IEC 62841-2-3

Edition 1.1 2024-10
CONSOLIDATED VERSION

INTERNATIONAL STANDARD

colour inside

Electric motor-operated hand-held tools, transportable tools and lawn and garden machinery – Safety –
Part 2-3: Particular requirements for hand-held grinders, disc-type polishers and disc-type sanders

IEC 62841-2-3:2020-04+AMD1:2024-10 CSV(en)

IEC Secretariat
3, rue de Varembé
CH-1211 Geneva 20
Switzerland

Tel.: +41 22 919 02 11
info@iec.ch
www.iec.ch

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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This consolidated version of the official IEC Standard and its amendment has been prepared for user convenience.

IEC 62841-2-3 edition 1.1 contains the first edition (2020-04) [documents 116/444/FDIS and 116/454/RVD], its corrigendum 1 (2021-04) and its amendment 1 (2024-10) [documents 116/813/FDIS and 116/832/RVD].

In this Redline version, a vertical line in the margin shows where the technical content is modified by amendment 1. Additions are in green text, deletions are in strikethrough red text. A separate Final version with all changes accepted is available in this publication.

International Standard IEC 62841-2-3 has been prepared by IEC technical committee 116: Safety of motor-operated electric tools.

This document has been drafted in accordance with the ISO/IEC Directives, Part 2.

This Part 2-3 is to be used in conjunction with the first edition of IEC 62841-1:2014.

This Part 2-3 supplements or modifies the corresponding clauses in IEC 62841-1, so as to convert it into the IEC Standard: Particular requirements for hand-held grinders, disc-type polishers and disc-type sanders.

Where a particular subclause of Part 1 is not mentioned in this Part 2-3, that subclause applies as far as relevant. Where this standard states “addition”, “modification” or “replacement”, the relevant text in Part 1 is to be adapted accordingly.

The following print types are used:

– requirements: in roman type;
– *test specifications: in italic type;*
– notes: in small roman type.

The terms in **bold typeface** in the text are defined in Clause 3.

Subclauses, notes and figures which are additional to those in Part 1 are numbered starting from 101.

A list of all parts of the IEC 62841 series, under the general title: *Electric motor-operated hand-held tools, transportable tools and lawn and garden machinery – Safety*, can be found on the IEC website.

The committee has decided that the contents of this document and its amendment will remain unchanged until the stability date indicated on the IEC website under webstore.iec.ch in the data related to the specific document. At this date, the document will be

- reconfirmed,
- withdrawn, or
- revised.

NOTE The attention of National Committees is drawn to the fact that equipment manufacturers and testing organizations may need a transitional period following publication of a new, amended or revised IEC publication in which to make products in accordance with the new requirements and to equip themselves for conducting new or revised tests.

It is the recommendation of the committee that the content of this publication be adopted for implementation nationally not earlier than 36 months from the date of publication.

IMPORTANT – The "colour inside" logo on the cover page of this document indicates that it contains colours which are considered to be useful for the correct understanding of its contents. Users should therefore print this document using a colour printer.

ELECTRIC MOTOR-OPERATED HAND-HELD TOOLS, TRANSPORTABLE TOOLS AND LAWN AND GARDEN MACHINERY – SAFETY –

Part 2-3: Particular requirements for hand-held grinders, disc-type polishers and disc-type sanders

1 Scope

This clause of Part 1 is applicable, except as follows:

Addition:

This ~~part of IEC 62841~~ document applies to hand-held **grinders**, **disc-type polishers** and **disc-type sanders**, including angle, straight and vertical tools, intended for use on various materials except magnesium, with a **rated capacity** not exceeding 230 mm. For **grinders**, the **rated no-load speed** does not exceed a peripheral speed of the **accessory** of 80 m/s at **rated capacity**.

This document also applies to **concrete surface grinders** for use on various masonry materials with a **rated capacity** not exceeding 230 mm.

This document does not apply to **grinders** intended to be fitted with an **accessory** other than a bonded abrasive product or a **diamond wheel**.

This document does not apply to **grinders** intended to be fitted with **diamond wheels** with

– peripheral gaps exceeding 10 mm; or
– a positive rake angle.

This ~~standard~~ document does not apply to dedicated cut-off machines.

NOTE 101 It is planned that a document on cut-off machines will be published.

This ~~standard~~ document does not apply to orbital polishers and orbital sanders.

NOTE 102 ~~It is planned that a document on orbital polishers and orbital sanders will be published.~~ Orbital polishers and orbital sanders are covered by IEC 62841-2-4.

This ~~standard~~ document does not apply to die grinders.

NOTE 103 ~~Die grinders are covered by IEC 62841-2-23.~~ It is planned that a document on die grinders will be published.

2 Normative references

This clause of Part 1 is applicable, except as follows:

Addition:

ISO 525:~~2013~~2020, *Bonded abrasive products – ~~General requirements~~ Shape types, designation and marking*

3 Terms and definitions

This clause of Part 1 is applicable, except as follows:

3.101
blotter
thin piece of an easily compressible material, between the abrasive product and **flange**

3.102
diamond wheel
metal wheel with continuous or segmented diamond abrasives

3.102.1
diamond cutting wheel
metal wheel with the abrasives located on the periphery of the wheel

3.102.2
diamond grinding wheel
metal wheel with abrasives located on the face of the wheel

3.103
disc-type polisher
tool equipped with a rotating flexible disc or pad intended for polishing

Note 101 to entry: Polishing is an operation to produce a smooth or shiny surface.

3.104
disc-type sander
tool, constructed like a **grinder**, intended for sanding

Note 101 to entry: Sanding is an operation to remove material using flexible abrasive material, such as sandpaper.

3.105
flange
collar, disc or plate between or against which wheels are mounted

3.105.1
unrecessed (flange)
flange fixed to the machine spindle having an **unrecessed** flat surface against which a threaded hole abrasive product is screwed, e.g. a cup wheel, a cone or a plug

3.105.2
inner flange
flange which contacts and provides support to the back side of the wheel and is located on the spindle between wheel and tool

3.105.3
outer flange
flange which supports the front side of the wheel and secures and clamps the wheel to the spindle and the **inner flange**

Note 101 to entry: In Canada and the United States of America, the following additional definition applies:

3.105.UC1
adaptor backing flange
inner flange which contacts and supports in the hub area and extends past the raised portion to reduce the flexing of the wheel periphery

3.106
grinder
tool driving a rotating spindle on which a bonded abrasive product or a **diamond wheel** is mounted

3.106.1
angle grinder
grinder with the rotating spindle at an angle to the axis of the tool body which acts as a grasping surface, intended for peripheral and lateral grinding

Note 101 to entry: See Figure 101.

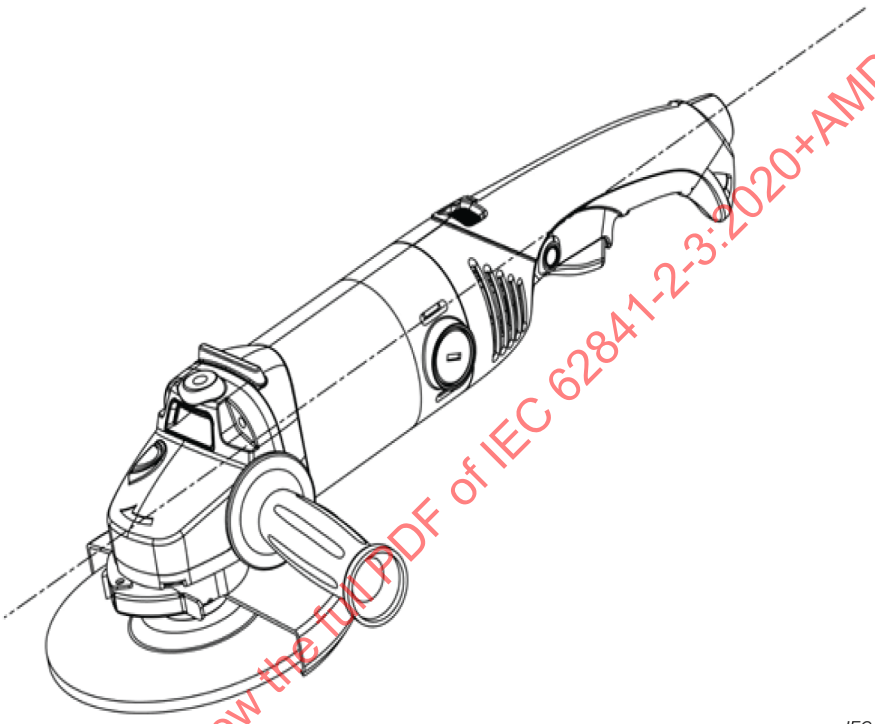

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Figure 101 – Example of an angle grinder

3.106.2
straight grinder
grinder with the rotating spindle in-line with the axis of the tool body which acts as a grasping surface, intended for peripheral grinding only and not equipped with a collet or chuck

Note 101 to entry: See Figure 102.

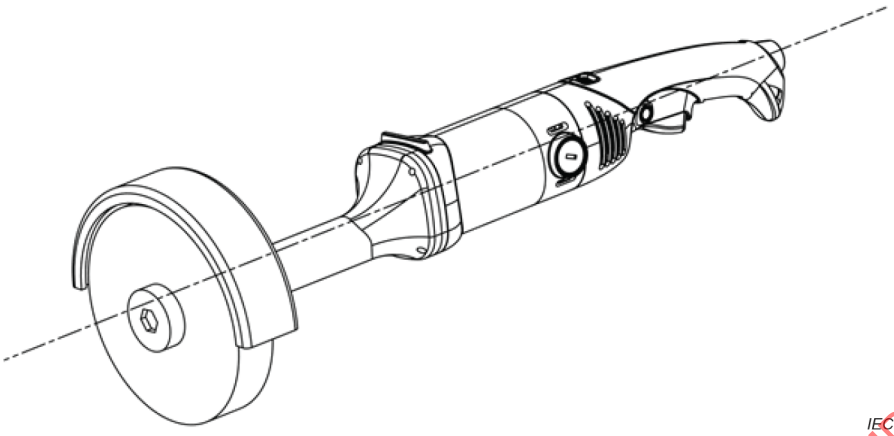

Figure 102 – Example of a straight grinder

3.106.3
vertical grinder
grinder with the rotating spindle in-line with the axis of the tool body and with handles that are substantially perpendicular to the axis of the rotating spindle, intended for peripheral and lateral grinding

Note 101 to entry: See Figure 103.

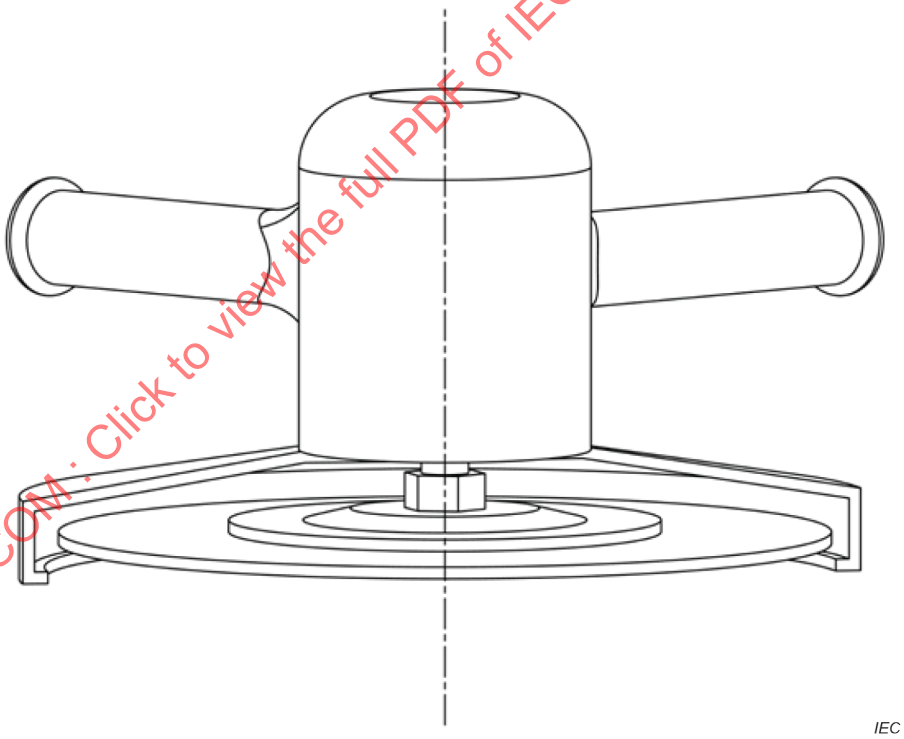

Figure 103 – Example of a vertical grinder

3.106.4
concrete surface grinder
grinder intended for facial grinding with a **diamond grinding wheel** and not intended for other grinding or cut-off operations

Note 101 to entry: See Figure 116.

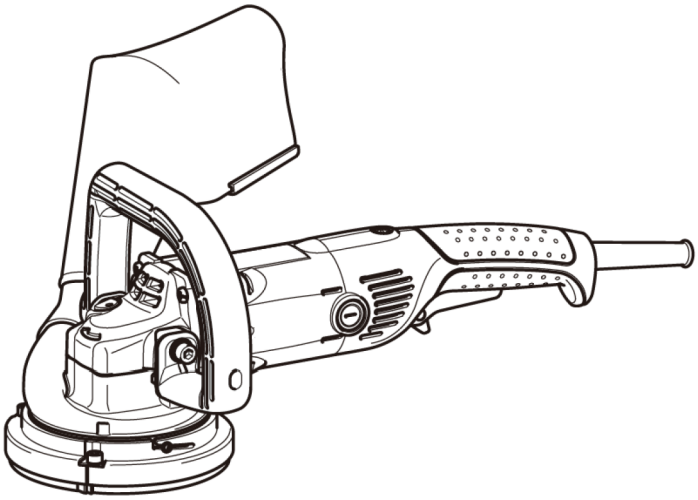

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Figure 116 – Example of a concrete surface grinder

3.107
guide plate
flat plate on the machine which rests on the material to be cut

3.108
guide roller
roller on the machine which rests on the material to be cut

3.109
minor fragment
particles less than 1/16 of the mass of the abrasive wheel

3.110
rated capacity
maximum diameter of the rotating **accessory** to be fitted on the tool as specified by the manufacturer's instruction

3.111
wheel guard
device which partly encloses the abrasive wheel and gives protection to the operator

3.112
wheel types
alphanumeric designation of wheels based upon application and shape

Note 101 to entry: Shapes for **wheel types** are given in Annex CC.

4 General requirements

This clause of Part 1 is applicable.

5 General conditions for the tests

This clause of Part 1 is applicable, except as follows:

5.17 *Addition:*

*The mass of a **grinder** includes the **wheel guard**, the **flanges** and the handles.*

*The mass of a **disc-type polisher** or **disc-type sander** includes the **flanges** and the handles.*

6 Radiation, toxicity and similar hazards

This clause of Part 1 is applicable.

7 Classification

This clause of Part 1 is applicable.

8 Marking and instructions

This clause of Part 1 is applicable, except as follows:

8.1 *Addition:*

Tools shall also be marked with:

– **rated no-load speed**;
– **rated capacity**.

NOTE 101 The requirement for marking **rated capacity** does not prohibit the additional marking of smaller permitted diameters of the rotating **accessory** other than **rated capacity** (e.g. 115 mm / 125 mm, where 125 mm is the **rated capacity**).

8.2 *Addition:*

Tools shall also be marked with:

"**WARNING** Always wear eye protection" or sign M004 of ISO 7010 or the following safety sign:

The eye protection symbol may be modified by adding other personal protective equipment such as ear protection, dust mask, etc.

Tools that require at least two handles in accordance with 19.4 shall be marked with

– "**WARNING** Always operate with two hands"; or
– the following safety sign:

NOTE In Canada and the United States of America, the following additional requirements apply:

Tools shall be marked with the following additional safety warnings:

– "WARNING – To reduce the risk of injury, use only accessories rated at least equal to the maximum speed marked on the tool."

In Canada, the equivalent French wording of the above warning is as follows: “AVERTISSEMENT – Pour réduire le risque de blessure, utiliser uniquement les accessoires convenant au moins à la vitesse maximale inscrite sur l’outil.”

All **grinders** required to have a **wheel guard** by 19.101.2 shall be marked with the following warning:

– “WARNING – To reduce the risk of injury, always use proper guards when grinding.”

In Canada, the equivalent French wording of the above warning is as follows: “AVERTISSEMENT – Pour réduire le risque de blessure, utiliser toujours les protecteurs appropriés pendant le meulage.”

If the above cautionary markings are included as part of a list of cautionary markings, the words “WARNING – To reduce the risk of injury” need not be repeated.

8.2.101 A Type B **wheel guard** in accordance with Annex AA shall be marked with

– “ **WARNING** Not for cut-off operations”; or

– the following safety sign:

8.3 *Addition:*

Tools provided with a threaded spindle intended to accept threaded **accessories** in accordance with 8.14.2 shall be marked with the spindle thread size.

The direction of rotation of the spindle shall be indicated on the tool by an arrow, raised or recessed or by any other means no less visible and indelible.

8.4 *Modification:*

The marking specified in 8.2.101 may be located on a Type B **wheel guard** that is a **detachable part**.

8.6 *Addition:*

linear dimension..... mm

always operate with two hands

do not use this type of guard for cut-off operations

8.12 *Addition:*

The safety sign required by 8.2.101 need not be in accordance with the red colour requirements of ISO 3864-2.

8.14.1 *Addition:*

The additional safety instructions as specified in 8.14.1.101 shall be given. This part may be printed separately from the "General Power Tool Safety Warnings".

In these safety instructions, terms such as grinding or **grinder**, sanding or sander, **concrete surface grinder** or concrete surface grinding, wire brushing or wire brush, polishing or polisher, or cutting-off or cut-off tool are selected as specified by the manufacturer. These terms in the warnings and headings shall be consistently used or deleted based on the selected operations. The "and"/"or" conjunctions may be used as appropriate.

If the power tool is intended only for one of the listed operations, the heading of that section is to be used for all warnings. Grinding and cutting off shall be included for **angle grinders** with a **rated capacity** exceeding 55 mm.

8.14.1.101 Additional safety instructions for grinders, disc-type polishers and disc-type sanders

8.14.1.101.1 General

The additional safety instructions as specified in 8.14.1.101.2 to 8.14.1.101.8 shall be given. This part may be printed separately from the "General Power Tool Safety Warnings".

In these safety instructions, terms such as grinding/**grinder**, sanding/sander, wire brushing/wire brush, polishing/polisher or cutting-off/cut-off tool are selected as specified by the manufacturer. These terms in the warnings and headings shall be consistently used or deleted based on the selected operations. The "and"/"or" conjunctions may be used as appropriate.

If the power tool is intended only for one of the listed operations, the heading of that section is to be used for all warnings.

