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Shot blasting machinery — Safety and environmental requirements

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l'environnement*

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Foreword

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This document was prepared by Technical Committee ISO/TC 306, *Foundry machinery*, in collaboration with the European Committee for Standardization (CEN) Technical Committee CEN/TC 202, *Foundry machinery*, in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

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Introduction

This document is a type C standard as stated in ISO 12100:2010 and also deals with aspects of environmental impact and energy efficiency.

The design, the construction and the actual operation of shot blasting machinery affects aspects of safety, energy usage and environmental impact. It is essential to minimize energy usage and environmental impact while achieving the safety requirements given in this document.

The machinery concerned and the extent to which hazards, hazardous situations and hazardous events are covered are indicated in the scope of this document. When provisions of this type C standard are different from those which are stated in type A or B standards, the provisions of this type C standard take precedence over the provisions of the other standards, for machines that have been designed and built according to the provisions of this type C standard.

Where for clarity an example of a preventative measure is given in the text, this should not be considered as the only possible solution. Other solutions can be used as far as they fulfil correctly the criteria expressed in the requirement.

This document assumes that the shot blasting machinery is operated and maintained by trained personnel.

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Shot blasting machinery — Safety and environmental requirements

1 Scope

This document specifies safety and environmental requirements for shot blasting machinery.

Shot blasting machinery includes:

- wheel blasting machinery;
- air blasting machinery for dry and wet blasting;
- combined wheel and air blasting machinery.

NOTE [Annex A](#) illustrates examples of shot blasting machinery.

This document is applicable to:

- all significant hazards, hazardous situations and hazardous events relevant to shot blasting machinery, when used as intended and under the conditions foreseen by the manufacturer, including reasonably foreseeable misuse;
- measures for minimization of environmental impact and energy usage of shot blasting machinery.

Interfaces between shot blasting machinery and other equipment used in shot blasting but not in the scope of this document are:

- mechanical and electrical interface to external workpiece transport system;
- connector to electrical energy supply;
- connector to fresh air supply ducting;
- connector to exhaust air ducting;
- connector to pressurized air supply;
- connector to water supply;
- connector to waste water system;
- interface for safe exchange of control signals;
- connector for fresh air supply for respiratory protection device (in blast rooms).

NOTE [Annex C](#) gives an illustration of interfaces between shot blasting machinery and other equipment used in shot blasting but not in the scope of this document.

The specific significant risks related to mobile and movable shot blasting machinery (e.g. shot blasting machines designed for operation at changing locations) are not dealt with in this document.

This document does not apply to:

- high pressure water jet machinery;
- dry-ice blasting machinery.

This document does not apply to shot blasting machines manufactured before the date of its publication as an ISO standard.

NOTE The requirements specified in this document can serve as a guideline for a risk assessment of shot blasting machines manufactured before the date of its publication as an ISO standard.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 3743-1:2010, *Acoustics — Determination of sound power levels and sound energy levels of noise sources using sound pressure — Engineering methods for small movable sources in reverberant fields — Part 1: Comparison method for a hard-walled test room*

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

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

ISO 3864-1:2011, *Graphical symbols — Safety colours and safety signs — Part 1: Design principles for safety signs and safety markings*

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

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

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

ISO 7000:2019, *Graphical symbols for use on equipment — Registered symbols*

ISO 7731:2003, *Ergonomics — Danger signals for public and work areas — Auditory danger signals*

ISO 10218-2:2011, *Robots and robotic devices — Safety requirements for industrial robots — Part 2: Robot systems and integration*

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

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

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

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

ISO 13849-1:2023, *Safety of machinery — Safety-related parts of control systems — Part 1: General principles for design*

ISO 13850:2015, *Safety of machinery — Emergency stop function — Principles for design*

ISO 13857:2019, *Safety of machinery — Safety distances to prevent hazard zones being reached by upper and lower limbs*

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

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ISO 14120:2015, *Safety of machinery — Guards — General requirements for the design and construction of fixed and movable guards*

