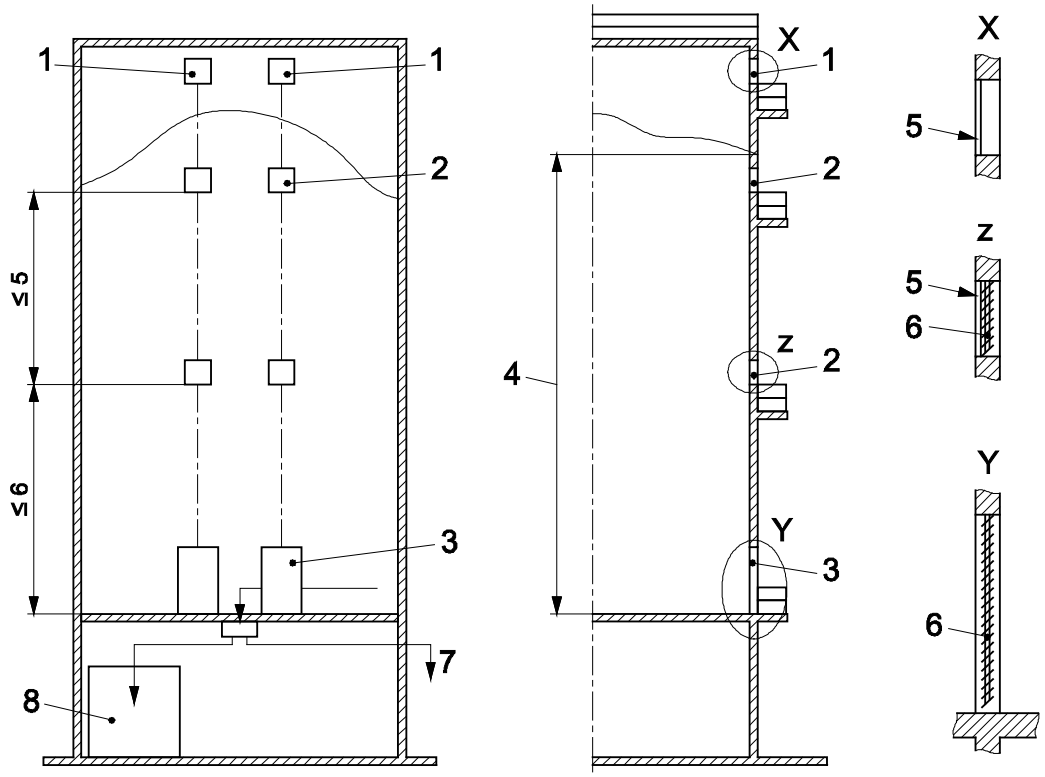
Where the filling height exceeds 6 m, poking openings are required in the silo through which long poles for poking can be introduced in the direction towards the access doors. These openings shall be placed directly above the access doors (see Figure E.1), each pocking opening shall be equipped with a working platform, and the opening shall be at least 1 m above the platform level. Where the filling height exceeds 9 m, additional poking openings are required. The vertical distance between such openings shall not exceed 5 m.

To protect personnel when emptying the silo by hand, boards shall be installed in the door openings. The boards shall cover the full door opening and shall be removable one-by-1 starting from the bottom upwards, see Figure E.1 in Annex E.

Table E.1 — Silos with a cross section up to 45 m²

<table>
<tr><td rowspan="4"> 
</td><td colspan="3">Silo: circular form</td></tr>
<tr><td colspan="2">Inside Diameter</td><td>Number of doors</td></tr>
<tr><td colspan="2">Up to and including 5,0 m</td><td>1</td></tr>
<tr><td colspan="2">More than 5,0 up to 7,5 m</td><td>2</td></tr>
<tr><td rowspan="4"> 
</td><td colspan="3">Silo: in the shape of a square</td></tr>
<tr><td colspan="2">internal width “a”</td><td>Number of doors</td></tr>
<tr><td colspan="2">Up to and including 4,0 m</td><td>1</td></tr>
<tr><td colspan="2">More than 4,0 up to 6,5 m</td><td>2</td></tr>
<tr><td rowspan="4"> 
</td><td colspan="3">Silo: in the shape of a rectangle, Inner dimensions (a, b), dimension “a” measured in emptying direction</td></tr>
<tr><td rowspan="3">“a” up to and including 6,5 m</td><td>“b”</td><td>Number of doors</td></tr>
<tr><td>Up to and including 4,0 m</td><td>1</td></tr>
<tr><td>More than 4,0 up to 7 m</td><td>2</td></tr>
</table>

A warning sign, clearly visible from the operator's position, shall indicate the hazards related to emptying the silo by hand.