8.14.1.101.2 Safety instructions for all operations

Safety warnings common for grinding, sanding, wire brushing, polishing or cutting-off operations:

NOTE 101 In the above heading, those operations not applicable are omitted.

a) **This power tool is intended to function as a grinder, sander, wire brush, polisher, hole cutter or cut-off tool. Read all safety warnings, instructions, illustrations and specifications provided with this power tool**. *Failure to follow all instructions listed below may result in electric shock, fire and/or serious injury.*

NOTE 102 Only the applicable operations are listed.

b) **Operations such as grinding, sanding, wire brushing, polishing, hole cutting or cutting-off are not to be performed with this power tool**. *Operations for which the power tool was not designed may create a hazard and cause personal injury.*

NOTE 103 Only those operations are listed that were not included in the first warning. If all listed operations are intended, then this warning is omitted, but all subsequent warnings are given without exclusion.

c) **Do not convert this power tool to operate in a way which is not specifically designed and specified by the tool manufacturer**. *Such a conversion may result in a loss of control and cause serious personal injury.*

d) **Do not use accessories which are not specifically designed and specified by the tool manufacturer**. *Just because the accessory can be attached to your power tool, it does not assure safe operation.*

e) **The rated speed of the accessory must be at least equal to the maximum speed marked on the power tool**. *Accessories running faster than their rated speed can break and fly apart.*

f) **The outside diameter and the thickness of your accessory must be within the capacity rating of your power tool**. *Incorrectly sized accessories cannot be adequately guarded or controlled.*

g) **The dimensions of the accessory mounting must fit the dimensions of the mounting hardware of the power tool**. *Accessories that do not match the mounting hardware of the power tool will run out of balance, vibrate excessively and may cause loss of control.*

h) **Do not use a damaged accessory. Before each use inspect the accessory such as abrasive wheels for chips and cracks, backing pad for cracks, tear or excess wear, wire brush for loose or cracked wires. If power tool or accessory is dropped, inspect for damage or install an undamaged accessory. After inspecting and installing an accessory, position yourself and bystanders away from the plane of the rotating accessory and run the power tool at maximum no-load speed for one minute.** *Damaged accessories will normally break apart during this test time.*

i) **Wear personal protective equipment. Depending on application, use face shield, safety goggles or safety glasses. As appropriate, wear dust mask, hearing protectors, gloves and workshop apron capable of stopping small abrasive or workpiece fragments**. *The eye protection must be capable of stopping flying debris generated by various applications. The dust mask or respirator must be capable of filtrating particles generated by the particular application. Prolonged exposure to high intensity noise may cause hearing loss.*

j) **Keep bystanders a safe distance away from work area. Anyone entering the work area must wear personal protective equipment.** *Fragments of workpiece or of a broken accessory may fly away and cause injury beyond immediate area of operation.*

k) **Hold the power tool by insulated gripping surfaces only, when performing an operation where the cutting accessory may contact hidden wiring or its own cord.** *Cutting accessory contacting a "live" wire may make exposed metal parts of the power tool "live" and could give the operator an electric shock.*

NOTE 104 The above warning is omitted if polishing or sanding are the only Intended operations.

l) **Position the cord clear of the spinning accessory**. *If you lose control, the cord may be cut or snagged and your hand or arm may be pulled into the spinning accessory.*

m) **Never lay the power tool down until the accessory has come to a complete stop**. *The spinning accessory may grab the surface and pull the power tool out of your control.*

n) **Do not run the power tool while carrying it at your side**. *Accidental contact with the spinning accessory could snag your clothing, pulling the accessory into your body.*

o) **Regularly clean the power tool's air vents**. *The motor's fan will draw the dust inside the housing and excessive accumulation of powdered metal may cause electrical hazards.*

p) **Do not operate the power tool near flammable materials.** *Sparks could ignite these materials.*

q) **Do not use accessories that require liquid coolants.** *Using water or other liquid coolants may result in electrocution or shock.*

NOTE 105 The above warning does not apply for power tools specifically designed for use with a **liquid system**.

8.14.1.101.3 Further safety instructions for all operations

Kickback and related warnings:

Kickback is a sudden reaction to a pinched or snagged rotating wheel, backing pad, brush or any other accessory. Pinching or snagging causes rapid stalling of the rotating accessory which in turn causes the uncontrolled power tool to be forced in the direction opposite of the accessory's rotation at the point of the binding.

For example, if an abrasive wheel is snagged or pinched by the workpiece, the edge of the wheel that is entering into the pinch point can dig into the surface of the material causing the wheel to climb out or kick out. The wheel may either jump toward or away from the operator, depending on direction of the wheel's movement at the point of pinching. Abrasive wheels may also break under these conditions.

Kickback is the result of power tool misuse and/or incorrect operating procedures or conditions and can be avoided by taking proper precautions as given below.

a) **Maintain a firm grip with both hands on the power tool and position your body and arms to allow you to resist kickback forces. Always use auxiliary handle, if provided, for maximum control over kickback or torque reaction during start-up.** *The operator can control torque reactions or kickback forces, if proper precautions are taken.*

b) **Never place your hand near the rotating accessory**. *Accessory may kickback over your hand.*

c) **Do not position your body in the area where power tool will move if kickback occurs.** *Kickback will propel the tool in direction opposite to the wheel's movement at the point of snagging.*

d) **Use special care when working corners, sharp edges, etc. Avoid bouncing and snagging the accessory**. *Corners, sharp edges or bouncing have a tendency to snag the rotating accessory and cause loss of control or kickback.*

e) **Do not attach a saw chain woodcarving blade, segmented diamond wheel with a peripheral gap greater than 10 mm or toothed saw blade.** *Such blades create frequent kickback and loss of control.*

8.14.1.101.4 Additional safety instructions for grinding and cutting-off operations

NOTE 101 If grinding and cutting-off operations are not intended by the manufacturer, this subclause is omitted.

Safety warnings specific for grinding and cutting-off operations:

a) **Use only wheel types that are specified for your power tool and the specific guard designed for the selected wheel.** *Wheels for which the power tool was not designed cannot be adequately guarded and are unsafe.*

b) **The grinding surface of centre depressed wheels must be mounted below the plane of the guard lip.** *An improperly mounted wheel that projects through the plane of the guard lip cannot be adequately protected.*

c) **The guard must be securely attached to the power tool and positioned for maximum safety, so the least amount of wheel is exposed towards the operator.** *The guard helps to protect the operator from broken wheel fragments, accidental contact with wheel and sparks that could ignite clothing.*

NOTE 102 The above warning is omitted for **grinders** with a **rated capacity** of less than 55 mm.

d) **Wheels must be used only for specified applications. For example: do not grind with the side of cut-off wheel.** *Abrasive cut-off wheels are intended for peripheral grinding, side forces applied to these wheels may cause them to shatter.*

e) **Always use undamaged wheel flanges that are of correct size and shape for your selected wheel.** *Proper wheel flanges support the wheel thus reducing the possibility of wheel breakage. Flanges for cut-off wheels may be different from grinding wheel flanges.*

f) **Do not use worn down wheels from larger power tools.** *A wheel intended for larger power tool is not suitable for the higher speed of a smaller tool and may burst.*

NOTE 103 The above warning does not apply for tools only designated to be used with **diamond wheels**.

g) **When using dual purpose wheels always use the correct guard for the application being performed.** *Failure to use the correct guard may not provide the desired level of guarding, which could lead to serious injury.*

8.14.1.101.5 Additional safety instructions for cutting-off operations

NOTE 101 If cutting-off operation is not intended by the manufacturer, this subclause is omitted.

Additional safety warnings specific for cutting-off operations:

a) **Do not "jam" the cut-off wheel or apply excessive pressure. Do not attempt to make an excessive depth of cut.** *Overstressing the wheel increases the loading and susceptibility to twisting or binding of the wheel in the cut and the possibility of kickback or wheel breakage.*

b) **Do not position your body in line with and behind the rotating wheel.** *When the wheel, at the point of operation, is moving away from your body, the possible kickback may propel the spinning wheel and the power tool directly at you.*

c) **When the wheel is binding or when interrupting a cut for any reason, switch off the power tool and hold it motionless until the wheel comes to a complete stop. Never attempt to remove the cut-off wheel from the cut while the wheel is in motion otherwise kickback may occur.** *Investigate and take corrective action to eliminate the cause of wheel binding.*

d) **Do not restart the cutting operation in the workpiece. Let the wheel reach full speed and carefully re-enter the cut.** *The wheel may bind, walk up or kickback if the power tool is restarted in the workpiece.*

e) **Support panels or any oversized workpiece to minimize the risk of wheel pinching and kickback.** *Large workpieces tend to sag under their own weight. Supports must be placed under the workpiece near the line of cut and near the edge of the workpiece on both sides of the wheel.*

f) **Use extra caution when making a "pocket cut" into existing walls or other blind areas.** *The protruding wheel may cut gas or water pipes, electrical wiring or objects that can cause kickback.*

g) **Do not attempt to do curved cutting.** *Overstressing the wheel increases the loading and susceptibility to twisting or binding of the wheel in the cut and the possibility of kickback or wheel breakage, which can lead to serious injury.*

8.14.1.101.6 Additional safety instructions for sanding operations

NOTE 101 If sanding operation is not intended by the manufacturer, this subclause is omitted.

Safety warnings specific for sanding operations:

a) **Use proper sized sanding disc paper. Follow manufacturers recommendations, when selecting sanding paper**. *Larger sanding paper extending too far beyond the sanding pad presents a laceration hazard and may cause snagging, tearing of the disc or kickback.*

8.14.1.101.7 Additional safety instructions for polishing operations

NOTE 101 If polishing operation is not intended by the manufacturer, this subclause is omitted.

Safety warnings specific for polishing operations:

a) **Do not allow any loose portion of the polishing bonnet or its attachment strings to spin freely. Tuck away or trim any loose attachment strings.** *Loose and spinning attachment strings can entangle your fingers or snag on the workpiece.*

8.14.1.101.8 Additional safety instructions for wire brushing operations

NOTE 101 If wire brushing operation is not intended by the manufacturer, this subclause is omitted.

Safety warnings specific for wire brushing operations:

a) **Be aware that wire bristles are thrown by the brush even during ordinary operation. Do not overstress the wires by applying excessive load to the brush.** *The wire bristles can easily penetrate light clothing and/or skin.*

~~b) **If the use of a guard is specified for wire brushing, do not allow any interference of the wire wheel or brush with the guard.** *Wire wheel or brush may expand in diameter due to work load and centrifugal forces.*~~

8.14.1.101 Safety warnings for grinders, disc-type polishers and disc-type sanders

1) Safety instructions for all operations

Safety warnings common for grinding, sanding, concrete surface grinding, wire brushing, polishing or cutting-off operations:

NOTE 101 In the above heading, those operations not applicable are omitted.

a) **This power tool is intended to function as a grinder, sander, wire brush, polisher, hole cutter or cut-off tool. Read all safety warnings, instructions, illustrations and specifications provided with this power tool**. *Failure to follow all instructions listed below may result in electric shock, fire and/or serious injury*.

NOTE 102 Only the applicable operations are listed in item 1) a) above.

b) **Operations such as grinding, sanding, wire brushing, polishing, hole cutting or cutting-off are not to be performed with this power tool**. *Operations for which the power tool was not designed may create a hazard and cause personal injury*.

NOTE 103 Only those operations that were not included in item 1) a) above are listed in item 1) b) above. If all listed operations are intended, then the warning in item 1) b) above is omitted, but all subsequent warnings are given without exclusion.

c) **Do not convert this power tool to operate in a way which is not specifically designed and specified by the tool manufacturer**. *Such a conversion may result in a loss of control and cause serious personal injury.*

d) **Do not use accessories which are not specifically designed and specified by the tool manufacturer**. *Just because the accessory can be attached to your power tool, it does not assure safe operation*.

e) **The rated speed of the accessory must be at least equal to the maximum speed marked on the power tool**. *Accessories running faster than their rated speed can break and fly apart.*

f) **The outside diameter and the thickness of your accessory must be within the capacity rating of your power tool**. *Incorrectly sized accessories cannot be adequately guarded or controlled.*

g) **The dimensions of the accessory mounting must fit the dimensions of the mounting hardware of the power tool**. *Accessories that do not match the mounting hardware of the power tool will run out of balance, vibrate excessively and may cause loss of control.*

h) **Do not use a damaged accessory. Before each use inspect the accessory such as abrasive wheels for chips and cracks, backing pad for cracks, tear or excess wear, wire brush for loose or cracked wires. If power tool or accessory is dropped, inspect for damage or install an undamaged accessory. After inspecting and installing an accessory, position yourself and bystanders away from the plane of the rotating accessory and run the power tool at maximum no-load speed. If unusual vibration is detected, turn the power tool off immediately and replace the cut-off wheel. If unusual vibration is not detected, continue to run the power tool for one minute.** *Damaged accessories will normally break apart during this test time*.

i) **Wear personal protective equipment. Use safety glasses, and, depending on the application, a face shield. As appropriate, wear breathing protection, such as a dust mask or respirator, hearing protection, gloves and workshop apron capable of stopping small abrasive or workpiece fragments**. *The eye protection must be capable of stopping flying debris generated by various applications. The dust mask or respirator must be capable of filtering particles generated by the particular application. Prolonged exposure to high intensity noise may cause hearing loss*.

j) **Keep bystanders a safe distance away from work area. Anyone entering the work area must wear personal protective equipment**. *Fragments of workpiece or of a broken accessory may fly away and cause injury beyond immediate area of operation*.

k) **Hold the power tool by insulated gripping surfaces only, when performing an operation where the cutting accessory may contact hidden wiring or its own cord.** *Cutting accessory contacting a "live" wire may make exposed metal parts of the power tool "live" and could give the operator an electric shock*.

NOTE 104 The warning in item 1) k) above is omitted if polishing or sanding are the only intended operations.

l) **Position the cord clear of the spinning accessory**. *If you lose control, the cord may be cut or snagged and your hand or arm may be pulled into the spinning accessory.*

m) **Never lay the power tool down until the accessory has come to a complete stop**. *The spinning accessory may grab the surface and pull the power tool out of your control.*

n) **Do not run the power tool while carrying it at your side**. *Accidental contact with the spinning accessory could snag your clothing, pulling the accessory into your body*.

o) **Regularly clean the power tool's air vents**. *The motor's fan will draw the dust inside the housing and excessive accumulation of powdered metal may cause electrical hazards*.

p) **Do not operate the power tool near flammable materials.** *Sparks could ignite these materials*.

q) **Do not use accessories that require liquid coolants.** *Using water or other liquid coolants may result in electrocution or shock*.

NOTE 105 The warning in item 1) q) above does not apply for power tools specifically designed for use with a **liquid system**.

2) Further safety instructions for all operations

Kickback and related warnings

Kickback is a sudden reaction to a pinched or snagged rotating wheel, backing pad, brush or any other accessory. Pinching or snagging causes rapid stalling of the rotating accessory which in turn causes the uncontrolled power tool to be forced in the direction opposite of the accessory's rotation at the point of the binding.

For example, if an abrasive wheel is snagged or pinched by the workpiece, the edge of the wheel that is entering into the pinch point can dig into the surface of the material causing the wheel to climb out or kick out. The wheel may either jump toward or away from the operator, depending on direction of the wheel's movement at the point of pinching. Abrasive wheels may also break under these conditions.

Kickback is the result of power tool misuse and/or incorrect operating procedures or conditions and can be avoided by taking proper precautions as given below.

a) **Maintain a firm grip with both hands on the power tool and position your body and arms to allow you to resist kickback forces. Always use auxiliary handle, if provided, for maximum control over kickback or torque reaction during start-up**. *The operator can control torque reactions or kickback forces, if proper precautions are taken.*

b) **Never place your hand near the rotating accessory**. *Accessory may kickback over your hand.*

c) **Do not position your body in the area where power tool will move if kickback occurs.** *Kickback will propel the tool in direction opposite to the wheel's movement at the point of snagging.*

d) **Use special care when working corners, sharp edges, etc. Avoid bouncing and snagging the accessory**. *Corners, sharp edges or bouncing have a tendency to snag the rotating accessory and cause loss of control or kickback.*

e) **Do not attach a saw chain woodcarving blade, segmented diamond wheel with a peripheral gap greater than 10 mm or toothed saw blade.** *Such blades create frequent kickback and loss of control.*

3) Additional safety instructions for grinding and cutting-off operations

NOTE 106 If grinding and cutting-off operations are not Intended by the manufacturer, all of the verbatim text in item 3) below is omitted.

Safety warnings specific for grinding and cutting-off operations

a) **Use only wheel types that are specified for your power tool and the specific guard designed for the selected wheel.** *Wheels for which the power tool was not designed cannot be adequately guarded and are unsafe*.

b) **The grinding surface of centre depressed wheels must be mounted below the plane of the guard lip.** An improperly mounted wheel that projects through the plane of the guard lip cannot be adequately protected.

c) **The guard must be securely attached to the power tool and positioned for maximum safety, so the least amount of wheel is exposed towards the operator.** *The guard helps to protect the operator from broken wheel fragments, accidental contact with wheel and sparks that could ignite clothing.*

NOTE 107 The warning in item 3) c) above is omitted for **grinders** with a **rated capacity** of less than 55 mm.

d) **Wheels must be used only for specified applications. For example: do not grind with the side of cut-off wheel.** *Abrasive cut-off wheels are intended for peripheral grinding, side forces applied to these wheels may cause them to shatter.*

e) **Always use undamaged wheel flanges that are of correct size and shape for your selected wheel.** *Proper wheel flanges support the wheel thus reducing the possibility of wheel breakage. Flanges for cut-off wheels may be different from grinding wheel flanges*.

f) **Do not use worn down wheels from larger power tools.** *A wheel intended for larger power tool is not suitable for the higher speed of a smaller tool and may burst.*

NOTE 108 The warning in item 3) f) above does not apply for tools only designated to be used with **diamond wheels**.

g) **When using dual purpose wheels always use the correct guard for the application being performed.** *Failure to use the correct guard may not provide the desired level of guarding, which could lead to serious injury*.

4) Additional safety instructions for cutting-off operations

NOTE 109 If cutting-off operation is not intended by the manufacturer, all of the verbatim text in item 4) below is omitted.

Additional safety warnings specific for cutting-off operations:

a) **Do not "jam" the cut-off wheel or apply excessive pressure. Do not attempt to make an excessive depth of cut.** *Overstressing the wheel increases the loading and susceptibility to twisting or binding of the wheel in the cut and the possibility of kickback or wheel breakage.*

b) **Do not position your body in line with and behind the rotating wheel.** *When the wheel, at the point of operation, is moving away from your body, the possible kickback may propel the spinning wheel and the power tool directly at you.*

c) **When the wheel is binding or when interrupting a cut for any reason, switch off the power tool and hold it motionless until the wheel comes to a complete stop. Never attempt to remove the cut-off wheel from the cut while the wheel is in motion otherwise kickback may occur.** *Investigate and take corrective action to eliminate the cause of wheel binding.*

d) **Do not restart the cutting operation in the workpiece. Let the wheel reach full speed and carefully re-enter the cut.** *The wheel may bind, walk up or kickback if the power tool is restarted in the workpiece.*

e) **Support panels or any oversized workpiece to minimize the risk of wheel pinching and kickback.** *Large workpieces tend to sag under their own weight. Supports must be placed under the workpiece near the line of cut and near the edge of the workpiece on both sides of the wheel.*

f) **Use extra caution when making a "pocket cut" into existing walls or other blind areas.** *The protruding wheel may cut hidden objects that can cause kickback.*

g) **Do not attempt to do curved cutting.** *Overstressing the wheel increases the loading and susceptibility to twisting or binding of the wheel in the cut and the possibility of kickback or wheel breakage, which can lead to serious injury.*

5) Additional safety instructions for sanding operations

NOTE 110 If sanding operation is not intended by the manufacturer, all of the verbatim text in item 5) below is omitted.

