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Hand-held non-electric power tools — Safety requirements —

Part 7: Grinders

Machines portatives à moteur non électrique — Exigences de sécurité —

Partie 7: Meuleuses

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ISO copyright office
Case postale 56 • CH-1211 Geneva 20
Tel. + 41 22 749 01 11
Fax + 41 22 749 09 47
E-mail copyright@iso.org
Web www.iso.org

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

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

ISO 11148-7 was prepared by Technical Committee ISO/TC 118, *Compressors and pneumatic tools, machines and equipment*, Subcommittee SC 3, *Pneumatic tools and machines*.

ISO 11148 consists of the following parts, under the general title *Hand-held non-electric power tools — Safety requirements*:

— *Part 1: Assembly power tools for non-threaded mechanical fasteners*

— *Part 2: Cutting-off and crimping power tools*

— *Part 3: Drills and tappers*

— *Part 4. Non-rotary percussive power tools*

— *Part 5: Rotary percussive drills*

— *Part 6: Assembly power tools for threaded fasteners*

— *Part 7: Grinders*

— *Part 8: Sanders and polishers*

— *Part 9: Die grinders*

— *Part 10: Compression power tools*

— *Part 11: Nibblers and shears*

— *Part 12: Circular, oscillating and reciprocating saws*

A Part 13 dealing with fastener driving tools is under preparation.

Introduction

This document is a type-C standard as stated in ISO 12100.

The machinery concerned and the extent to which hazards, hazardous situations and events are covered are defined in the Scope of this part of ISO 11148.

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

ISO 11148 consists of a number of independent parts for individual types of hand-held non-electric power tools.

Certain parts of ISO 11148 cover hand-held non-electric power tools driven by internal combustion engines powered by gaseous or liquid fuel. In these parts, the safety aspects relating to internal combustion engines are found in a normative annex.

The parts are type-C standards and refer to pertinent standards of type A and B where such standards are applicable.

Hand-held non-electric power tools — Safety requirements —

Part 7:
Grinders

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1 Scope

This part of ISO 11148 specifies safety requirements for hand-held non-electric power tools (hereinafter "grinders") intended for grinding and cutting-off with abrasive products, for use on all kinds of materials. The grinders can be powered by compressed air or hydraulic fluid and are intended to be used by one operator and supported by the operator's hand or hands, with or without a suspension, e.g. a balancer.

NOTE 1 At the time of publication, no grinders driven by internal combustion engines are known (other than cutting-off machines within the scope of ISO 19432). Once these are identified, it is intended to amend this part of ISO 11148 to include such power tools.

This part of ISO 11148 is applicable to grinders used with:

— abrasive products with a peripheral operating speed less than or equal to 80 m/s;

— cutting-off wheels with a peripheral operating speed less than or equal to 100 m/s;

— abrasive products with an outside nominal diameter less than or equal to 230 mm;

— cutting-off wheels with an outside nominal diameter less than or equal to 250 mm;

— wire brushes;

— diamond and reinforced (segmented) wheels with an outside nominal diameter less than or equal to 450 mm;

— flap discs and flap wheels.

NOTE 2 For examples of grinders, see Annex B.

NOTE 3 Typical abrasive products used together with hand-held grinders are listed in Annex D.

This part of ISO 11148 does not cover special requirements and modifications of grinders for the purpose of mounting them in fixtures.

This part of ISO 11148 is not applicable to:

— die grinders with collets, which are treated in ISO 11148-9;

— polishers and sanders (i.e. tools used with coated abrasives except flap discs and flap wheels), which are treated in ISO 11148-8;

— cutting-off machines which are driven by internal combustion engines and are used for cutting construction materials, which are treated in ISO 19432;

— shaft-mounted wire brushes, which are treated in ISO 11148-9.

This part of ISO 11148 deals with all significant hazards, hazardous situations or hazardous events relevant to grinders when they are used as intended and under conditions of misuse which are reasonably foreseeable by the manufacturer, with the exception of the use of grinders in potentially explosive atmospheres.

NOTE 4 EN 13463-1 gives requirements for non-electrical equipment for potentially explosive atmospheres.