Key

1 opening for level control

2 opening for poking

3 access opening (door) for emptying the silo in case of a fire and for maintenance

4 maximum filling height

5 bars to avoid entrance

6 boards in the door openings

7 emptying the silo in case of a fire and overfilling with the discharge equipment

8 combustion system

Figure E.1 — Silo with a cross section up to 45°m²

Table E.2 — Minimum size openings in silo walls and platforms which give access to these openings for silos with manual emergency discharge

	Minimum opening size		Minimum platform size	
	height *h* [m]	width *w* [m]	width *w* [m]	depth *d* [m]
Access opening (door)	2,0	1,2	2,6	1,3
Poking opening	0,8 [a]	0,7 [a]	1,6	1,0
Level control opening	0,8 [a]	0,7 [a]	1,6	1,0

[a] The size of the level control openings is related to the silo wall thickness. A dimension of 0,8 m (height) × 0,7 m (width) is recommended for concrete silos. A steel silo can have smaller openings (see EN 617:2001+A1:2010).

Annex F
(informative)

Measurement of residual dust content

The evaluation of residual dust content should be carried out using a standardized measurement process.

The filter system to be measured is run with a nominal volume flow rate and extracts wood dust with a concentration of approximately 5 g m^{-3} of air and with the following specifications:

— medium particle size approx..100 µm, 20 µm ≤ d 90 ≤ 300 µm;

— wood moisture 8 % ± 2 %.

Measuring time follows the detection limit of the sampling system, it should also cover the cycles of the filter cleaning.

The measurements shall to be repeated at least twice and the results should be presented as mean value plus one-sided confidence interval at the confidence level of 95 % according to ISO 2602:1980.

The value thus determined shall be less than 0,1 mg m^{-3}.

The results shall be summarized in a test report which should contain at least the following information:

a) description of the tested filter unit (e.g. manufacturer, model, type, version, construction, size, year of manufacture, serial number) for the machine and for each additional equipment;

b) technical data and mode of operation of the filter during testing (filter material, dedusting system, filter area load, filter resistance during operation, extracted volume flow);

c) wood dust used (type, concentration; grain size distribution);

d) description of the measurement procedure including position of the measurement points;

e) measurement equipment used;

f) description of the test environment;

g) test results;

h) test laboratory, name of the responsible test person;

i) test personnel, date of test;

j) additional remarks, if required.

Gravimetric measurement can be performed in addition to other procedures.

Testing (residual dust content after filtration) takes place by isokinetic withdrawal of a partial volume flow in the return air duct and by the determination of the residual dust content by gravimetric measurement.

Measuring time should be at least 2 h.

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 one means of conforming to Essential Requirements of the New Approach Machinery Directive 2006/42/EC.

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 given in Table ZA.1 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.

Table ZA.1 — Correspondence between this European Standard and Directive 2006/42/EC