Safety warnings specific for sanding operations:

a) **Use proper sized sanding disc paper. Follow the manufacturer's recommendations when selecting sanding paper**. *Larger sanding paper extending too far beyond the sanding pad presents a laceration hazard and may cause snagging, tearing of the disc or kickback.*

6) Additional safety instructions for polishing operations

NOTE 111 If polishing operation is not intended by the manufacturer, all of the verbatim text in item 6) below is omitted.

Safety warnings specific for polishing operations:

a) **Do not allow any loose portion of the polishing bonnet or its attachment strings to spin freely. Tuck away or trim any loose attachment strings.** *Loose and spinning attachment strings can entangle your fingers or snag on the workpiece.*

7) Additional safety instructions for wire brushing operations

NOTE 112 If wire brushing operation is not intended by the manufacturer, all of the verbatim text in item 7) below is omitted.

Safety warnings specific for wire brushing operations:

a) **Be aware that wire bristles are thrown by the brush even during ordinary operation. Do not overstress the wires by applying excessive load to the brush.** *The wire bristles can easily penetrate light clothing and/or skin.*

b) **If the use of a guard is specified for wire brushing, do not allow any interference of the wire wheel or brush with the guard.** *Wire wheel or brush may expand in diameter due to work load and centrifugal forces.*

8.14.2 a) *Addition:*

101) Instruction on which types of **accessories** and **guards** to be used for the intended applications of the tool in accordance with 8.14.1.101.2 a) that comply with the substance of Table 101, as applicable;

102) When using dual purpose (combined grinding and cutting-off abrasive) flange mounted wheels, instruction to only use either a Type A (cut-off) or Type C (combination) **wheel guard**;

103) Information on the risks associated with using incorrect **guards**, including

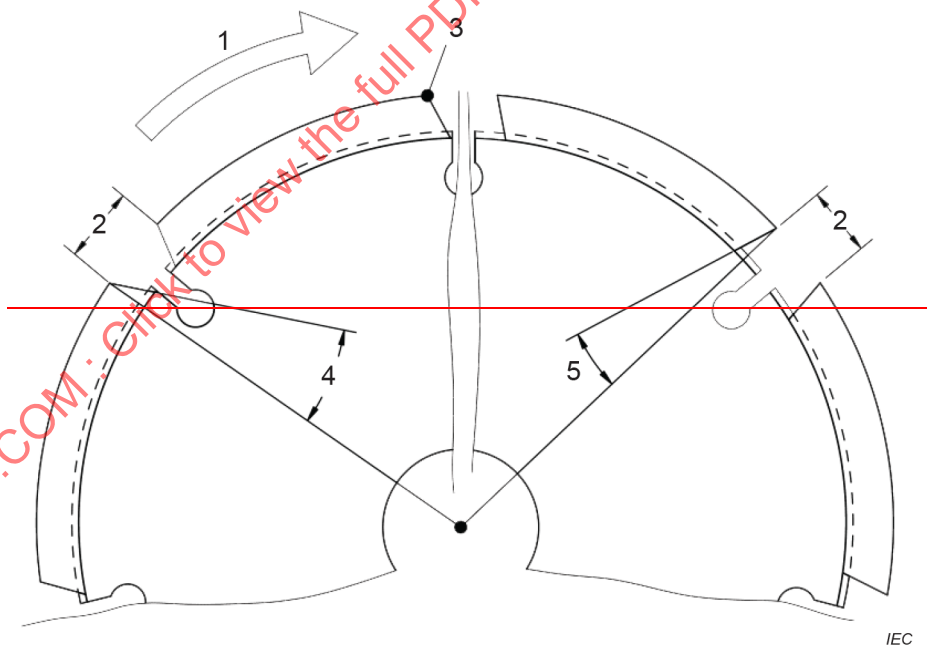
- when using a Type A (cut-off) **wheel guard** for facial grinding, the **wheel guard** may interfere with the workpiece causing poor control;
- when using a Type B (grinding) **wheel guard** for cutting-off operations with bonded abrasive wheels, there is an increased risk of exposure to emitted sparks and particles, as well as exposure to wheel fragments in the event of wheel burst;
- when using a Type A (cut-off), Type B (grinding) or Type C (combination) **wheel guard** for cutting-off and facial operations in concrete or masonry, there is an increased risk of exposure to dust and loss of control resulting in kickback;
- when using a Type A (cut-off), Type B (grinding) or Type C (combination) **wheel guard** with a wheel-type wire brush with a thickness greater than the maximum thickness as specified in 8.14.2 a) 105), the wires may catch on the guard leading to breaking of wires;

104) Information about the permitted thickness and diameter of grinding wheels;

105) Information about the maximum ~~thickness and~~ diameter of wheel-type wire brushes;

106) ~~Information about the permitted construction of cutting-off wheels (diamond or bonded reinforced, if diamond segmented, maximum peripheral gap between segments is 10 mm, only with a negative rake angle, see Figure 104), and about the permitted wheel diameter and wheel thickness.~~ Information about the permitted construction of cutting-off wheels (**diamond cutting wheel** or bonded reinforced wheel), including the permitted wheel diameter and thickness. If a **diamond cutting wheel** is segmented, instruction that the maximum peripheral gap between segments is 10 mm with no positive rake angle.

NOTE 101 An example of a segmented **diamond cutting wheel** construction is shown in Figure 104.



~~**Key**~~

~~1 direction of rotation~~

~~2 gap~~

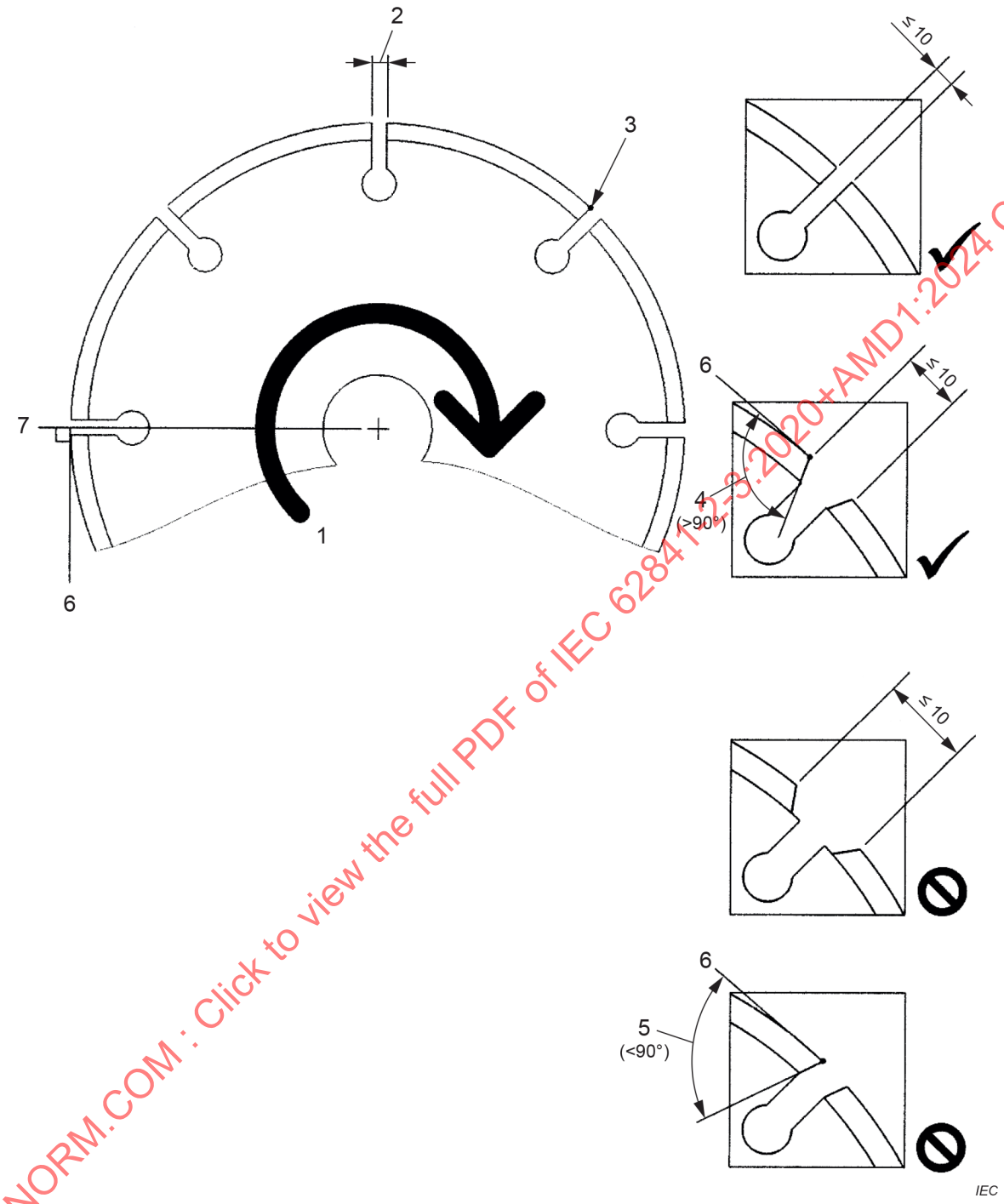
~~3 leading tip of segment~~

~~4 negative rake angle~~

~~5 positive rake angle~~

~~**Figure 104 – Examples of gaps and rake angles**~~

Dimensions in millimetres



Key

1	direction of rotation	5	positive rake angle
2	gap	6	line tangent to the periphery of the diamond cutting wheel and perpendicular to the centreline of the diamond cutting wheel and gap
3	leading tip of segment	7	centreline of the diamond cutting wheel and gap
4	negative rake angle		

Figure 104 – Examples of segmented diamond cutting wheel constructions

8.14.2 b) *Addition*:

101) Instruction on the proper use of **blotters**, when they are provided with the bonded abrasive product;

102) Information about the specific **flanges** to be used with all **wheel types** in accordance with 8.14.2 a) 101). Instruction on the mounting of **accessories** and the use of the correct **flanges**. For reversible **flanges**, instruction on the correct method of fitting the **flanges**;

103) For all **accessories** specified in accordance with 8.14.2 a) 101), instruction on their proper use. For grinding and cut-off wheels, instruction on their use for side grinding and peripheral grinding applications, and for Type 27 and 28 wheels, the recommended angle to the work surface;

104) Instruction for mounting and securing of the **wheel guard** identifying allowable adjustments to ensure maximum protection of the operator;

105) Instruction on proper support for the workpiece;

106) In case of cup-wheels, cones or plugs with a threaded hole intended to be mounted on the machine spindle, information about critical dimensions and other data in order to prevent the spindle end from touching the bottom of the mounting hole of the abrasive product;

107) For **disc-type sanders** exclusively intended for sanding wooden floors, instruction how to connect the external dust collection equipment, where applicable;

108) For **grinders** intended to be used with a **wheel guard** of Type E or Type F, instruction how to connect the external dust collection equipment, where applicable.

8.14.2 c) *Addition*:

101) Instruction on storage and handling of specified **accessories**.

9 Protection against access to live parts

This clause of Part 1 is applicable.

10 Starting

This clause of Part 1 is applicable.

11 Input and current

This clause of Part 1 is applicable.

12 Heating

This clause of Part 1 is applicable.

13 Resistance to heat and fire

This clause of Part 1 is applicable.

14 Moisture resistance

This clause of Part 1 is applicable.

15 Resistance to rusting

This clause of Part 1 is applicable.

16 Overload protection of transformers and associated circuits

This clause of Part 1 is applicable.

17 Endurance

This clause of Part 1 is applicable.

18 Abnormal operation

This clause of Part 1 is applicable, except as follows:

18.8 *Replacement of Table 4*:

Table 4 – Required performance levels

Type and purpose of SCF	Minimum performance level (PL)
Power switch – prevent unwanted switch-on for **grinders** with a **rated capacity** exceeding 55 mm	*Shall be evaluated using the fault conditions of 18.6.1 without the loss of this **SCF***
Power switch – prevent unwanted switch-on for **grinders** with a **rated capacity** up to and including 55 mm	c
Power switch – prevent unwanted switch-on for disc-type sanders and **disc-type polishers**	b
Power switch – provide desired switch-off for **grinders** with a **rated capacity** exceeding 55 mm	c
Power switch – provide desired switch-off for **grinders** with a **rated capacity** up to and including 55 mm, **disc-type sanders** and **disc-type polishers**	b
Provide desired direction of rotation for **grinders**	c
Provide desired direction of rotation for **disc-type polishers** and **disc-type sanders**	Not an **SCF**
Any electronic control to pass the test of 18.3	c
Prevent output speed from exceeding 120 % of **rated no-load speed** without **accessories** mounted for **grinders** and **disc-type sanders**	c
Prevent output speed from exceeding 130 % of **rated no-load speed** without accessories mounted for **disc-type polishers**	b
Prevent exceeding thermal limits as in ~~Clause 18~~ 18.4 and 18.5.3	a
Prevent unwanted lock-on of the **power switch** function	b
Restart prevention as required by 21.18.1.1	b
Lock-off function as required by 21.18.1.2	c
Prevent self-resetting as required in 23.3	c

19 Mechanical hazards

This clause of Part 1 is applicable, except as follows:

19.1 *Replacement of the first and second paragraph:*

Moving and other dangerous parts other than the spindle, the **accessory** and the **flanges** shall be so positioned or enclosed to provide adequate protection against personal injury. The guarding of ~~the spindle,~~ the **accessory** ~~and the **flanges**~~ is covered by 19.101.

Protective enclosures, covers, **guards** and the like shall have adequate mechanical strength for their intended purpose. Except for the **wheel guard** as required by 19.101.2, they shall not be removable without the aid of a tool.

19.3 *Addition:*

The requirements of this subclause are not applicable for the dust collection ports on **wheel guards**, if any.

19.4 *Addition:*

Tools with a **rated capacity** exceeding 100 mm shall have at least two handles. One of the handles may be the body of the tool if suitably shaped.

Compliance is checked by inspection.

NOTE 101 In Japan, the following requirements apply:

Tools with a **rated capacity** exceeding 105 mm shall have at least two handles. One of the handles may be the body of the tool if suitably shaped.

Compliance is checked by inspection.

19.6 *Replacement:*

For **grinders** and **disc-type sanders**, the no-load speed of the spindle at **rated voltage** shall not exceed the **rated no-load speed**.

*Compliance is checked by measuring the speed of the spindle after the tool has been operating for 5 min at no-load. During the test, the **accessory** in accordance with 8.14.2 a) 101) that produces the maximum speed shall be installed.*

For **disc-type polishers**, the no-load speed of the spindle at **rated voltage** shall not exceed 110 % of the **rated no-load speed**.

*Compliance is checked by measuring the speed of the spindle after the tool has been operating for 5 min at no-load. During the test, separable **accessories** are not mounted.*

19.101 Wheel guard

19.101.1 General requirements

The **wheel guard** shall protect the user during operation of the tool against:

– accidental contact with the abrasive product;
– ejection of fragments of the abrasive product;
– sparks and other debris.

Wheel guard types are specified in Annex AA.

The **wheel guard** may be removable either with the aid of a tool or by requiring two separate and dissimilar actions to remove the entire **wheel guard** from the tool, e.g. pushing a lever and moving the **wheel guard**.

The **wheel guard** shall also:

– facilitate the change of the abrasive wheel without the need to remove the **wheel guard**, except for **wheel guards** of Type F;

– be designed so that the risk of an accidental contact between the operator and the wheel is minimized e.g. by a possibility of adjustment.

For **wheel guards** of Type A, Type B, Type C, Type D or Type G, in order to prevent the installation of an oversized wheel, the clearance between the inside of the **wheel guard** and the periphery of a new abrasive product of **rated capacity** in accordance with 8.14.2 a) 101) shall, in at least one location, be

– for **wheel guards** of Type A, Type B, Type C or Type G, 8 mm maximum for tools with a **rated capacity** not exceeding 130 mm and 10 mm maximum for tools with a **rated capacity** exceeding 130 mm; and

– for **wheel guards** of Type D, 11 mm maximum.

Compliance is checked by inspection and by measurement.

19.101.2 Supply of wheel guards

Grinders with a **rated capacity** up to and including 55 mm, **disc-type sanders** and **disc-type polishers** need not be supplied with a **wheel guard**.

Angle grinders with a **rated capacity** exceeding 55 mm shall be supplied with at least either

– both a **wheel guard** of Type A (cut-off) and of Type B (grinding); or

NOTE 101 In Japan, the above dash is replaced by the following:

- a **wheel guard** of Type B (grinding); or

– a **wheel guard** of Type B (grinding) and additional elements that ~~are to~~ can be fixed to the **wheel guard** Type B (grinding) in order to convert it into a **wheel guard** of Type A (cut-off); or

– a **wheel guard** of Type C (combination).

Straight grinders with a **rated capacity** exceeding 55 mm shall be supplied with a Type G **wheel guard**.

For tools with a **rated capacity** exceeding 55 mm, **wheel guards** as specified in Table 101 for the intended applications and **accessory** types of the tool in accordance with 8.14.2 a) 101) shall

– be supplied with the tool for any **accessory** type supplied with the tool;

– be available from the manufacturer and be listed in the instructions in accordance with 8.14.2 c) 3); and

– comply with all applicable requirements of 19.101, Clause 20 and Annex AA.

Concrete surface grinders shall be supplied with a Type E **wheel guard**.

Compliance is checked by inspection, by measurement and by relevant tests.

Table 101 – Accessories and guards for various applications

Application	Accessory types	Guard types
Facial grinding	**Wheel types** 27, 28, 29	Type B or Type C (grinding or combination **wheel guard**)
	Wheel types 6, 11	Type D (cup **wheel guard**)
	Diamond grinding wheels for masonry/concrete	Type E (diamond surface grinding **wheel guard**)
Peripheral grinding	**Wheel type** 1, 4	Type G (straight grinder **wheel guard**)
	Cones, plugs	None
Cutting-off	**Wheel types** 41 (1A), 42 (27A) for metal	Type A or Type C (cut-off or combination **wheel guard**)
	Wheel types 41 (1A), 42 (27A) for masonry/concrete	Type A or Type F (cut-off or masonry/concrete cut-off **wheel guard**)
	Diamond cutting wheel for metal	Type A or Type C (cut-off or combination **wheel guard**)
	Diamond cutting wheel for masonry/concrete	Type A or Type F (cut-off or masonry/concrete cut-off **wheel guard**)
	Abrasive wheels for materials other than metal or masonry/concrete	Type A or Type C (cut-off or combination **wheel guard**)
Dual purpose (combined cut-off and grinding)	Dual purpose abrasive wheel	Type A or Type C (cut-off or combination **wheel guard**)
Hole cutting	Diamond hole cutters	None
Wire brushing	Wheel-type wire brush	Type A or Type B or Type C (cut-off or grinding or combination **wheel guard**)
	Cup-type wire brush	None
Sanding	Flap disc	Type B or Type C (grinding or combination **wheel guard**)
	Flexible abrasive (e.g. sanding paper) supported by a flexible backing pad	None
	Hard metal wheel (sanding of materials other than metal or masonry/concrete)	None
Polishing	Polishing **accessory**	None
Any operation	**Accessory** with a diameter up to and including 55 mm	None

19.102 Spindles

Spindles shall be designed so that they provide for or aid in securing and driving the abrasive products designed for the tool.