2 Normative references

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

ISO 3857-3, *Compressors, pneumatic tools and machines — Vocabulary — Part 3: Pneumatic tools and machines*

ISO 5391, *Pneumatic tools and machines — Vocabulary*

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

ISO 13732-1, *Ergonomics of the thermal environment — Methods for the assessment of human responses to contact with surfaces — Part 1: Hot surfaces*

ISO 13732-3, *Ergonomics of the thermal environment — Methods for the assessment of human responses to contact with surfaces — Part 3: Cold surfaces*

ISO 15744, *Hand-held non-electric power tools — Noise measurement code — Engineering method (grade 2)*

ISO 17066, *Hydraulic tools — Vocabulary*

ISO 20643, *Mechanical vibration — Hand-held and hand-guided machinery — Principles for evaluation of vibration emission*

ISO 28927-1:2009, *Hand-held portable power tools — Test methods for evaluation of vibration emission — Part 1: Angle and vertical grinders*

ISO 28927-4, *Hand-held portable power tools — Test method for evaluation of vibration emission — Part 4: Straight grinders*

EN 10111, *Continuously hot rolled low carbon steel sheet and strip for cold forming — Technical delivery conditions*

EN 10130, *Cold rolled low carbon steel flat products for cold forming — Technical delivery conditions*

EN 12096, *Mechanical vibration — Declaration and verification of vibration emission values*

EN 12418, *Masonry and stone cutting-off machines for job site — Safety*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 3857-3, ISO 5391, ISO 12100 and ISO 17066 (for hydraulic tools) and the following apply.

3.1 General terms and definitions

3.1.1
hand-held power tool
machine operated by one or two hands and driven by rotary or linear motors powered by compressed air, hydraulic fluid, gaseous or liquid fuel, electricity or stored energy (e.g. by a spring) to do mechanical work and so designed that the motor and the mechanism form an assembly that can easily be brought to its place of operation

NOTE Hand-held power tools driven by compressed air or gas are called pneumatic tools (or air tools). Hand-held power tools driven by hydraulic liquid are called hydraulic tools.

3.1.2
inserted tool
tool inserted in the grinder to perform the intended work

3.1.3
service tool
tool intended for performing maintenance or service on the grinder

3.1.4
control device
device to start and stop the grinder or to change the direction of the rotation or to control the functional characteristics, such as speed and power

3.1.5
start-and-stop device
throttle
manually operated control on the grinder by which the energy supply to the motor can be turned on and off

3.1.6
hold-to-run start-and-stop device
constant-pressure throttle
start-and-stop device that automatically returns to the OFF position when force on the start and stop device actuator is released

3.1.7
lock-on start-and-stop device
constant pressure throttle with instant release lock
hold-to-run start-and-stop device that can be locked in the ON position and designed so that it permits the grinder to be turned off by a single motion of the same finger or fingers used to turn it on

3.1.8
lock-off start-and-stop device
lock-off throttle
start-and-stop device that automatically latches in the OFF position when the actuator is released and where two motions are required to energize the grinder

3.1.9
positive on-off start-and-stop device
positive on-off throttle
start and stop device that remains in an ON position until it is manually changed

3.1.10
maximum operating pressure
maximum pressure at which a grinder may be operated

3.1.11
whip hose
air hose connecting the main air hose with an air tool for the purpose of providing more flexibility

3.1.12
rated air pressure
air pressure, required at an air tool inlet port to ensure rated performance of the tool, also considered the maximum pressure at which the tool may be operated

3.1.13 Rated speed

3.1.13.1
rated speed
⟨pneumatic tool⟩ speed of an air tool at no load and rated air pressure at the tool inlet port

NOTE 1 The rated speed is expressed in revolutions per minute.

NOTE 2 The rated speed is also considered the maximum speed at which an abrasive tool, such as a grinder, may be operated.

3.1.13.2
rated speed
⟨hydraulic tool⟩ nominal speed of a hydraulic tool at no load and rated flow at the tool inlet port

NOTE 1 The rated speed is expressed in revolutions per minute.

NOTE 2 The rated speed is also considered the maximum speed at which an abrasive tool, such as a grinder, may be operated.