Clause(s)/sub-clause(s) of this EN	Essential Requirements (ESRs) of Directive 2006/42	
	1.1.2	Principles of safety integration
5.2.1, 5.2.2, 5.2.3	a)	fitted for its function
Clauses 5 and 6	b)	eliminate or reduce the risks, give measures, inform
Clauses 5 and 6	c)	intended use and reasonably foreseeable misuse
6.3	d)	constrain in use
5.3.1, 5.4.1.1, 5.4.2.3, 5.4.3.3, 5.6.3, 5.6.4.2, 5.8.2, 5.8.3	e)	equipment
5.6	1.1.3	Materials and products
	1.2	Control Systems
5.2.1	1.2.1	Safety and reliability of control systems
5.2.1, 5.6.2, 5.6.4.1, 5.6.4.2	1.2.2	Control devices
5.2.3	1.2.3	Starting
	1.2.4	Stopping
5.1	1.2.4.1	Normal stop
5.2.2, 5. 3.2, 5.8.3	1.2.4.3	Emergency stop
5.2.1, 5.3.2, 5.8.3	1.2.5	Selection of control or operating modes
5.2.3	1.2.6	Failure of the power supply
	1.3	Protection against mechanical hazards
5.3.1	1.3.1	Risk of loss of stability
5.6.1	1.3.2	Risk of break-up during operation

Clause(s)/sub-clause(s) of this EN	Essential Requirements (ESRs) of Directive 2006/42	
5.4.3.3	1.3.3	Risks due to falling or ejected objects
5.1	1.3.4	Risks due to surfaces, edges or angles
5.3.2, 5.8.3	1.3.6	Risks related to variations in operating conditions
5.3.2, 5.8.3	1.3.7	Risks related to moving parts
5.3.2	1.3.8	Choice of protection against risks arising from moving parts
5.3.2	1.3.8.1	Moving transmission parts
5.8.2, 5.8.3	1.3.8.2	Moving parts involved in the process
5.8.3	1.3.9	Risks of uncontrolled movements
	1.4	Required characteristics of guards and protective devices
5.3.2, 5.8.3	1.4.1	General requirements
	1.4.2	Special requirements for guards
5.3.2, 5.8.3	1.4.2.1	Fixed guards
5.3.2, 5.8.3	1.4.2.2	interlocking movable guards
5.3.2, 5.8.3	1.4.3	Special requirements for protective devices
	1.5	Risks due to other hazards
5.7	1.5.1	Electricity supply
5.4.3.2.5	1.5.2	Static electricity
5.3.4	1.5.3	Energy supply other than electricity
5.4.1, 5.4.1.1, 5.4.1.2, 5.4.2.1, 5.4.2.2, 5.4.2.3, 5.8.2, 6.3.6	1.5.6	Fire
5.4.1, 5.4.1.1, 5.4.1.2, 5.4.3.1, 5.4.3.2.1, 5.4.3.2.2, 5.4.3.2.3, 5.4.3.2.4, 5.4.3.2.5, 5.4.3.2.6, 5.4.3.3	1.5.7	Explosion
5.5, 6.3.7	1.5.8	Noise
5.6.1, 5.6.2, 5.6.3, 5.6.4.1, 5.6.4.2	1.5.13	Emissions of hazardous materials and substances
5.3.3, 5.8.3	1.5.15	Risk of slipping, tripping or falling
5.4.3.2.6	1.5.16	Lighting
	1.6	Maintenance
5.8.3, 6.3.4	1.6.1	Machinery maintenance
5.3.2, 5.3.3, 5.8.3	1.6.2	Access to operating positions and servicing points
5.3.4, 5.7	1.6.3	Isolation of energy sources
5.8.3, 6.3.4, 6.3.5	1.6.4	Operator intervention
5.8.3, 6.3.4, 6.3.5	1.6.5	Cleaning of internal parts
	1.7	Information
6.2	1.7.1	Information and warnings on the machinery

Clause(s)/sub-clause(s) of this EN	Essential Requirements (ESRs) of Directive 2006/42	
5.4.1.1, 5.6.3, 6.3.1	1.7.1.2	Warning devices
6.3.1, 6.3.3	1.7.2	Warning of residual risks
6.2	1.7.3	Marking of machinery
6.1, 6.3	1.7.4	Instructions
6.1, 6.3.1	1.7.4.1	General principles for the drafting of instructions
6.3.1, 6.3.2, 6.3.3, 6.3.4, 6.3.5, 6.3.6, 6.3.7	1.7.4.2	Contents of the instructions

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[14] Directive 1999/92/EC of the European Parliament and of the Council of 16 December 1999 on *minimum requirements for improving the safety and health protection of workers potentially at risk from explosive atmospheres*

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