Either the direction of spindle threads or the design of an equivalent securing means shall be such that any clamping device or wheel with threaded hole tends to tighten during working, or the **outer flange** shall have positive locking to the spindle.

Compliance is checked by inspection.

In order to limit the unbalance of any rotating **accessory**, the eccentricity of the spindle shall be less than 0,1 mm.

For tools that provide for mounting of the **accessory** through the **flange** or similar clamping and locating device, the total eccentricity of the combination of the spindle, the diameter of the **flange** bore and the diameter of the part of the **flange** which locates and guides the **accessory** shall be less than:

– 0,30 mm for **rated no-load speeds** less than 15 000 min^{-1} ·
– 0,15 mm for **rated no-load speeds** from 15 000 min^{-1} to less than 25 000 min^{-1} ·
– 0,10 mm for **rated no-load speeds** equal 25 000 min^{-1} and higher.

Compliance is checked by measurement. The eccentricity is measured as the difference between the minimum and the maximum reading of the indicator.

*For tools with **flanges**, the eccentricity of the **flange** in the worst off-centre position allowed by the mounting procedure is measured.*

19.103 Flanges

The tool shall be designed so as to prevent the abrasive product coming loose under **normal use**.

Grinders shall be provided with at least **inner flange**(s) and **outer flange**(s) for mounting the type of grinding wheels that are intended to be used with the **wheel guard(s)** supplied with the **grinder**. The **flanges** shall meet the requirements of 19.104 and 19.105.

~~**Flanges** are not required to be provided if the tool is designed to only accept wheels with a non-reusable plate mount or other non-threaded mounting affixed to the wheel.~~

Flanges are not required to be provided if the tool is designed to only accept wheels with

– a non-reusable plate mount or other non-threaded mounting affixed to the wheel, provided the requirements of 19.106 are fulfilled; or
– threaded inserts or projecting studs.

Compliance is checked by inspection.

19.104 Flange dimensions

19.104.1 **Flanges** required by 19.103 shall be designed so that they secure and locate the abrasive products to the **grinder**. At least one of the **flanges** shall be keyed, screwed, shrunk-on or otherwise secured to prevent rotation relative to the tool spindle.

The **flanges** shall be flat and have no sharp edges.

The **flanges** shall have the dimensions specified in 19.104.~~1~~2 and 19.104.~~2~~3 as illustrated in Figure 105 or the dimensions specified in 19.104.~~3~~4 as illustrated in Figure 106, where D is the outside diameter of the abrasive wheel, G and W are the dimensions of the recess and D_f is the outside diameter of the **flange** clamping surface.

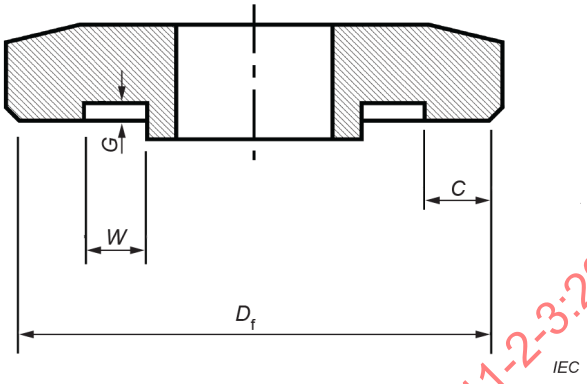
Flanges for wheels under 55 mm diameter may be **unrecessed**.

~~For wheels of any diameter with threaded inserts or projecting studs, the **flanges** shall be **unrecessed**, i.e. $G = 0$.~~

The **inner flange** and the **outer flange** shall have the same diameter D_f or the overlap of the **inner flange** and **outer flange** bearing surfaces shall be at least equal to dimension *C*.

In order to prevent interference, the **outer flange** and/or nut shall not extend beyond the plane defined by the lip of the **wheel guard** when mounted with the thickest Type 27, 28 or 29 wheel as specified in accordance with 8.14.2 a) 104).

Compliance is checked by inspection and by measurement.



Key

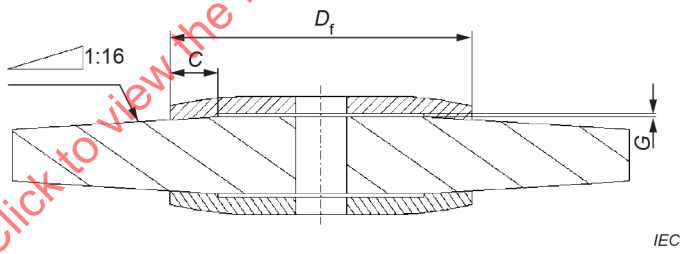
C radial width of the clamping surface

D_f outside diameter of the **flange** clamping surface

G depth of recess

W width of recess

Figure 105 – Principal dimensions of flanges for wheels other than Type 4



Key

C radial width of the clamping surface

D_f outside diameter of the **flange** clamping surface

G depth of recess

Figure 106 – Principal dimensions of flanges for wheels type 4

19.104.2 The **flange** diameter for **wheel type** 1 that are thicker than 5 mm shall be:

$$D_f \geq 0{,}33D$$

The **flange** diameter for **wheel type** 1 that are 5 mm and thinner and **wheel types** 6, 11, 27, 28, 29, 41 and 42 shall be:

$D_f = (20 \pm 1)$ mm	for 55 mm ≤ *D* < 80 mm
$D_f = (20 \pm 1)$ mm	for 80 mm ≤ *D* ≤ 105 mm for wheels with a bore diameter of 10 mm (3/8 inch UNC)

D_f = (29 ± 1) mm for 80 mm ≤ D ≤ 105 mm for wheels with a bore diameter of 16 mm (5/8 inch UNC)

D_f = (41 ± 1) mm for 105 mm < D ≤ 230 mm

For **wheel type** 41 and **diamond wheels**, the D_f dimension may exceed the above values for **inner flanges** and **outer flanges**. For all other **wheel types**, the diameter D_f may exceed the above values for **inner flanges** only.

If the clamping surface of the **outer flange** is chamfered, the bevel angle, measured from the clamping surface, shall be at least 45° and the non-clamping surface outside diameter of the **flange** may be increased by not more than 4 mm.

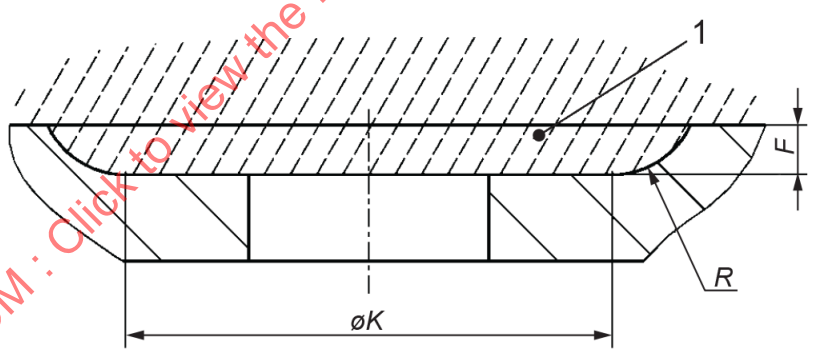
Compliance is checked by measurement.

NOTE 101 In Europe (EN 62841-2-3), the above paragraph is replaced by the following:

For **wheel types** 27, 28 and 42: The outer dimensions of the **outer flange** shall be limited so that there is no interference with the depressed centre of wheels in accordance with ISO 603-14:~~1999~~2022 and ISO 603-16:~~1999~~2022 as illustrated in Figure Z101 with the dimensions *ØK, R* and *F* as specified in Table Z101.

Table Z101 – Dimensions of depressed centre wheels

Outside diameter of the abrasive wheel *D* mm	***ØK*** mm	**Radius *R*** mm	***F*** mm
≤ 80	23	6	4
> 80 and ≤ 100	35,5	6	4
> 100 and ≤ 230	45	8	4,6



IEC

Key

1 area without interference

ØK diameter of the depressed centre bottom

R radius

F height of the depressed centre

Figure Z101 – Depressed centre of abrasive wheels

19.104.3 The dimensions *C, G and W* in Figure 105 shall be:

C ≥ 3 mm

W ≥ 1 mm, *G* ≥ 0,5 mm for D_f < 50 mm

$W \geq 1{,}5$ mm, $G \geq 1{,}0$ mm for $D_f \geq 50$ mm

The cross-section of the recess need not be rectangular.

Compliance is checked by inspection and by measurement.

19.104.4 Flanges for **wheel type** 4 as illustrated in Figure 106 shall have minimum dimensions in accordance with Table 102.

NOTE 101 In Canada and the United States of America, this subclause is not applicable.

Table 102 – Minimum flange dimensions for wheel type 4

Outside diameter of the abrasive wheel *D* mm	**Outside diameter of the flange clamping surface D_f** mm	**Radial width of the clamping surface *C*** mm	**Depth of recess *G*** mm
≤ 100	50	8	1,0
> 100 and ≤ 125	63	10	1,0
> 125 and ≤ 150	75	13	1,0
> 150 and ≤ 175	88	14	1,0
> 175 and ≤ 200	100	16	2,0

Compliance ~~of the requirements in 19.104.1, 19.104.2, 19.104.3 and 19.104.4~~ is checked by measurement.

NOTE 102 In Canada and the United States of America, this following additional subclause applies.

19.104.UC1 An **adaptor backing flange** may be used in place of the **inner flange** to mount **wheel types** 27, 28 and 29 with a diameter greater than 155 mm. The **adaptor backing flange** shall extend beyond the central hub, or raised portion, of the wheel. The adaptors are exempt from the **flange** strength test specified in 19.105.

19.105 Strength of flanges

Flanges required by 19.103 shall be designed so that they are of adequate strength.

Compliance is checked by the following test.

~~*The **grinder** is fitted with a steel disc having an equal thickness and shape as the abrasive product.*~~

*The **grinder** is fitted with a steel disc having any one of the thicknesses between the **flange** clamping surfaces of the abrasive product specified in accordance with 8.14.2 a) 104) or 8.14.2 a) 106), as applicable.*

*The clamping nut is tightened with a first test torque according to Table 103. A feeler gauge of a thickness of 0,05 mm is used to test whether the **flanges** are in contact with the disc all around the circumference. The test is satisfactory if at no place the feeler gauge can be pushed underneath the **flanges**.*

*The clamping nut is further tightened to the second test torque according to Table 103. A feeler gauge of a thickness of 0,05 mm is used to test the deflection of the **flanges**. The result is satisfactory if at no place the feeler gauge can be pushed underneath the **flanges** by more than 1 mm.*

Table 103 – Torques for testing flanges

Thread		First test torque	Second test torque
Metric	UNC	Nm	Nm
5		0,5	2
6		1	4
8	2	2	8
10	3/8	4	15
12	½	7,5	30
14		11	45
16	5/8	17,5	70
> 16	> ¾	35	140

19.106 A non-reusable plate mount or other non-threaded mounting affixed to the wheel in accordance with 19.103, if any, shall be designed in such a manner as to ensure that there is no damage to the mounting means under a stalled condition.

Compliance is checked by inspection and by the following test.

The tool is fitted with a steel test disc with

– *a thickness of at least 2 mm, except as needed to be compatible with the tool mounting means; and*
– *the largest diameter in accordance with 8.14.2 a) 101); and*
– *an attachment point which may be a hole or other means located at a radial distance of (20 ± 1) mm from the outer periphery of the steel test disc for applying the test forces.*

The tool spindle is locked during the application of the test forces. A force in N equal to 1,1 times the diameter of the steel disc in mm is applied to the attachment point in a direction

– *tangential to the periphery of the steel disc for 1 min; and*
– *perpendicular to the plane of the steel disc for 1 min.*

The tool is then operated at no-load for 30 s. During the test, the steel test disc shall not disengage from the tool mounting. After the test, the tool mounting shall not be damaged.

20 Mechanical strength

This clause of Part 1 is applicable, except as follows:

20.1 *Replacement of the fifth paragraph:*

*Deformation of a **wheel guard** is acceptable. If there is any mechanical damage to other parts of the tool that is likely to compromise compliance with a relevant requirement of Clause 19, the requirement in Clause 19 shall be re-evaluated.*

NOTE 1 The strength of the **wheel guard** is evaluated in 20.101, 20.102 or 20.103.

NOTE 2 See Annex BB for the recommended minimum thickness of wheel guards.

20.5 *Modification:*

This subclause is not applicable for **disc-type polishers** and **disc-type sanders**, provided these tools are not intended to be used as a **grinder** as specified in the instructions in accordance with 8.14.1.101.2 a).

20.101 Strength of wheel guards of Types A, B, C and D

20.101.1 Wheel guards of Types A, B, C and D specified in accordance with 8.14.2 a) 101) shall have sufficient mechanical strength to prevent the wheel fragments from being ejected towards the operator in the event of the wheel breakage.

*Compliance is checked by ~~submitting~~ subjecting three samples of ~~the~~ each **wheel guard** type to the test specified in 20.101.2 to 20.101.5. At the manufacturer's discretion, the test may be conducted with ~~three **wheel guards** for each **wheel guard** type but~~ less than three separate **grinders** for each **wheel guard** type.*

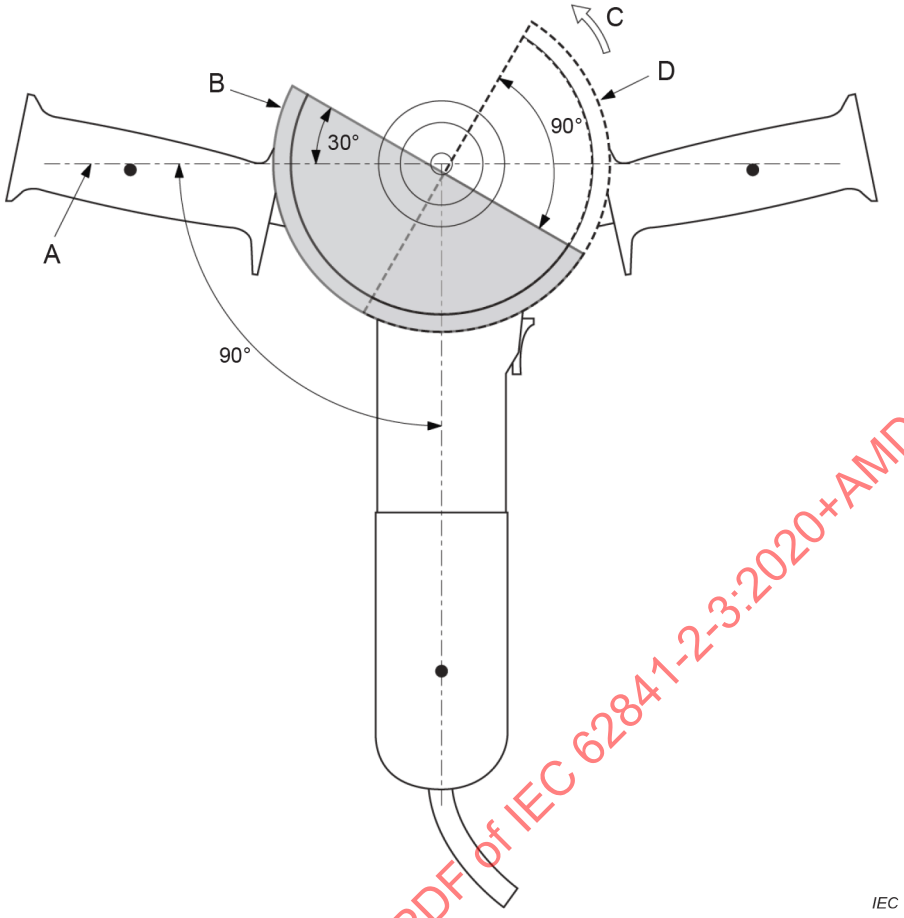
*The test is conducted with the thickest bonded reinforced wheel that may be used with the **wheel guard** in accordance with 8.14.2 a) 101).*

After the test, the tool shall meet the acceptance criteria of 20.101.6.

*For **wheel guards** intended only for **diamond wheels** or flap discs, compliance is checked either by:*

- *submitting three samples of the **wheel guard** to the test specified in 20.102.2 to 20.102.5, also using bonded reinforced wheels with a minimum thickness of 2,5 mm and a diameter approximately equal to the diameter of the **diamond wheels** or flap discs in accordance with 8.14.2 a) 101). After the test, the tool shall meet the acceptance criteria of 20.102.6; or*
- *meeting the design requirements in Table 105.*

20.101.2 *The **wheel guard** is mounted and securely fixed to the **grinder** in accordance with the instructions of 8.14.2 b) 104). If the **wheel guard** is adjustable, it is positioned as close as possible to 30° from the neutral or the symmetrical wheel covering position against the direction of the wheel's rotation. See Figures 107 a) and 107 b). For **wheel guards** of Type D, the axial adjustment is such that the lower edge of the **wheel guard** extends beyond the grinding surface of the wheel by not more than 1,0 mm.*



Key

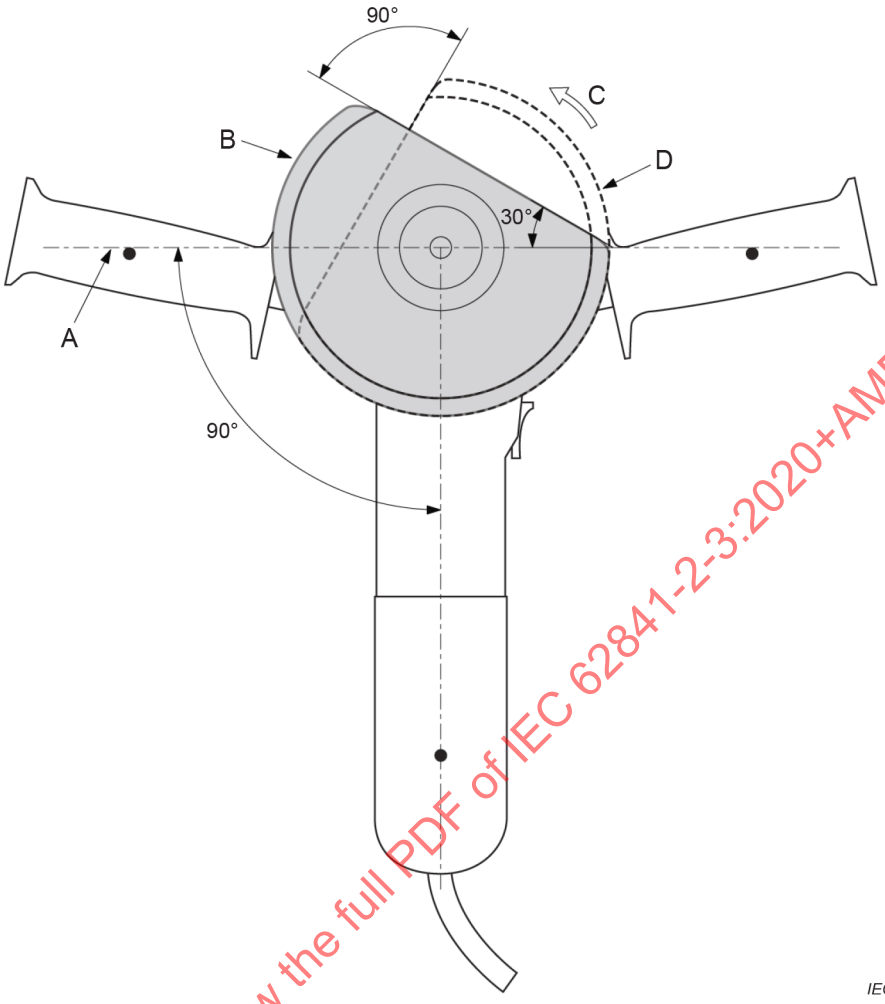
A neutral **wheel guard** position

B initial **wheel guard** position (**wheel guard** turned 30° from neutral position against the direction of wheel rotation)