3.1.14
maximum attainable speed
maximum speed which the tool can achieve under the most adverse condition of possible maladjustment or malfunction of its speed control devices, when supplied with compressed air at the pressure marked on the grinder or when supplied with hydraulic fluid at the maximum flow rate marked on the grinder

3.1.15
suspension device
device, which is attached to the tool, whose primary purpose is to reduce the strain on the operator caused by the mass of the tool

NOTE The device can also have a secondary purpose of transmitting a reaction torque.

3.2 Terms and definitions related to grinders

3.2.1
grinder
hand-held power tool driving a rotary output spindle adapted in order to carry an abrasive wheel/product for material removal

NOTE A grinder equipped with a cutting-off wheel is often called a cutting-off machine. For examples of grinders, see Annex B.

3.2.2
machine spindle
shaft of the grinder that supports, locates and drives the abrasive product

3.2.3
flange
disc, normally of metal, mounted on the machine spindle to support and clamp the abrasive wheel/product

3.2.4
flange set
means provided to clamp an unthreaded abrasive product, on the rotating machine spindle

3.2.5
backing flange
driving flange
flange that is affixed to, or integral with, the spindle and is assembled before the abrasive wheel/product

3.2.6
front flange
outer flange
flange that is placed on the grinder's spindle after the abrasive wheel/product, which is secured by the spindle end nut

3.2.7
flange contact diameter
d_f
outside diameter of the clamping surface of a flange

3.2.8
guard
device that partly encloses the abrasive wheel/product

3.2.9
blotter
thin piece of a compressible material placed between the abrasive wheel/product and the flange of the grinder

3.2.10
tightening torque
torque for tightening the clamping device that fastens the abrasive product to the machine spindle

3.2.11
maximum operating speed of an abrasive wheel/product
maximum peripheral speed of an abrasive wheel/product, as specified by the manufacturer of the abrasive product

NOTE It is expressed in metres per second [m/s (or sfpm)].

3.2.12
abrasive product
common term for products used for abrasive material removal

EXAMPLE Grinding wheels, cutting-off wheels, diamond and reinforced wheels (superabrasives), wire brushes, flap discs and flap wheels.

3.3 Symbols

Symbol	Description	Unit
C	Radial dimension of the flange clamping surface	mm
d_f	Outside diameter of the flange clamping surface	mm
d_{f2}	Backing flange outside diameter	mm
D	Outside diameter of the abrasive wheel	mm
D_g	Guard diameter	mm
F_t	Test load	N
G	Depth of the flange recess	mm
H	Bore diameter of the abrasive wheel	mm
P	Rated power	W
n_{nom}	Rated speed	r/min

4 Safety requirements and/or protective measures

4.1 General

The machine shall comply with the following safety requirements and/or protective measures and be verified in accordance with Clause 5. In addition, the machine shall be designed in accordance with the principles of ISO 12100 for relevant, but not necessarily significant, hazards which are not dealt with by this part of ISO 11148.

The measures adopted to comply with the requirements of Clause 4 shall take account of the state of the art.

It is recognized that optimizing the design with respect to some safety measures can result in a degradation of performance against other safety requirements. In such cases, it is required to find a balance between

the various requirements in order to achieve a grinder design that satisfies each requirement, so far as is reasonably practicable, and remains fit for purpose.

4.2 Mechanical safety

4.2.1 Surfaces, edges and corners

Accessible parts of grinders, except the inserted tool, shall not have sharp edges or angles or rough or abrasive surfaces (see ISO 12100:2010, 6.2.2.1).

4.2.2 Supporting surface and stability

The grinder shall be so designed that it can be laid aside and remain in a stable position on a plane surface.

4.2.3 Hydraulic fluid ejection

Hydraulic systems of the grinder shall be enclosed so as to provide protection against high-pressure fluid ejection.

4.2.4 Speed control

The rated speed of the grinder shall not be exceeded under the conditions marked on the grinder. It shall be possible to measure rotational speed using a tachometer.

The speed control device of a grinder shall be designed to prevent incorrect assembly. The speed control device shall be manufactured from non-corrodible material.

4.2.5 Power tool construction

The grinder shall be so designed and constructed as to prevent the loosening or loss of components during expected use, including rough handling and occasional dropping, which can cause its safety functions to be compromised.