ISO 14122-2:2016, *Safety of machinery — Permanent means of access to machinery — Part 2: Working platforms and walkways*

ISO 14122-3:2016, *Safety of machinery — Permanent means of access to machinery — Part 3: Stairs, stepladders and guard-rails*

ISO 80079-36:2016, *Explosive atmospheres — Part 36: Non-electrical equipment for explosive atmospheres — Basic method and requirements*

IEC 60204-1:2016, *Safety of machinery — Electrical equipment of machines — Part 1: General requirements*

IEC 60079-0:2017, *Explosive atmospheres — Part 0: Equipment — General requirements*

3 Terms and definitions

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

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

- ISO Online browsing platform: available at <https://www.iso.org/obp>
- IEC Electropedia: available at <https://www.electropedia.org/>

3.1

external workpiece transport system

system that transports the workpiece to or from the shot blasting machine

3.2

internal workpiece transport system

system that transports the workpiece within the shot blasting machine

3.3

wheel blaster

device which accelerates the shot blasting media by a rotating wheel with blades

3.4

air blaster

assembly consisting of a nozzle and connected hose(s) or tube(s), which accelerates the shot blasting media by pressurized air

3.5

accessible blasting chamber

blasting chamber which, by designated use, is designed to be entered by personnel

3.6

workspace

workplace for the operator as specified by the manufacturer of the shot blasting machine

3.7

interior workspace

workspace inside of a shot blasting machine

3.8

screw conveyor

device that uses a rotating helical blade to move shot blasting media, horizontally or at a slight incline

3.9

belt conveyor

endless belt between two, or more, pulleys to move shot blasting media or products, horizontally or incline

3.10

vibrating conveyer

device that transports shot blasting media or products by vibration and gravity

3.11

scraper conveyer

device to transport bulk shot blasting media over a plane with the help of scrapers

3.12

hopper

container for storing shot blasting media or for providing or replenishing shot blasting media for the shot blasting process

3.13

bucket elevator

continuous conveyer that uses a series of bucket shaped hoppers uniformly fixed on the endless circular traction component to vertically lift shot blasting media

3.14

hopper discharge conveyer

mechanical device, screw conveyer, belt conveyer or other suitable transport system, to feed shot blasting media from the hopper to the shot blasting machine

3.15

switch valve

electrical, pneumatical or magnetical operated device for closing or opening the shot blasting media flow to the shot blasting process

3.16

magnetic separator

system, mostly operating with partial magnetic drums, where a ferromagnetic- and non-ferromagnetic mixture is separated to obtain reusable shot blasting media for the shot blasting process

3.17

cleaning system

device to separate small particles from shot blasting media, to obtain a required grain size distribution, mostly combined with a sieve for separating large particles

4 Significant hazards, environmental impact and energy usage

4.1 General

The variety of machinery could not be covered in all details in a standard. To deal with this fact, an individual risk assessment of the machinery in question shall be carried out considering the safety requirements of this document.

Significant hazards identified in the individual risk assessment but not dealt with in this document shall be avoided or reduced by applying the principles of ISO 12100:2010.

Safety requirements described in different clauses of this document shall be considered together if they are referring to the same hazard zone.

4.2 Significant hazards

[Clause 5](#) gives requirements to prevent or minimise all hazards, hazardous situations and events identified by risk assessment as significant for this type of machinery.

See ISO 12100:2010 for measures against hazards that are relevant but not significant for this machine type.

NOTE ISO 12100:2010 contains information for the procedure of risk assessment.

4.3 Environmental impact and energy usage

[Clause 6](#) contains measures for minimization of:

- environmental impact and
- energy usage.

5 Safety requirements, protective measures, risk reduction measures

5.1 General

Shot blasting machinery shall comply with the safety requirements and/or protective measures against the significant hazards given in [Clause 5](#).

Warning devices and safety signs shall be in accordance with ISO 3864-1:2011, ISO 7000:2019 or ISO 7731:2003.