C direction of the wheel rotation

D maximum permissible **wheel guard** position after the test (90° from initial position in the direction of the wheel rotation)

a) Wheel guard strength test: wheel guard positions for wheel types 1, 27, 28, 29, 41 and 42



Key

A neutral **wheel guard** position

B initial **wheel guard** position (**wheel guard** turned 30° from neutral position against the direction of wheel rotation)

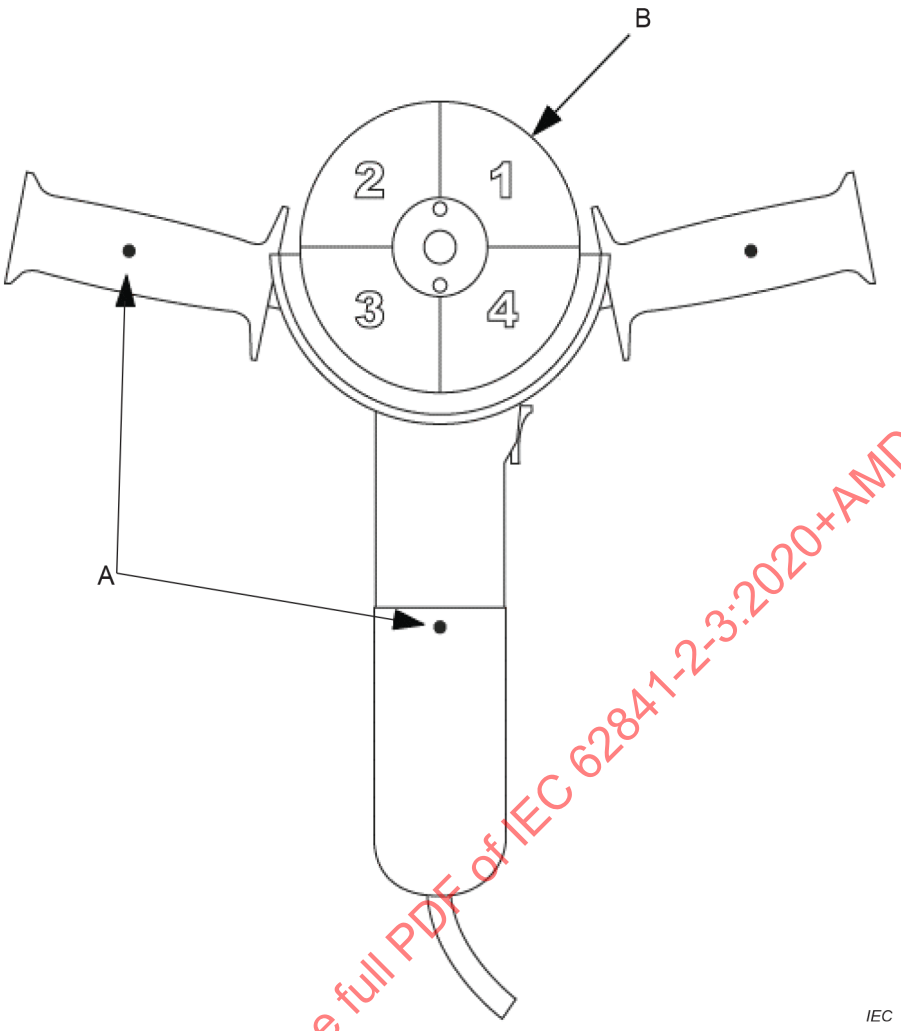
C direction of the wheel rotation

D maximum permissible **wheel guard** position after the test (90° from initial position in the direction of the wheel rotation)

b) Wheel guard strength test: wheel guard positions for cup wheel types 6 and 11

Figure 107 – Wheel guard strength test: explanation of wheel guard positions

*The maximum thickness grinding wheel in accordance with 8.14.2 a) 104) with a diameter equal to the **rated capacity** of the **grinder** shall be notched into four equal segments (quadrants). The width of each notch shall not exceed 2,5 mm. For **wheel types** 1, 27, 28, 29, 41, 42 and dual purpose wheels, the cut is directed from the outer edge radially towards the centre (see Figure 108). For **wheel types** 6 and 11, the cut starts across the working surface towards the mounting end (see Figure 109).*

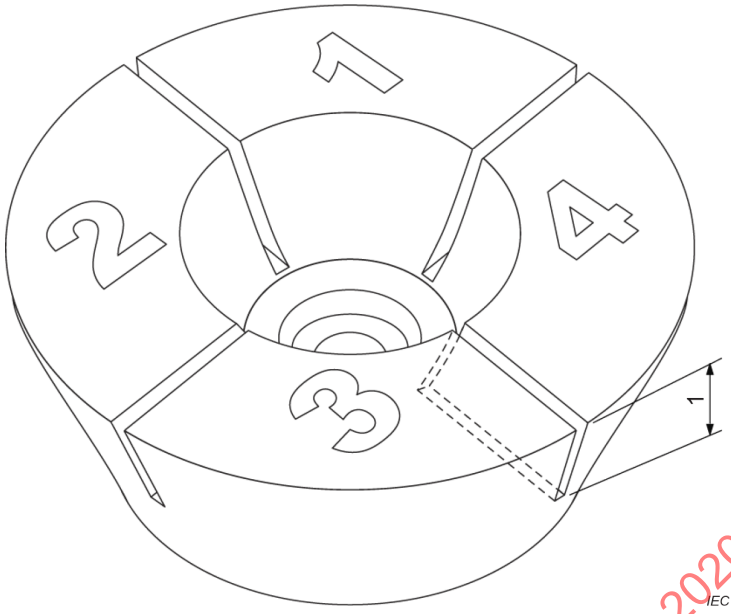


Key

A midpoints of the gripping zone

B grinding wheel quadrant

Figure 108 – Wheel guard strength test: preparation of the grinder



Key

1 cut

Figure 109 – Wheel guard strength test: preparation of cup wheel types 6 and 11

*The notched grinding wheel is mounted to the spindle with any mounting means that will allow for the centrifugal forces to cause the wheel to disintegrate at a speed equal to or greater than 90 % of the **rated no-load speed** of the **grinder**. The mounting means shall position the wheel at the same location relative to the **wheel guard** as would occur with the **flanges** recommended in accordance with the instructions in 8.14.2 b) 102).*

20.101.3 Table 104 provides typical pre-cut length ranges for standard wheel dimensions.

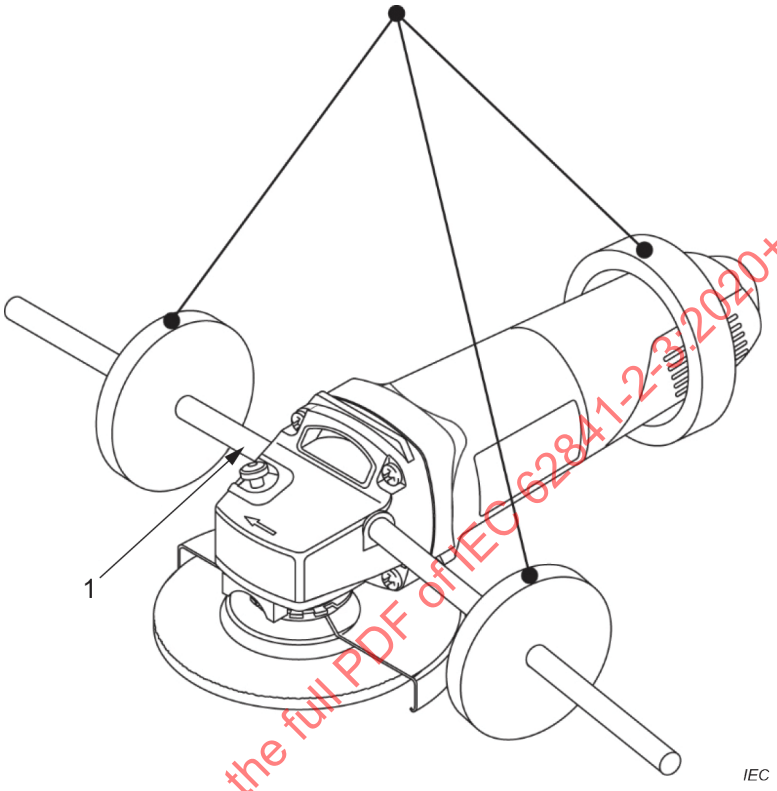
Table 104 – Typical pre-cut length ranges for standard wheel dimensions

Wheel type	Wheel dimensions (diameter × thickness × bore diameter) mm	Average burst speed min^{-1}	Pre-cut length range mm
Type 27	115 × 6 × 22,23	10 200	37,6 to 39,6
	125 × 6 × 22,23	9 800	42,7 to 45,7
	180 × 6 × 22,23	5 900	67,3 to 72,1
	230 × 6 × 22,23	5 700	83,3 to 93,5
Type 11	125 × 50 × 22,23	6 150	28
	150 × 50 × 22,23	5 400	30
Type 1	125 × 25 × 16	6 950	46
	155 × 25 × 16	5 800	57 to 60

20.101.4 *For **angle grinders** and **vertical grinders** with side handles, a mass of 1 kg is mounted at the midpoint of the **power switch** handle and a mass of 0,5 kg is mounted at the midpoint of a side handle installed on each side of the **grinder** (see Figure 108). Using a flexible nylon braided rope, the **grinder** is suspended at the midpoint of the gripping zone on each side handle and at the midpoint of the **power switch** handle.*

NOTE 101 The above test requires a second side handle or adaptor.

*For **angle grinders** and **vertical grinders** without side handles, a mass of 1 kg is attached at the midpoint of the **power switch** handle. An adaptor with simulated side handles as means of suspension and weight attachment of 0,5 kg at each side is to be provided for the test (see Figure 110). The adaptor shall have a mass as small as possible and be located at less than half the **rated capacity** distance behind the output spindle for **angle grinders** and **vertical grinders**. The suspension point and weight attachment on the left and right side of the tool are located at a distance from the centre of the spindle which is equivalent to **rated capacity** and at 90° to the centre line through the length of the tool.*



Key

1 adaptor

Figure 110 – Wheel guard strength test: angle grinders and vertical grinders without side handles

*The three suspension ropes are anchored to a single point and the tool is positioned inside a test box (see Figure 111). For **wheel guards** of Type D that cover 360° of the wheel's periphery, it is not required to position the tool inside the test box of Figure 111. In this case, the tool should be positioned inside a suitable enclosure for test operator safety.*

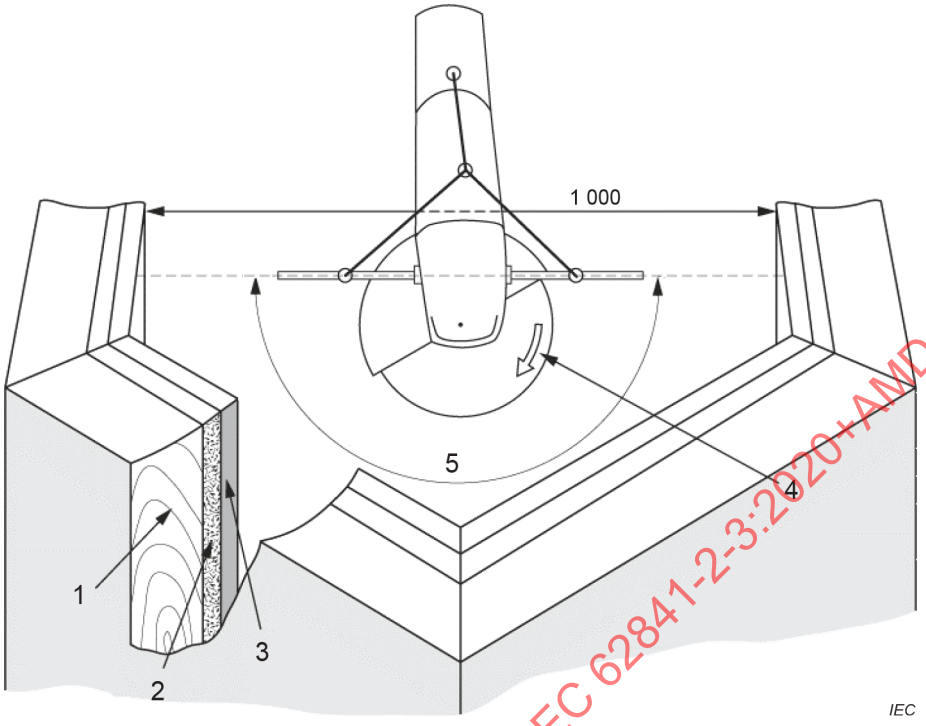
The test box, preferably with a hexagonal, octagonal or round shape, approximately 1 m in interior diameter and approximately 1 m deep, shall have an outer shell capable of restraining the disintegrating wheel segments and the interior surfaces, lined with material able to absorb and retain the wheel segments or the impression of the impacting segments (see Figure 111).

NOTE 102 An example of a material for the lining is a 25 mm to 35 mm thick layer of modelling clay, backed by an additional 25 mm to 35 mm thick layer of cork.

*An **angle grinder** or a **vertical grinder** with the mounted **wheel guard** and the notched wheel facing down in the horizontal plane is positioned with the wheel approximately in the centre and 300 mm from the bottom of the box (see Figure 111). To align the **grinder** inside the box and to prevent the **grinder** from twisting during the wheel's acceleration, the two side handles are secured to the box with a force less than 5 N.*

NOTE 103 One possible method to achieve the force necessary is the use of permanent magnets.

Dimensions in millimetres



Key

1 outer shell

2 cork

3 liner material

4 direction of the wheel rotation

5 fragment zone defined by midpoints of handles

Figure 111 – Wheel guard strength test box

As an alternative method, the use of a high-speed camera is allowed to fix the position of the tool just prior to the wheel burst.

20.101.5 *While monitoring the wheel speed with a tachometer, the ~~voltage to~~ speed of the tool is gradually increased until 90 % of the* ***rated no-load speed*** *of the* ***grinder*** *is achieved.*

If the wheel does not disintegrate at this specified speed,

– *stop the* ***grinder****, increase the length of the pre-cuts and repeat the test above; or*

– *at the manufacturer's option, continue increasing the wheel speed beyond the specified speed*

until the wheel bursts.

Dust, ***minor fragments*** *and segments remaining in the* ***wheel guard*** *are ignored. Most of the four major segments will be captured by the liner material wall. If any of the major segments rebound from the liner material, the segment's impression is to be identified. Afterward, the segments of the wheel in the liner material wall are removed.*

NOTE 101 Typically, the wheel will burst within 5 min.

20.101.6 *The* ***wheel guard*** *complies with the requirements of 20.101 if the following results a) to d) have been achieved:*

a) The speed of the wheel just prior to the wheel bursting is at least the speed specified in 20.101.5.

*b) The **wheel guard** and the fasteners or the **wheel guard's** mounting hardware shall remain mounted. Deformation, hairline cracks or scratches and gouges to the **wheel guard** and mounting hardware are acceptable.*

*c) The impression of the impact in the wall from the major wheel segments shall be within the fragment zone. The fragment zone is defined by extending a straight line through the midpoints of the two side handles onto the wall facing the unguarded wheel in the position of the **grinder** just prior to the wheel bursting (see Figure 111). For **wheel guards** of Type D that cover 360° of the wheel's periphery, this requirement is not applicable.*

*d) The **wheel guard** shall not have rotated in the direction of the wheel rotation by more than 90° (see Figures 107 a) and 107 b). If the **wheel guard** covers 360° of the wheel's periphery, the 90° limitation on the **wheel guard's** rotation is not applicable.*

NOTE 101 An example of a method to measure the rotation of the **wheel guard** is the use of a high-speed camera.

*If the **wheel guard** has failed any of the requirements in b) to d) above at a wheel burst speed that is above the speed specified in 20.101.~~6~~5, the test shall be repeated using the method of increasing the length of the pre-cut segments.*

20.102 Strength of wheel guards of Type F

20.102.1 A **wheel guard** of Type F shall have sufficient mechanical strength to withstand a wheel breakage.

*For **wheel guards** intended for bonded reinforced wheels or intended for both **diamond cutting wheels** and bonded reinforced wheels, compliance is checked by submitting three samples of any recommended Type F **wheel guard** to the test specified in 20.102.2 to 20.102.5. At the manufacturer's discretion, the test may be conducted with three **wheel guards** but less than three separate **grinders**. After the test, the tool shall meet the acceptance criteria of 20.102.6.*

*For **wheel guards** intended only for **diamond cutting wheels**, compliance is checked either by:*

- *submitting three samples of the **wheel guard** to the test specified in 20.102.2 to 20.102.5, also using bonded reinforced wheels with a minimum thickness of 2,5 mm and a diameter approximately equal to the diameter of the **diamond cutting wheels** in accordance with 8.14.2 a) 101). After the test, the tool shall meet the acceptance criteria of 20.102.6; or*
- *meeting the design requirements in Table 105.*

Table 105 – Guard thickness for diamond cutting wheels

Material of wheel guard	Ultimate tensile strength N/mm²	Minimum fracture elongation	Minimum thickness mm	
			Peripheral part	Side part
Metal	≥ 380	-	1,25	0,75
Metal	≥ 350 and < 380	-	1,50	1,00
Metal	≥ 200 and < 350	-	2,00	1,50
Metal	≥ 160 and < 200	-	2,50	1,75
Polycarbonate	60	80 %	3,00	2,00

20.102.2 *The **wheel guard** is mounted and securely fixed to the **grinder** in accordance with the instructions of 8.14.2 b) 104).*

*Regardless the intended wheel construction, a bonded reinforced wheel with the maximum thickness recommended in 8.14.2 a) 104) and with a diameter equal to the **rated capacity** of the **grinder** is mounted to the spindle in accordance with the instructions.*

*The **grinder** is operated at **rated voltage** for a minimum of 5 min. The speed of the wheel is measured and recorded.*

20.102.3 *The wheel as specified in 20.102.2 is notched into four equal segments (quadrants). The cut is directed from the outer edge radially towards the centre (see Figure 108). The width of each notch shall not exceed 2,5 mm. The extent of the notches shall allow for the centrifugal forces to cause the wheel to disintegrate at ~~a speed equal to, or greater than either the speed established in 20.102.2 or~~ 90 % of the **rated no-load speed** of the **grinder**~~, whichever is higher~~.*

*The notched grinding wheel is mounted to the spindle with any mounting means that will allow for the centrifugal forces to cause the wheel to disintegrate. The mounting means shall position the wheel at the same location relative to the **wheel guard** as would occur with the **flanges** recommended in accordance with 8.14.2 b) 102).*

20.102.4 *For **grinders** with side handles, a mass of 1 kg is mounted at the midpoint of the **power switch** handle and a mass of 0,5 kg is mounted at the midpoint of a side handle installed on each side of the **grinder**. Using a flexible nylon braided rope, the **grinder** is suspended at the midpoint of the gripping zone on each side handle and at the midpoint of the **power switch** handle.*

NOTE 101 The above test requires a second side handle or adaptor.