4.2.6 Attachment of abrasive product

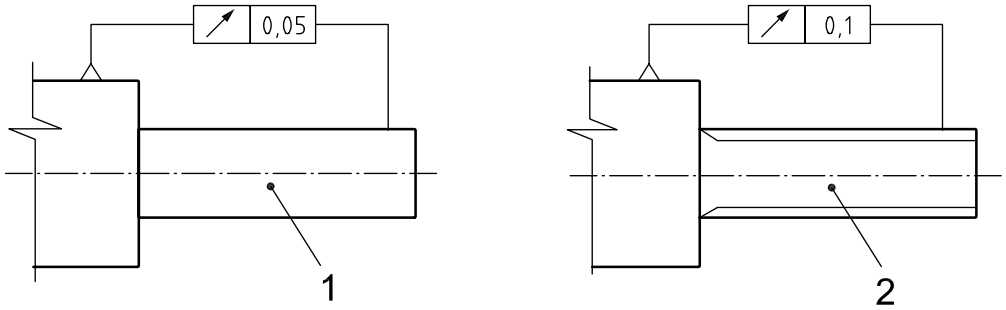
The grinder shall be designed to prevent the abrasive product from coming loose, for instance unscrewed by inertia and spun off, after the stop command has been given.

4.2.7 Spindles

Spindles shall be designed so that they locate and secure the abrasive product.

All grinders shall incorporate means to hold the spindle where a grinding wheel is being mounted or removed. For threaded spindles, the direction of the spindle threads shall be such that the clamping device, collet or wheel with threaded hole shall tend to tighten during grinding.

In order to decrease vibrations, for spindles which locate a plain bore wheel, the diameter shall have a maximum total indicator reading of 0,05 mm to the true axis of the spindle (see Figure 1).



Key

1 machine spindle

2 machine spindle with threads

Figure 1 — Maximum spindle run-out

For spindles with a threaded portion intended for locating abrasive products with threaded bores, the pitch diameter of the thread shall have a maximum total indicator reading of 0,1 mm to the true axis of the spindle.

The diameter of the part, which locates the abrasive product, shall have a tolerance of e8 or narrower (but not press fit).

Spindles shall have a suitable means of receiving a tachometer.

4.2.8 Flanges

4.2.8.1 General

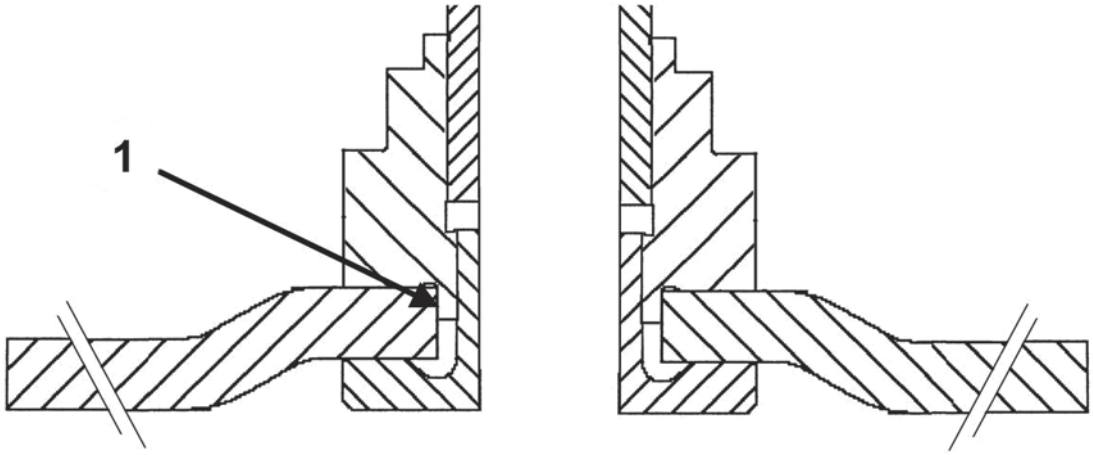
4.2.8.1.1 Flange design

Flanges shall be designed so that they provide for, or aid in, securing and driving the abrasive products, which are intended to be used with the grinder. Grinders not designed for use with certain wheels are not required to have flanges capable of mounting such wheels.

NOTE Wheel types for which grinders are designed are expected to be identified in the instructions handbook, which accompanies the grinder, or else on the exterior of the grinder.