5.2 Guards and doors

All potential accesses to hazardous areas shall be secured by guards in accordance with ISO 13857:2019, ISO 14120:2015 and ISO 14119:2013. If access to a work area is limited by interlocking movable guards (e.g. doors), these shall be secured by the safety-related control system according to the performance level given in [Table 1](#).

5.3 Electrical equipment

Electrical equipment of shot blasting machinery shall comply with IEC 60204-1:2016.

5.4 Emergency stop

Emergency stop devices shall comply with ISO 13850:2015.

5.5 Control systems

Safety related control systems shall be designed according to ISO 13849-1:2023. This applies also for input and processing of safety related parameters (e.g. operating parameters).

Table 1 — Required performance level (PLr) for control systems of shot blasting machinery

Safety function	Clause	PLr
Guard locking of access points of wheel blasters by interlocking movable guards associated with an interlocking device interlocked with the hazardous movement and a guard locking device	5.2 5.6, Table 2 , row 1 5.6, Table 3 , row 1	d
Guard locking of access points of wheel blasters by fixed guards associated with an interlocking device interlocked with the hazardous movement	5.2 5.6, Table 2 , row 1 5.6, Table 3 , row 1	c
Guard locking of access to the blasting chamber of wheel blasting machines without additional safety measures	5.2 5.6, Table 2 , row 2 5.6, Table 3 , row 1	d
Guard locking of access to the blasting chamber of wheel blasting machines with additional safety measures	5.2 5.6, Table 2 , row 2 5.6, Table 3 , row 1	c
Maximum overrun time of hold-to-run nozzle control device	5.7, Table 4 , row 4	d

Table 1 (continued)

Safety function	Clause	PLr
Interlocking of means of access with the shot blasting process and hazardous movement of parts, for blasting chambers without interior workspace If access is possible before the shot blasting process has stopped, interlocking with guard locking is required	5.2 5.8, Table 5, row 2, sub-row 1	c
Interlocking of means of access with the shot blasting process and hazardous movement of parts, for blasting chambers with interior workspace	5.2 5.8, Table 5, row 2, sub-row 2	c
Interlocking to prevent start up of the shot blasting process	5.8, Table 5, row 3	c
Interlocking between wheel drive and air blaster	5.8, Table 5, row 3	c
Interlocking with guard locking with hazardous movement of parts	5.8, Table 7, row 1 5.8, Table 7, row 2	c
Access to hazardous moving parts of the shot blasting media transport and recovery system	5.9, Table 9, row 1	c
Avoid uncontrolled movement of machine parts	5.10, Table 10, row 1	c
Avoid uncontrolled movement of machine parts due to loss or reactivation of electric, pneumatic or hydraulic energy supply	5.10, Table 10, row 2	c
Interlocking with external equipment	5.16	Individual risk assessment

5.6 Wheel blaster

See Table 2 for significant hazards or hazardous situations concerning shearing and crushing, cutting and severing, the related safety requirements and/or measures and the requirements for verification of these measures.

Table 2 — Wheel blaster – Shearing and crushing, cutting and severing

Significant hazard	Hazardous situation	Safety requirements	Verification
Shearing Crushing Cutting Severing	Access to shear traps between fixed and internal rotating parts of the wheel blaster.	Access points to internal rotating parts of wheel blasters shall be guarded either by <ul style="list-style-type: none"> — fixed guards associated with an interlocking device interlocked with the hazardous movement or — interlocking movable guards associated with an interlocking device interlocked with the hazardous movement and a guard locking device. See Table 1 for safety related controls.	Visual inspection Functional test
		The shot blasting media supply opening of wheel blasters shall be guarded by fixed guards.	Visual inspection
	Access from the inside of the blasting chamber to shear traps between fixed and internal rotating parts of a wheel blaster.	Unauthorized access to process openings of wheel blasters shall be prevented by guarding with guard locking of the blasting chamber access (see 5.8, Table 5). Additional safety measures (e.g. key locking the access) can reduce the PLr of the guard locking. See Table 1 for safety related controls.	See 5.8, Table 5