*The tool is suspended such that the foot of the **wheel guard** is facing downwards. The test is set up such that the operator is protected and so that any rebounding fragments do not affect the test result.*

20.102.5 *While monitoring the wheel speed with a tachometer, the speed of the tool is gradually increased until ~~the speed specified in 20.102.3~~ 90 % of the **rated no-load speed** of the **grinder** is achieved.*

If the wheel does not disintegrate,

- *stop the **grinder**, increase the length of the pre-cuts and repeat the test above; or*
- *at the manufacturer's option, continue increasing the wheel speed*

until the wheel bursts.

NOTE 101 Typically, the wheel will burst within 5 min.

20.102.6 *The **wheel guard** and the fasteners or the **wheel guard's** mounting hardware shall remain in place. Deformation, hairline cracks or scratches and gouges to the **wheel guard** and mounting hardware are acceptable.*

20.103 Strength of wheel guards of Type G

20.103.1 All **wheel guards** for **straight grinders** specified in accordance with 8.14.2 a) 101) shall have sufficient mechanical strength to prevent the wheel fragments from being ejected towards the operator in the event of the wheel breakage.

*Compliance is checked by submitting three samples of any recommended **wheel guard** to the test specified in 20.103.2 to 20.103.4. At the manufacturer's discretion, the test may be conducted with three **wheel guards** but less than three separate **grinders**. After the test, the tool shall meet the acceptance criteria of 20.103.5.*

20.103.2 *The **wheel guard** is mounted and securely fixed to the **grinder** in accordance with 8.14.2 b) 104). If the **wheel guard** is adjustable, it is positioned horizontal to the floor.*

*The maximum thickness grinding wheel in accordance with 8.14.2 a) 104) with a diameter equal to the **rated capacity** of the **grinder** is notched into four equal segments (quadrants). The width of each notch shall not exceed 2,5 mm. For **wheel type** 1, the cut is directed from the outer edge radially towards the centre (see Figure 108). For **straight grinders** intended to be used only with **wheel type** 4, the test is conducted with a **wheel type** 1 that has at least the same thickness as the thickest **wheel type** 4 in accordance with 8.14.2 a) 104) for that tool, measured in the centre of the wheel.*

*The notched grinding wheel is mounted to the spindle with any mounting means that will allow for the centrifugal forces to cause the wheel to disintegrate at a speed equal to or greater than 90 % of the **rated no-load speed** of the **grinder**. The mounting means shall position the wheel at the same location relative to the **wheel guard** as would occur with the **flanges** recommended in accordance with in 8.14.2 b) 102).*

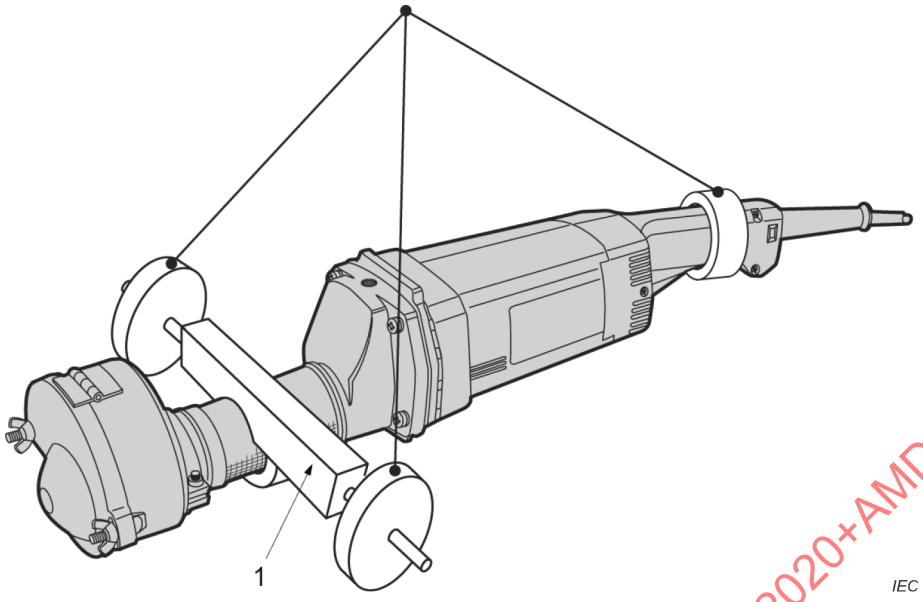
Table 106 provides typical pre-cut length ranges for standard wheel dimensions.

Table 106 –Typical pre-cut length ranges for standard wheel dimensions

Wheel type	Wheel dimensions (diameter × thickness × bore diameter) mm	Average burst speed min^{-1}	Pre-cut length range mm
Type 1	125 × 25 × 16	6 950	46
	155 × 25 × 16	5 800	57 to 60

20.103.3 *A mass of 1 kg is attached. An adaptor with means of suspension and weight attachment of 0,5 kg at each side is provided for the test (see Figure 112). The adaptor shall have a mass as small as possible and is located at the midpoint of the front gripping zone and less than half the **rated capacity** distance behind the output spindle. The suspension point and weight attachment on the left and right side of the tool is located at a distance from the centre of the spindle which is equivalent to **rated capacity** and at 90° to the centre line through the length of the tool.*

The three suspension ropes are anchored to a single point.



Key

1 adaptor

Figure 112 – Wheel guard strength test: straight grinder with additional masses

20.103.4 *While monitoring the wheel speed with a tachometer, the ~~voltage~~ speed ~~to~~ of the tool is gradually increased until 90 % of the **rated no-load speed** of the **grinder** is achieved. If the wheel does not disintegrate at this specified speed, stop the **grinder**, increase the length of the pre-cuts and repeat the test above until the wheel disintegrates. At the manufacturer's option, in place of stopping the **grinder** and increasing the length of the pre-cut segments, the wheel speed can be increased beyond the specified speed in order to cause the wheel to disintegrate.*

NOTE 101 Typically, the wheel will burst within 5 min.

20.103.5 *The **wheel guard** complies with the requirements of 20.103 if the following results a) to b) have been achieved:*

a) *the speed of the wheel just prior to the wheel bursting is at least ~~the speed specified in 20.103.2~~ 90 % of the **rated no-load speed**;*

b) *the **wheel guard** and the fasteners or the guard's mounting hardware shall remain mounted. Deformation, hairline cracks or scratches and gouges to the guard and mounting hardware are acceptable.*

*If the **wheel guard** has failed requirement b) at a wheel burst speed that was above the speed specified by in 20.103.2, the test shall be repeated using the method of increasing the length of the pre-cut segments.*

21 Construction

This clause of Part 1 is applicable, except as follows:

21.18.1 *Addition:*

For **angle grinders** and **vertical grinders** with a **rated capacity** not exceeding 100 mm and **straight grinders** with a **rated capacity** not exceeding 55 mm, **power switches** other than **momentary power switches** are permitted.

NOTE 101 In Japan, the following requirements apply:

21.18.1 *Addition:*

For **angle grinders** and **vertical grinders** with a **rated capacity** not exceeding 105 mm and **straight grinders** with a **rated capacity** not exceeding 55 mm, **power switches** other than **momentary power switches** are permitted.

21.18.1.1 *Replacement:*

For tools that are required to be fitted with a **momentary power switch** in accordance with 21.18.1, a lock-on device is allowed provided that two dissimilar actions are necessary to lock the **power switch** in the "on" position. In addition, only a single motion to the switch shall be required to automatically return to the "off" position.

For tools with both a lock-off and lock-on function, it shall not be possible to actuate both the

– lock-off function; and the
– lock-on function

with a single direction of motion, unless a distinct change in the direction of the motion is required to continue to the lock-on position

– after actuating the lock-off function; and
– before actuating the lock-on function.

NOTE An example of a design that fulfils this requirement is a slide-style **power switch** with integrated lock-off and lock-on features such that release of lock-off is achieved through an initial pressing or rocking motion, followed by a forward sliding motion that turns on the tool and permitting a lock-on function through a pressing or rocking motion near the end of the sliding action.

For mains-operated ~~single phase~~ **grinders**, either

– the **power switch** shall automatically switch off the motor as soon as the actuating member of the switch is released and shall have no locking arrangement in the "on" position,

or

– the tool incorporates a lock-on device and shall not restart after an interruption of the mains supply without releasing the lock-on device and re-actuating the **power switch**.

*Compliance is checked by inspection, by manual test and for mains-operated ~~single-phase~~ **grinders** incorporating a lock-on device, by the following test.*

*The **grinder** is operated with the lock-on device engaged. The **grinder** is then disconnected from the mains for at least 2 s. The **grinder** is then reconnected to the mains. The tool shall not operate without releasing the lock-on device and re-actuating the **power switch**.*

21.18.1.2 *Replacement:*

For **grinders** and **disc-type sanders** with a **rated capacity** greater than 55 mm ~~diameter~~, **power switches** shall be so located or designed that inadvertent operation is unlikely to occur during lifting, carrying or when the tool is resting on a flat surface.

For all tools ~~not provided with a lock-off device~~,

– it shall not be possible to start the tool when a sphere with a diameter of (100 ± 1) mm is applied to the **power switch** perpendicularly to the tool's surface where the switch is mounted with a lock off device engaged, if any; and

either

– the gripping length *L* of the grasping surface identified in accordance with 8.14.2 b) 6) immediately in front of or behind the **power switch** actuating member shall be a minimum of 70 mm. This length *L* includes

  - the straight line distance of any portion of the grasping surface that is straight or curved at a radius of greater than 100 mm; plus
  - the straight line distance of the length(s) *A* where the radius of the grasping surface is 10 mm to 100 mm, but each length *A* shall not exceed 10 mm. See Figures 113 and 114.

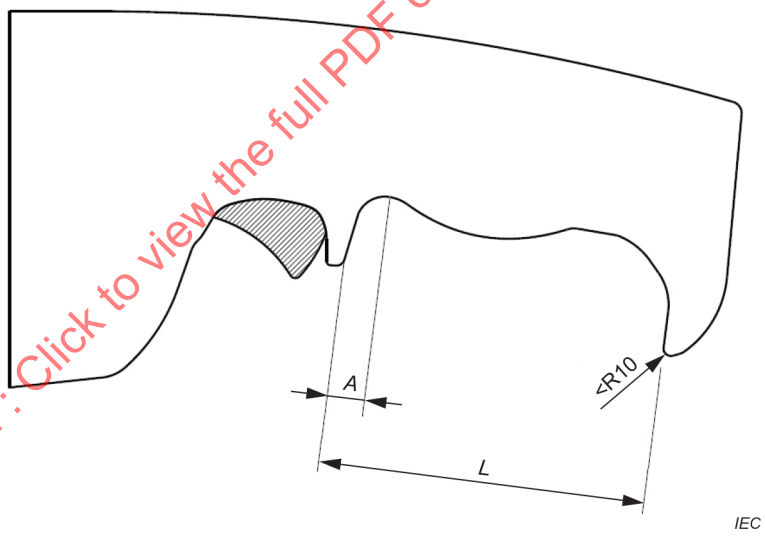
  If there are finger grips or similar superimposed profiles, the radius of the grasping surface shall not be measured along the surface, but only the arc(s) or straight line distance of the grasping surface, as applicable, shall be taken into account. See Figure 115;

or

– ~~for tools~~ if the tool has a gripping length *L* less than 70 mm, it shall be provided with a lock-off device, where

  - two separate and dissimilar actions shall be necessary before the motor is switched on (e.g. a **power switch** which ~~has~~ needs to be pushed in before it can be moved laterally to close the contacts to start the motor); and
  - it shall not be possible to achieve these two actions with a single grasping motion or a straight line motion; and
  - the lock-off device shall not be activated when the tool is in a stable resting position on a flat surface such that the **power switch** actuator is facing upwards.

Compliance is checked by inspection and by manual test.

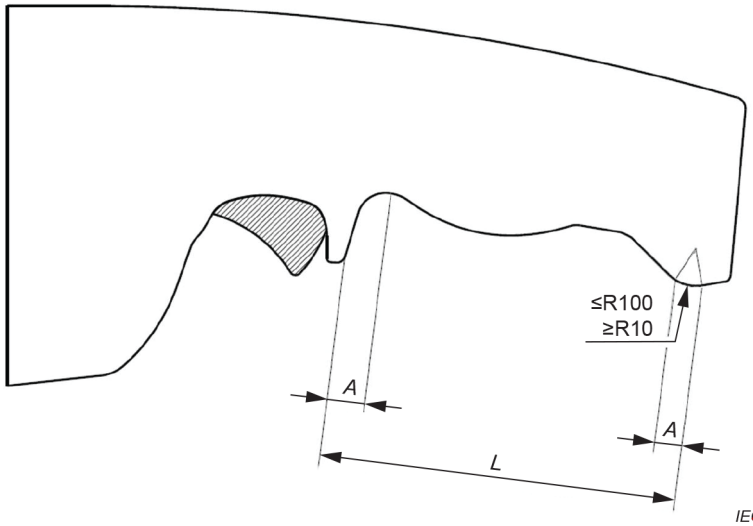


Key

L gripping length

A straight line distance of the length(s) where the radius of the grasping surface is 10 mm to 100 mm

Figure 113 – Measurement of handle gripping length

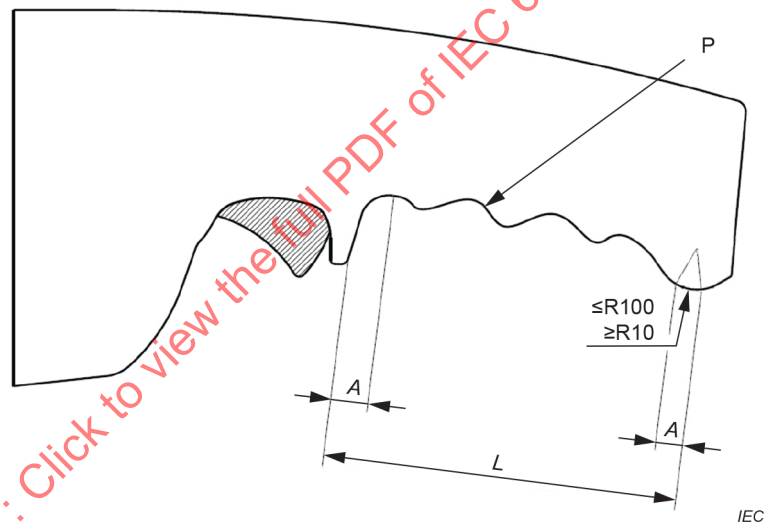


Key

L gripping length

A straight line distance of the length(s) where the radius of the grasping surface is 10 mm to 100 mm

Figure 114 – Measurement of handle gripping length



Key

L gripping length

A straight line distance of the length(s) where the radius of the grasping surface is 10 mm to 100 mm

P finger grips or similar superimposed profiles

Figure 115 – Measurement of handle gripping length for a handle with finger grips or similar superimposed profiles

21.30 *Modification:*

This subclause is not applicable for **disc-type polishers** and **disc-type sanders**, provided these tools are not intended to be used as a **grinder** as specified in the instructions in accordance with 8.14.1.101.2 a).

21.35 *Modification:*

This subclause is applicable only for

– **disc-type sanders** used exclusively for sanding wooden floors in accordance with 8.14.2 b) 107); and
– **grinders** intended to be used with a **wheel guard** of Type E or Type F in accordance with 8.14.2 a) 101).

22 Internal wiring

This clause of Part 1 is applicable.

23 Components

This clause of Part 1 is applicable, except as follows:

23.3 *Replacement of the first paragraph:*

Protection devices or circuits shall be of the non-self-resetting type unless the tool is equipped with a **momentary power switch** with no provision for being locked in the "on" position.

24 Supply connection and external flexible cords

This clause of Part 1 is applicable, except as follows:

24.4 *Replacement of the first paragraph:*

For **angle grinders** and **vertical grinders** with a **rated capacity** greater than 155 mm and for **straight grinders** with a **rated capacity** greater than 130 mm, the **supply cords** shall be not lighter than heavy polychloroprene-sheathed flexible cable (code designation 60245 IEC 66) or equivalent.

NOTE 101 In Europe (EN 62841-2-3), the following conditions apply:

For tools with a **rated capacity** greater than 155 mm, the **supply cord** shall be not lighter than heavy polychloroprene or PUR sheathed flexible cord (code designation 60245 IEC 66, H07RN-F or H07BQ-F) or equivalent.

NOTE 102 In the United States of America, the following conditions apply:

For tools with a **rated capacity** greater than 155 mm, the **supply cords** shall be oil, weather and water resistant hard service cord in accordance with the National Electrical Code, NFPA 70, such as SOOW or STOOW,

Attachment plugs and **supply cords** shall be equal to or greater than the rating of the tool.

NOTE 103 In Canada, the following conditions apply:

For tools with a **rated capacity** greater than 155 mm, the **supply cords** shall be oil, weather and water resistant extra hard usage cord in accordance with the Canadian Electrical Code, Part 1, such as SOOW or STOOW.

Attachment plugs and **supply cords** shall be equal to or greater than the rating of the tool.

25 Terminals for external conductors

This clause of Part 1 is applicable.

26 Provision for earthing

This clause of Part 1 is applicable.

27 Screws and connections

This clause of Part 1 is applicable.

28 Creepage distances, clearances and distances through insulation

This clause of Part 1 is applicable.

Annexes

The annexes of Part 1 are applicable except as follows.

Annex I
(informative)

Measurement of noise and vibration emissions

NOTE In Europe (EN 62841-2-3), Annex I is normative.

I.2 Noise test code (grade 2)

This clause of Part 1 is applicable except as follows:

I.2.4 Installation and mounting conditions of the power tools during noise tests

Addition:

~~**Grinders**, **disc-type polishers** and **disc-type sanders** are suspended and fitted with a wheel or pad as specified in I.3.5.3.101 and I.3.5.3.102. For angle and vertical tools, the wheel or pad shall be horizontal. For straight tools, the wheel or pad shall be vertical.~~

Angle grinders that are used for grinding and cut-off operations are suspended and fitted with an artificial wheel equivalent to the **rated capacity** as specified in Figure I.104 and Table I.102 for the application “grinding”. **Straight grinders** are suspended and fitted with an artificial wheel equivalent to the **rated capacity** as specified in Figure I.106 and Table I.105. **Disc-type polishers** are suspended and fitted with a lambswool polishing pad of **rated capacity**. **Disc-type sanders** are suspended and fitted with a sanding disc of **rated capacity**. For angle and vertical tools, the wheel or pad shall be horizontal. For straight tools, the wheel or pad shall be vertical. Tools for other applications are fitted with the most unfavourable **accessory** in accordance with 8.14.2 a) 101).

I.2.5 Operating conditions

Addition:

~~**Grinders**, **disc-type polishers** and **disc-type sanders** are tested at no-load.~~

The temperature requirements of 5.6 are not applicable.

Grinders are tested at no-load. **Disc-type polishers** are tested under load as specified in Table I.106. **Disc-type sanders** are tested under load as specified in Table I.107.

I.3 Vibration

This clause of Part 1 is applicable except as follows:

I.3.3.2 Location of measurement

Addition:

Figures I.101 to I.103 show the positions for different types of tools.