The driving flange shall be integral with the spindle or shall be mounted on the spindle in a manner that provides sufficient rotational driving action to prevent slipping of the abrasive product.

A piloting diameter (see Figure 2) shall locate the abrasive product radially to the shaft of the tool. The flange assembly shall have the piloting diameter on either the driving or the outer flange or on the shaft itself. It is not permitted to have piloting diameters on two parts simultaneously.



Key

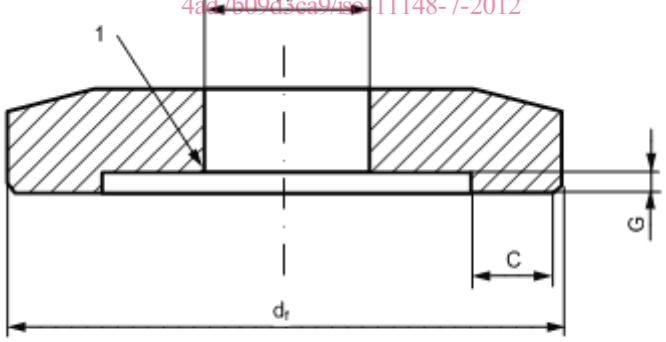
1 piloting diameter

Small indicator readings between the piloting diameter and the true axis of the spindle are essential to control the out-of-centre of the wheel and, hence, the vibrations. From this point of view, a piloting diameter on the driving flange is recommended.

Figure 2 — Flange piloting diameter

4.2.8.1.2 Chamfer and overlap

Flanges, both driving and outer, shall be designed to prevent pieces of the abrasive product from splintering due to high edge pressure arising during clamping. The most common design is with a chamfer or recess, as shown in Figure 3.



Key

1 chamfer or recess

C flange clamping surface

d_f outside diameter of the flange clamping surface

G depth of the recess

H bore diameter of the abrasive wheel

Figure 3 — Principal dimensions of flanges

The dimensions, C and G, in Figure 3, of flanges for all wheel types shall be:

$$3\,\text{mm} \le C \le \frac{(d_f - H - 2G)}{2} \quad (1)$$

$$G \ge 0{,}5\,\text{mm}$$

4.2.8.1.3 General tolerance of clamping surface

The clamping surface, C (see Figure 3), of the flanges shall run true with a tolerance giving a total indicator reading of maximum 0,1 % of the diameter at the position of the indicator. The indicator shall be positioned near the outside diameter.

4.2.8.1.4 General tolerance of flanges

The part of the flanges, which locates and guides the abrasive products with unthreaded holes, shall have an out-of-centre tolerance lower than 0,2 mm (see Figure 2).

4.2.8.1.5 Material of flanges

The steel in the flanges shall have a minimum tensile strength of 430 N/mm^2. Other materials may be used, in which case the flange shall be tested and fulfil the requirements of 5.4. The material should also provide necessary ductility.

4.2.8.2 Type 1 wheels

Flanges in a set shall have the same contact diameter and shall have equal contact surface.

For type 1 wheels, the flange diameter, d_f, shall be:

$$d_f \ge 0{,}33\ D \quad (2)$$

where D is the outside diameter of the abrasive wheel.

Both flanges shall be relieved to equal diameters and shall conform to the dimensions shown in Figure 3.

Exception: machines specifically designed for, and used only with, diamond and reinforced (segmented) wheels shall use flanges of not less than one fourth of the wheel diameter.

4.2.8.3 Types 6 and 11 wheels

4.2.8.3.1 Unthreaded wheels

For types 6 and 11 unthreaded wheels, the flange diameter, d_f, shall be:

$d_f = (20 \pm 1)$ mm for 55 mm $\le D <$ 80 mm;

$d_f = (20 \pm 1)$ mm for 80 mm $\le D <$ 105 mm for wheels with a bore diameter of 10 mm (3/8 in UNC);

$d_f = (29 \pm 1)$ mm for 80 mm $\le D <$ 105 mm for wheels with a bore diameter of 16 mm (5/8 in UNC);

$d_f = (41 \pm 1)$ mm for 105 mm $\le D \le$ 230 mm.

The backing flange (diameter d_{f2}) may have a larger contact surface than the outer flange, if this arrangement fulfils the requirement of absorbing the grinding forces (see Figure 4).