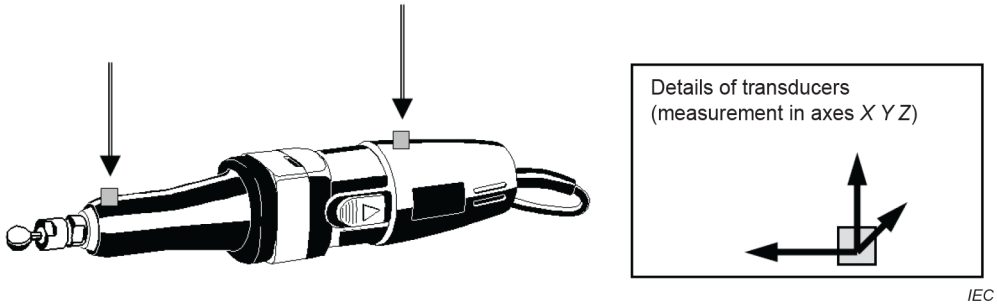


Figure I.101 – Positions of transducers for straight grinders

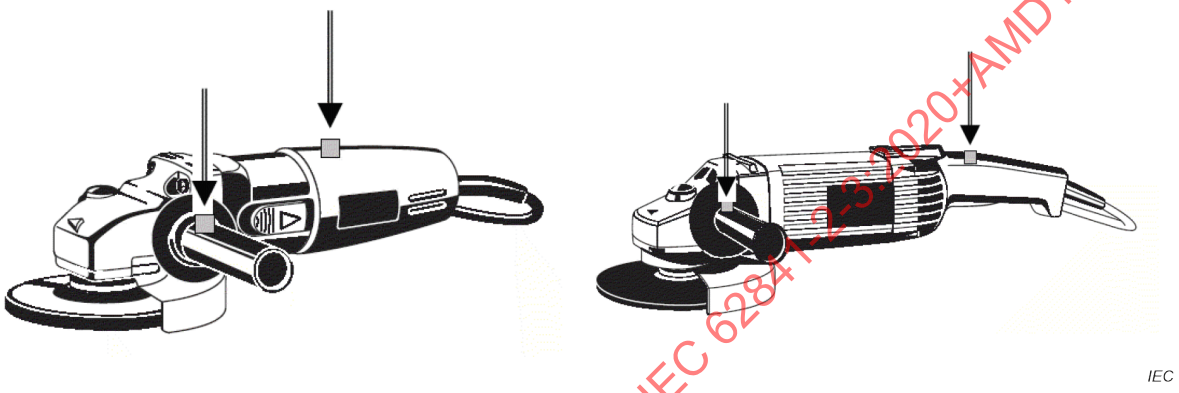


Figure I.102 – Positions of transducers for angle grinders

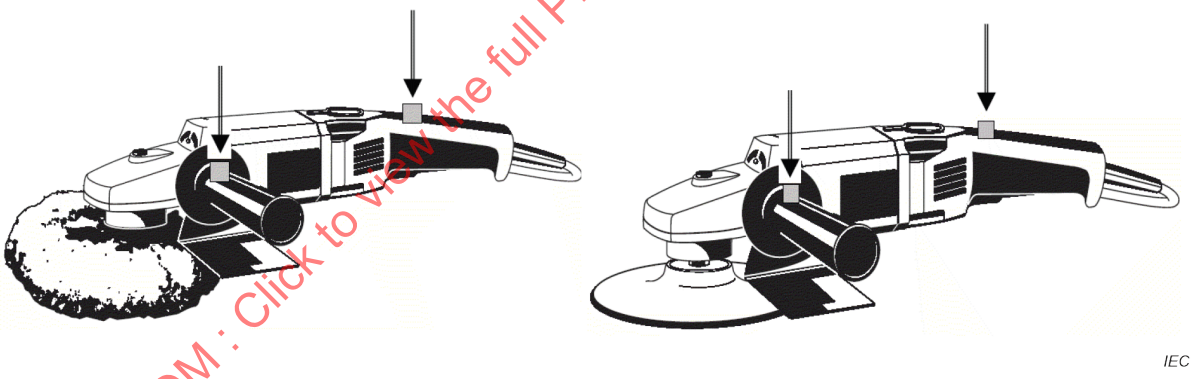


Figure I.103 – Positions of transducers for disc-type polishers and disc-type sanders

For vibration isolated stick type side handles, the transducer may alternatively be placed half way along the length of the handle. In this case, in order not to disturb the operator's normal grip, the transducer shall be placed inside the handle, without modifying the construction of the handle.

I.3.5.1 General

Addition:

For **battery** operated tools, the tests are conducted with the lightest **battery** in accordance with IEC 62841-1:2014, K.8.14.2 e) 2) that has sufficient capacity to operate the tool at no load, with the artificial wheel mounted, for at least 25 min.

I.3.5.3 Operating conditions

Addition:

The weight of the tool as used in this subclause is considered the force caused by the mass of the tool in accordance with 5.17, but with the artificial wheel mounted.

I.3.5.3.101 Grinding and cutting off applications

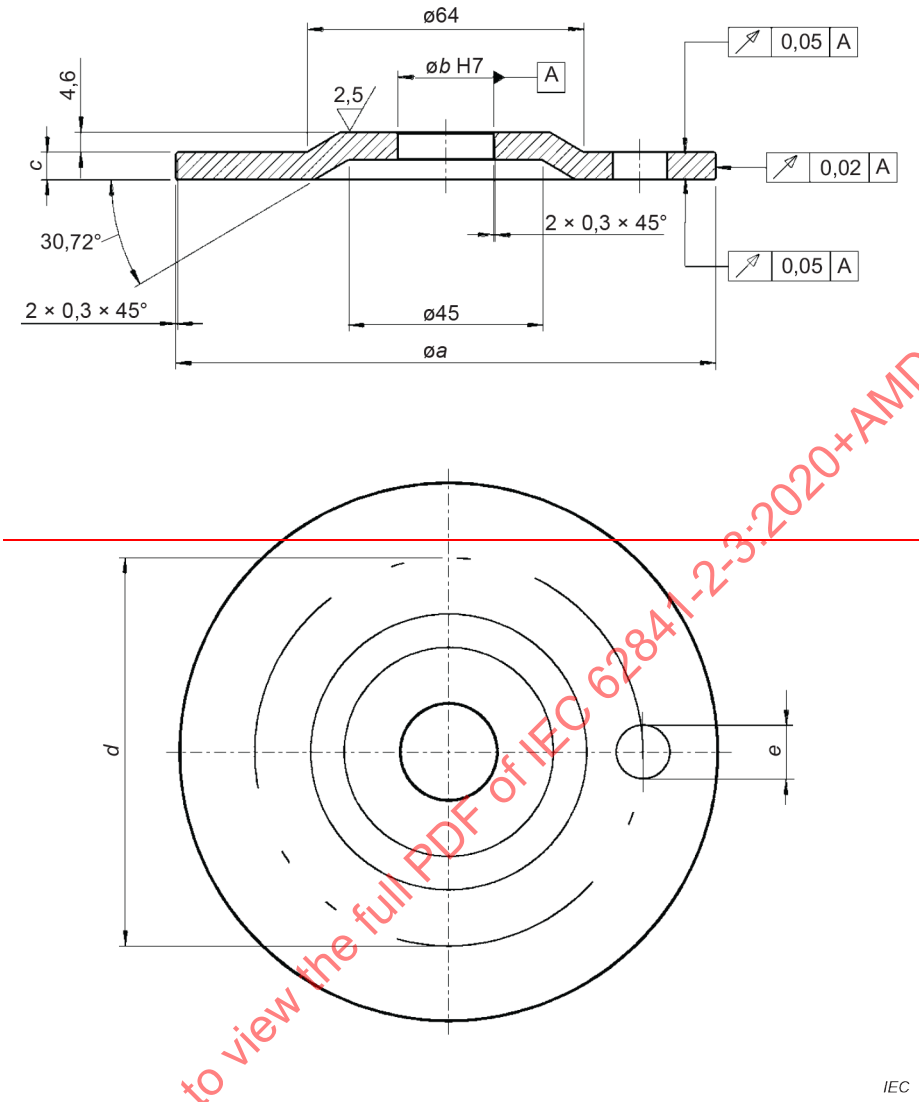
For tools intended for angle grinding that can also be used for other applications such as concrete grinding or cutting-off applications, the angle grinding application is considered to produce the highest vibration emission. Therefore, the tools shall be at least tested under load by using the artificial wheel for angle grinding under the conditions described below in Table I.101.

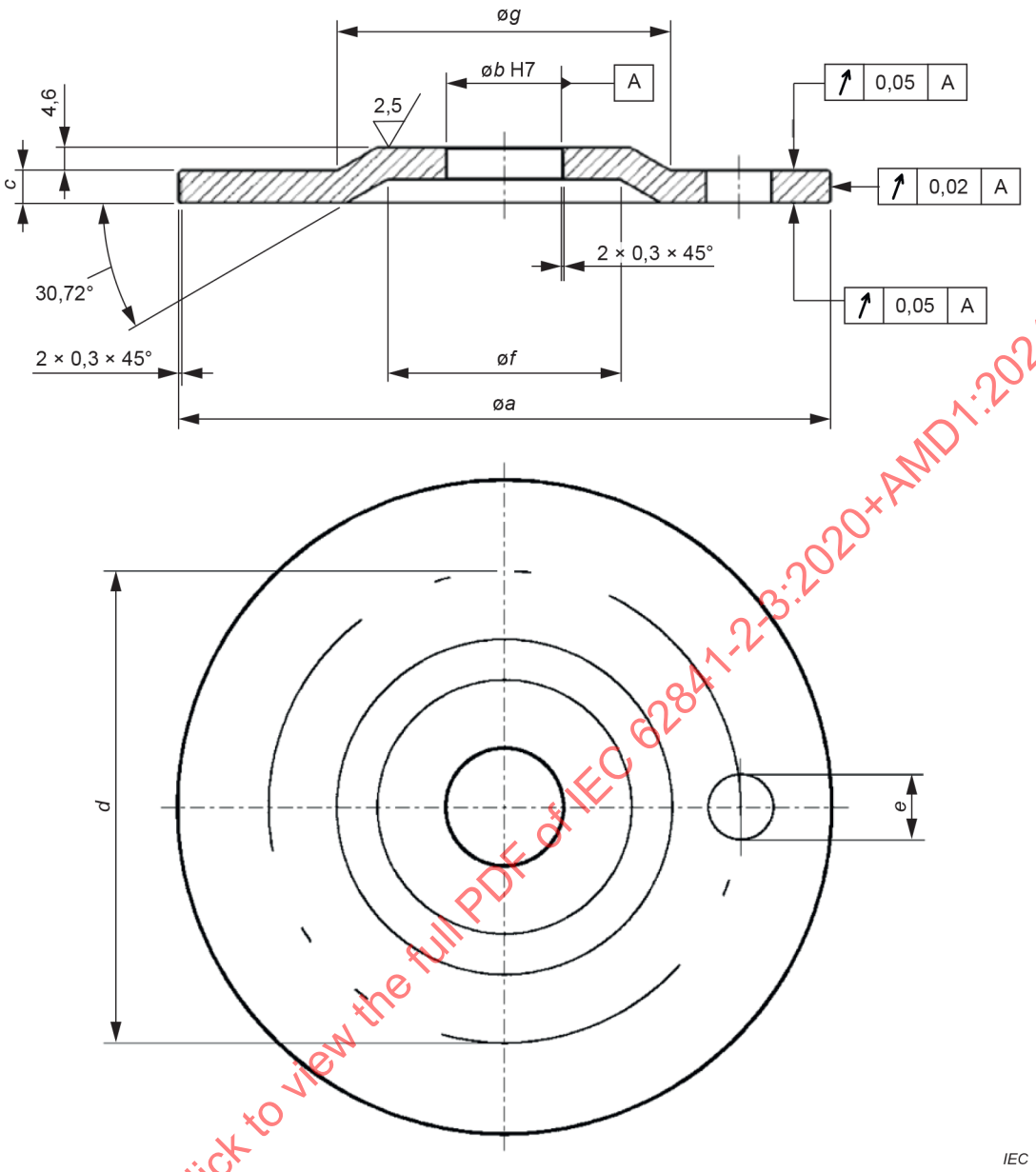
Tools intended for straight grinding applications shall be tested under load by using the artificial wheel for straight grinding under the conditions described below in Table I.104.

Table I.101 – Test conditions for angle grinding and concrete grinding

Orientation	Tool to be held as in **normal use** for grinding a horizontal plate.
Tool bit	Artificial wheel as specified in Figure I.104 of a diameter equivalent to the **rated capacity** and dimensions in accordance with Table I.102. When using the artificial wheel, start with a diameter (*e* – 1 mm) and increase the size at the hole in stages of 1/10 mm until the required unbalance is obtained. If the specifications in Figure I.104 and Table I.102 are not sufficient to mount the artificial wheel to the tool (e.g. for wheels with a non-reusable plate mount as specified in 19.103), the artificial wheel may be modified in order to permit mounting of the wheel to the tool.
Feed force	Applied at a position as close as that in **normal use**. The feed force is specified in Table I.103 and obtained by applying an upward force equal to the sum of the intended feed force and the weight of the tool. The upward force is normally applied using the threaded holes for the support handle. For tools where the support handle can be mounted on either side, insert an extra bolt in the empty hole. Fix a short sling of cord from the extra bolt to the inner part of the support handle. Fix the cord used for applying the upward force in that sling. On tools with anti-vibration handles, the sling shall be attached between the tool body and the handle without blocking the anti-vibration function. The tool being suspended on a cord, the force can be applied using a weight (see Figure I.105) or, alternatively, a dynamometer can be attached to the cord. The application of force shall be achieved with minimum adaptation to the machine. NOTE Any weight added to the tool, e.g. fixing devices for the upward force, will alter the inertia of the tool and thereby reduce the vibration magnitude.
Test cycle	A test cycle is given by conducting a measurement for at least 10 s. After each test the wheel shall be loosened and repositioned 360° / 5 = 72° from its previous position on the shaft. If the wheel design restricts the angle at which the wheel can be repositioned (e.g. for wheels with a non-reusable plate mount as specified in 19.103), the maximum possible repositioning angles shall be used, but not more than five. Three series of five consecutive tests shall be carried out using a different operator for each series.

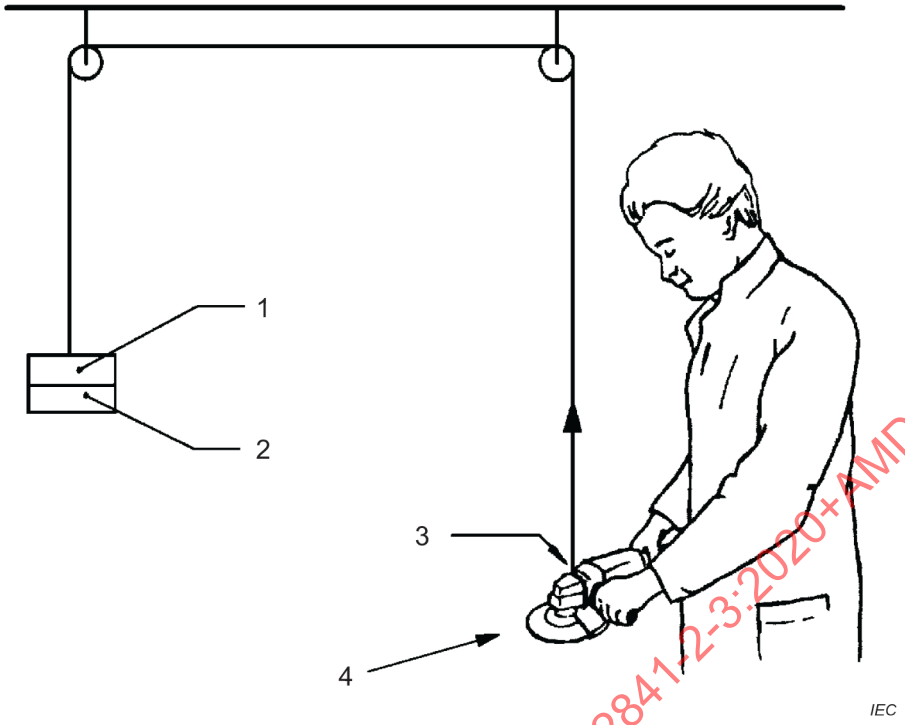
Dimensions in millimetres





Material: aluminium

Figure I.104 – Artificial grinding wheel for angle grinding and concrete grinding



Key

1 weight of the **grinder**

2 feed force weight

3 application of the feed force using a sling of cord

4 **grinder** is suspended at an angle of 20° ± 5° to the horizontal

Figure I.105 – Working positions of operator and application of force

Table I.102 – Dimensions of the artificial wheel of Figure I.104 or Figure I.106 for angle grinding, cutting off and concrete grinding

ø *a* mm	ø *b* mm	*c* mm	ø *d* mm	ø *e* for grinding mm	ø *e* for cutting off and concrete grinding mm	ø *f* mm	ø *g* mm	Unbalance for grinding *g* mm	Unbalance for cutting off and concrete grinding *g* mm
80 ± 0,2	10,0	6 ± 0,05	60 ± 0,02	8,9	5,6	23	42	30	12
100 ± 0,2	16,0	6 ± 0,05	70 ± 0,02	11,4	10,4	45	64	58	49
115 ± 0,2	22,23	6 ± 0,05	80 ± 0,02	12,2	11,2	45	64	76	64
125 ± 0,2	22,23	6 ± 0,05	90 ± 0,02	12,5	11,4	45	64	90	75
150 ± 0,2	22,23	6 ± 0,05	120 ± 0,02	13,0	11,9	45	64	130	109
180 ± 0,2	22,23	6 ± 0,05	150 ± 0,02	14,1	12,9	45	64	190	159
230 ± 0,2	22,23	6 ± 0,05	200 ± 0,02	15,5	14,2	45	64	305	255

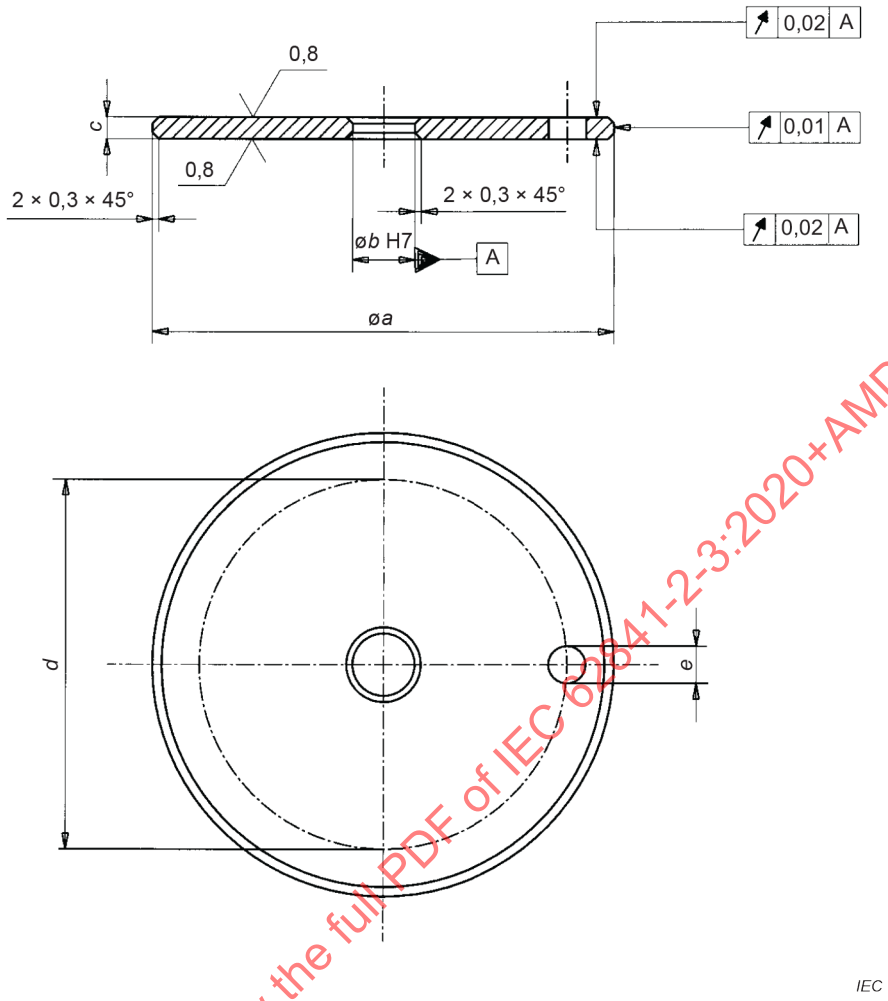
Table I.103 – Feed force

ø *a* mm	80	100	115	125	150	180	230
Feed force N	20 ± 5	40 ± 5	40 ± 5	40 ± 5	40 ± 5	60 ± 5	60 ± 5

Table I.104 – Test conditions for straight grinding

Orientation	Tool to be held as in **normal use** for grinding a horizontal plate
Tool bit	Artificial wheel as specified in Figure I.106 of a diameter equivalent to the **rated capacity** and dimensions in accordance with Table I.105. When using the artificial wheel, start with a diameter (*e* – 1 mm) and increase the size at the hole in stages of 1/10 mm until the required unbalance is obtained.
Feed force	Applied at a position as close as that in **normal use**. For a **rated capacity** less than or equal to 55 mm, the feed force is 20 N, and for a **rated capacity** exceeding 55 mm, the feed force is 50 N. The feed force is obtained by applying an upward force equal to the sum of the intended feed force and the weight of the tool. The upward force is applied to the front part of the handle or gripping area closest to the wheel. On tools with anti-vibration handles, the upward force shall be applied without blocking the anti-vibration function. The force can be applied using a weight (see Figure I.105) or, alternatively, a dynamometer can be attached. The application of force shall be achieved with minimum adaptation to the machine. NOTE Any weight added to the tool ,e.g. fixing devices for the upward force, will alter the inertia of the tool and thereby reduce the vibration magnitude.
Test cycle	A test cycle is given by conducting a measurement for at least 10 s.

Dimensions in millimetres



Material: aluminium

Figure I.106 – Artificial grinding wheel for straight grinding

Table I.105 – Dimensions of the artificial wheel of Figure I.106 for straight grinding

ø *a* mm	ø *b* mm	*c* mm	ø *d* mm	ø *e* mm	Unbalance g mm
25 ± 0,2	4,0	10 ± 0,05	18 ± 0,02	4,3	3,6
50 ± 0,2	4,0	10 ± 0,05	35 ± 0,02	6,2	14,5
80 ± 0,2	4,0	10 ± 0,05	65 ± 0,02	7,1	37
100 ± 0,2	19,0	25 ± 0,05	70 ± 0,02	5,6	58
125 ± 0,2	19,0	25 ± 0,05	90 ± 0,02	6,1	90
150 ± 0,2	19,0	25 ± 0,05	120 ± 0,02	6,4	130
200 ± 0,2	19,0	25 ± 0,05	170 ± 0,02	7,1	230

I.3.5.3.102 Polishing

Tools for polishing applications are tested under load and under the conditions described below in Table I.106.

Table I.106 – Test conditions for polishing

Orientation	Polishing a horizontal steel plate of minimum 400 mm × 400 mm × 20 mm mounted on a bench. The steel plate shall be mounted on an intermediate resilient material and fixed by screws, clamps, air cylinders or the like to the bench, in order to prevent the steel plate from vibrating excessively and radiating sound.
Tool bit	Polishing pad
Feed force	Vertical force applied on tool: – (30 ± 5) N, if the mass of the tool is less than 1,5 kg; – (50 ± 5) N, if the mass of the tool is equal or greater than 1,5 kg; or the force necessary to obtain **rated input**, whichever is the lower
Test cycle	A test cycle is given by conducting a measurement for at least 10 s

I.3.5.3.103 Disc-type sanding

Tools for disc-type sanding applications are tested under load and under the conditions described below in Table I.107.

Table I.107 – Test conditions for disc-type sanding

Orientation	Sanding a horizontal steel plate of minimum 400 mm × 400 mm × 20 mm mounted on a bench. The steel plate shall be mounted on an intermediate resilient material and fixed by screws, clamps, air cylinders or the like to the bench, in order to prevent the steel plate from vibrating excessively and radiating sound. Positioning the 20 mm thick steel plate with an intermediate resilient layer on the test bench described in ISO 11201.
Tool bit	Recommended sanding disc for steel with a grain size of 120
Feed force	Vertical force applied on the tool: – (30 ± 5) N, if the mass of the tool is less than 1,5 kg; – (50 ± 5) N, if the mass of the tool is equal or greater than 1,5 kg; or the force necessary to obtain **rated input**, whichever is the lower
Pre-test requirements	With a new sanding disc carry out 1 min sanding before starting measurements
Test cycle	A test cycle is given by conducting a measurement for at least 10 s

I.3.5.4 Operator

Replacement:

The vibration of the machine is influenced by the operators. The operators shall therefore be skilled enough to be able to hold the tool in a manner similar to that used in real grinding. Also the angle of attack should equal to that used in real grinding on a horizontal surface (e.g. for **angle grinders** 20° ± 5°).

The forces and torques applied to the handles influence the vibration. It is therefore important that the force and torque distribution between the handles equals that in real use.

I.3.6.1 Reported vibration value

Replacement of the third paragraph:

If the coefficient of variation C_V of the five vibration total values a_{hv}, recorded for each series, is less than 0,15 or the standard deviation s_{N-1} is less than 0,3 m/s^2, the results are accepted (the note in I.3.1 provides information on possible sources of errors of measurement). This requirement is not applicable for the measurement of $a_{h,SG}$, $a_{h,AG}$, $a_{h,CO}$ and $a_{h,CG}$.

Addition:

The result a_h for each operating mode measured shall be reported:

$a_{h,SG}$ or $a_{h,AG}$ = mean vibration for straight grinding or angle grinding in accordance with I.3.5.3.101;

$a_{h,CO}$ = mean vibration for cutting off in accordance with I.3.5.3.101;

$a_{h,CG}$ = mean vibration for concrete grinding in accordance with I.3.5.3.101;

$a_{h,P}$ = mean vibration for polishing in accordance with I.3.5.3.102;

$a_{h,DS}$ = mean vibration for disc-type sanding in accordance with I.3.5.3.103.

Underestimation of the vibration for tools equipped with technical means to automatically reduce unbalances shall be taken into account by multiplying the vibration values of such tools with a correction factor of 1,3.

In cases where the measurement was done at practical use with specific discs, information about the operating conditions (such as specification of the disc used, work piece material, feed force) shall be reported.

I.3.6.2 Declaration of the vibration total value

Addition:

For **angle grinders**, the vibration total value of the handle with the highest emission and the uncertainty *K* shall be declared:

– the value of $a_{h,SG}$ or $a_{h,AG}$ with the work mode description “surface grinding”.

In addition, the following applications may be reported, if measured:

– for cutting-off applications,
the value of $a_{h,CO}$ with the work mode description “cutting off”;
– for concrete grinding applications,
the value of $a_{h,CG}$ with the work mode description “concrete grinding”;
– for polishing applications,
the value of $a_{h,P}$ with the work mode description “polishing”;
– for disc-type sanding applications,
the value of $a_{h,DS}$ with the work mode description “disc sanding”.

For tools intended only for one or more of the following applications in accordance with 8.14.1.101.2 a), the vibration total value of the handle with the highest emission and the uncertainty *K* shall be declared, as applicable:

– for concrete grinding applications,
the value of $a_{h,CG}$ with the work mode description “concrete grinding”;
– for polishing applications,
the value of $a_{h,P}$ with the work mode description “polishing”;
– for disc-type sanding applications,
the value of $a_{h,DS}$ with the work mode description “disc sanding”.

In addition, the information shall be given in the instruction manual that other applications such as wire brushing, may have different vibration emission values.

Annex K
(normative)

Battery tools and battery packs

All clauses of the main body of this Part 2-3 apply unless otherwise specified in this annex. If a clause is stated in this annex, its requirements replace the requirements of the main body of this Part 2-3 unless otherwise specified.

~~**K.8.14.1.101.2 Safety instructions for all operations**~~

~~*Replacement of item k):*~~

~~k) **Hold the power tool by insulated gripping surfaces only, when performing an operation where the cutting tool may contact hidden wiring.** *Contact with a "live" wire will also make exposed metal parts of the power tool "live" and could give the operator an electric shock.*~~

~~NOTE 101 The above warning is omitted, if polishing or sanding are the only intended operations.~~

~~Item l) is not applicable.~~

K.8.14.1.101 Safety warnings for grinders, disc-type polishers and disc-type sanders

Replacement of item 1) k):

k) **Hold the power tool by insulated gripping surfaces only, when performing an operation where the cutting accessory may contact hidden wiring.** *Contact with a "live" wire will also make exposed metal parts of the power tool "live" and could give the operator an electric shock.*

NOTE 101 The warning in item 1) k) above is omitted, if polishing or sanding are the only intended operations.

Item l) is not applicable.

K.18.8 *Replacement of Table 4 by the following:*

Table 4 – Required performance levels

Type and purpose of SCF	Minimum performance level (PL)
Power switch – prevent unwanted switch-on for **grinders** with a **rated capacity** exceeding 55 mm	*Shall be evaluated using the fault conditions of 18.6.1 without the loss of this **SCF***
Power switch – prevent unwanted switch-on for **grinders** with a **rated capacity** up to and including 55 mm	c
Power switch – prevent unwanted switch-on for **disc-type sanders** and **disc-type polishers**	b
Power switch – provide desired switch-off for **grinders** with a **rated capacity** exceeding 55 mm	c
Power switch – provide desired switch-off for **grinders** with a **rated capacity** up to and including 55 mm, **disc-type sanders** and **disc-type polishers**	b
Provide desired direction of rotation for **grinders**	c
Provide desired direction of rotation for **disc-type polishers** and **disc-type sanders**	Not an **SCF**
Prevent output speed from exceeding 120 % of **rated no-load speed** without **accessories** mounted for **grinders** and **disc-type sanders**	c

Type and purpose of SCF	Minimum performance level (PL)
Prevent output speed from exceeding 130 % of **rated no-load speed** without **accessories** mounted for **disc-type polishers**	b
~~Prevent exceeding thermal limits as in Clause 18~~	~~a~~
Prevent unwanted lock-on of the **power switch** function	b
Restart prevention as required by K.21.18.1.1	a
Lock-off function as required by 21.18.1.2	c
Prevent self-resetting as required in 23.3	c

K.19.6 For **grinders** and **disc-type sanders**, the no-load speed of the spindle shall not exceed the **rated no-load speed**.

Compliance is checked by the following test.

*The tool is operated for 5 min at no-load. Immediately afterwards, the **battery** is replaced with a **fully charged battery**. The speed of the spindle is then measured after the tool has been operating for 1 min at no-load. During the test, the **accessory** in accordance with 8.14.2 a) 101) that produces the maximum speed shall be installed.*

For **disc-type polishers**, the no-load speed of the spindle shall not exceed 110 % of the **rated no-load speed**.

Compliance is checked by the following test.

*The tool is operated for 5 min at no-load. Immediately afterwards, the **battery** is replaced with a **fully charged battery**. The speed of the spindle is then measured after the tool has been operating for 1 min at no-load. During the test, separable **accessories** are not mounted.*

K.21.18.1.1 For tools with a **momentary power switch**, a lock-on device is allowed provided that two dissimilar actions are necessary to lock the **power switch** in the “on” position. In addition, only a single motion to the switch shall be required to automatically return to the “off” position.

For tools with both a lock-off and lock-on function, it shall not be possible to actuate both the

– lock-off function, and the
– lock-on function

with a single ~~uninterrupted~~ direction of motion, unless a distinct change in direction of the motion is required to continue to the lock-on position

– after actuating the lock-off function, and
– before actuating the lock-on function.

NOTE 1 An example of a design that fulfils this requirement is a slide-style **power switch** with integrated lock-off and lock-on features such that release of lock-off is achieved through an initial pressing or rocking motion, followed by a forward sliding motion that turns on the tool and permitting a lock-on function through a pressing or rocking motion near the end of the sliding action.

For **grinders** with a **detachable battery pack** or a **separable battery pack**, either

– the **power switch** shall automatically switch off the motor as soon as the actuating member of the switch is released and shall have no locking arrangement in the “on” position;

or

– the tool incorporates a lock-on device and shall not restart after reconnection of the **battery** pack without releasing the lock-on device and re-actuating the **power switch**.

*Compliance is checked by inspection, by manual test and for **grinders** with a **detachable battery pack** or a **separable battery pack** incorporating a lock-on device, by the following test.*

*With the **battery** pack disconnected from the **grinder** for at least 2 s, the lock-on device of the tool is engaged. The **battery** pack is then re-connected to the **grinder**. The tool shall not operate without releasing the lock-on device and re-actuating the **power switch**.*

NOTE 2 In Europe (EN 62841-2-3), the following additional subclause applies:

K.21.18.Z101 Isolation and disabling device

Tools with an **integral battery** shall either be equipped

– with an isolation device to prevent the risk of injury from mechanical hazards during servicing or **user maintenance**; or

– with a disabling device that prevents unintentional starting of the tool.

An isolation device shall

– provide disconnection of ~~all poles~~ at least one pole of the **battery** from the serviceable region of the tool;

– be equipped with an unambiguous indication of the state of the disconnection device which corresponds to each position of its manual control (actuator);

– be provided with protection against accidental reconnection.

NOTE 101 Examples of methods to achieve this disconnection include removable jumpers, **integral batteries** that can be disconnected for servicing or **user maintenance**, or an electromechanical **power switch** with a direct mechanical link between the actuator and the contact.

NOTE 102 The risk of accidental reconnection for a **power switch** is addressed by the requirement of 21.18.1.2. The other examples in Note 1 achieve this by the necessary actions for reconnection.

A disabling device may be achieved by any of the following:

– a self-restoring or non-self-restoring lock-off device where two separate and dissimilar actions are necessary before the motor is switched on (e.g. a **power switch** which has to be pushed in before it can be moved laterally to close the contacts to start the motor). It shall not be possible to achieve these two actions with a single grasping motion or a straight line motion;

– a removable disabling device provided with the tool where it shall not be possible for the tool to be operated when either applied or removed.

Compliance is checked by inspection and by manual test.

K.24.4 This subclause of Part 2-3 is not applicable.

Annex L
(normative)

Battery tools and battery packs provided with mains connection or non-isolated sources

All clauses of the main body of this Part 2-3 apply unless otherwise specified in this annex. If a clause is stated in this annex, its requirements replace the requirements of the main body of this Part 2-3 unless otherwise specified.

NOTE In Europe (EN 62841-2-3), the following additional subclause applies:

L.21.18.Z101 Isolation and disabling device

Tools with an **integral battery** shall either be equipped

– with an isolation device to prevent the risk of injury from mechanical hazards during servicing or **user maintenance**; or

– with a disabling device that prevents unintentional starting of the tool.

An isolation device shall

– provide disconnection of ~~all poles~~ at least one pole of the **battery** from the serviceable region of the tool;

– be equipped with an unambiguous indication of the state of the disconnection device which corresponds to each position of its manual control (actuator);

– be provided with protection against accidental reconnection.

NOTE 101 Examples of methods to achieve this disconnection include removable jumpers, **integral batteries** that can be disconnected for servicing or **user maintenance**, or an electromechanical **power switch** with a direct mechanical link between the actuator and the contact.

NOTE 102 The risk of accidental reconnection for a **power switch** is addressed by the requirement of 21.18.1.2. The other examples in Note 1 achieve this by the necessary actions for reconnection.

A disabling device may be achieved by any of the following:

– a self-restoring or non-self-restoring lock-off device where two separate and dissimilar actions are necessary before the motor is switched on (e.g. a **power switch** which has to be pushed in before it can be moved laterally to close the contacts to start the motor). It shall not be possible to achieve these two actions with a single grasping motion or a straight line motion;

– a removable disabling device provided with the tool where it shall not be possible for the tool to be operated when either applied or removed.

Compliance is checked by inspection and by manual test.

Annex AA
(normative)

Wheel guard types

AA.1 Wheel guards of Type A

A **wheel guard** of Type A (see Figure AA.1) shall cover the abrasive wheel periphery and both sides of the wheel for at least 175°. Enclosure of the spindle end, nut and the **outer flange** is not required. The front curtain that covers the **outer flange** side of the wheel shall be designed to allow replacement of the wheel. The front curtain may be removable such that its removal converts a **wheel guard** of Type A into a **wheel guard** of Type B, provided it requires removal with the aid of a tool or is fixed in a reliable manner in accordance with 21.22. ~~If a **wheel guard** with a removable front curtain is provided, it shall be supplied with the front curtain assembled to the **wheel guard**.~~

Compliance is checked by inspection and by measurement.

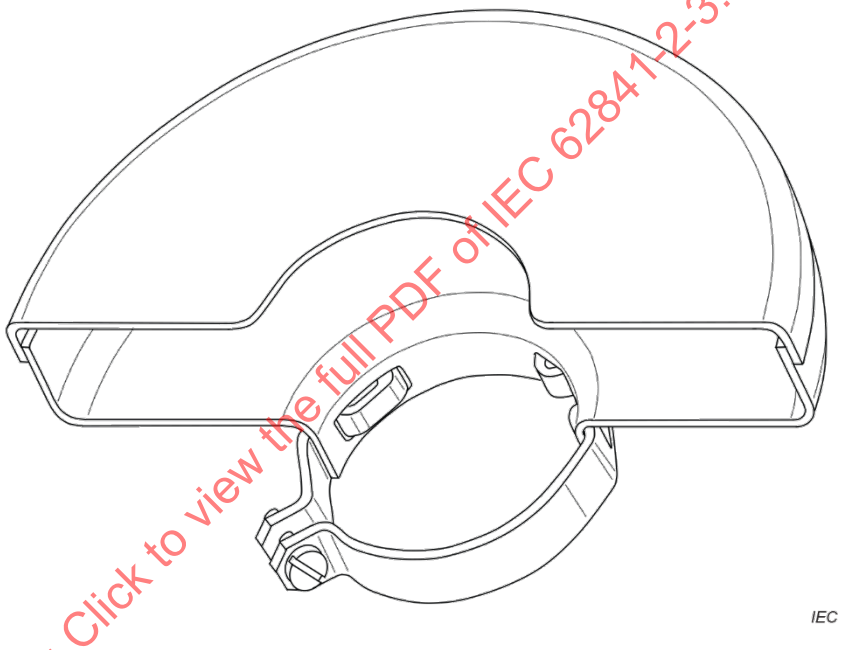


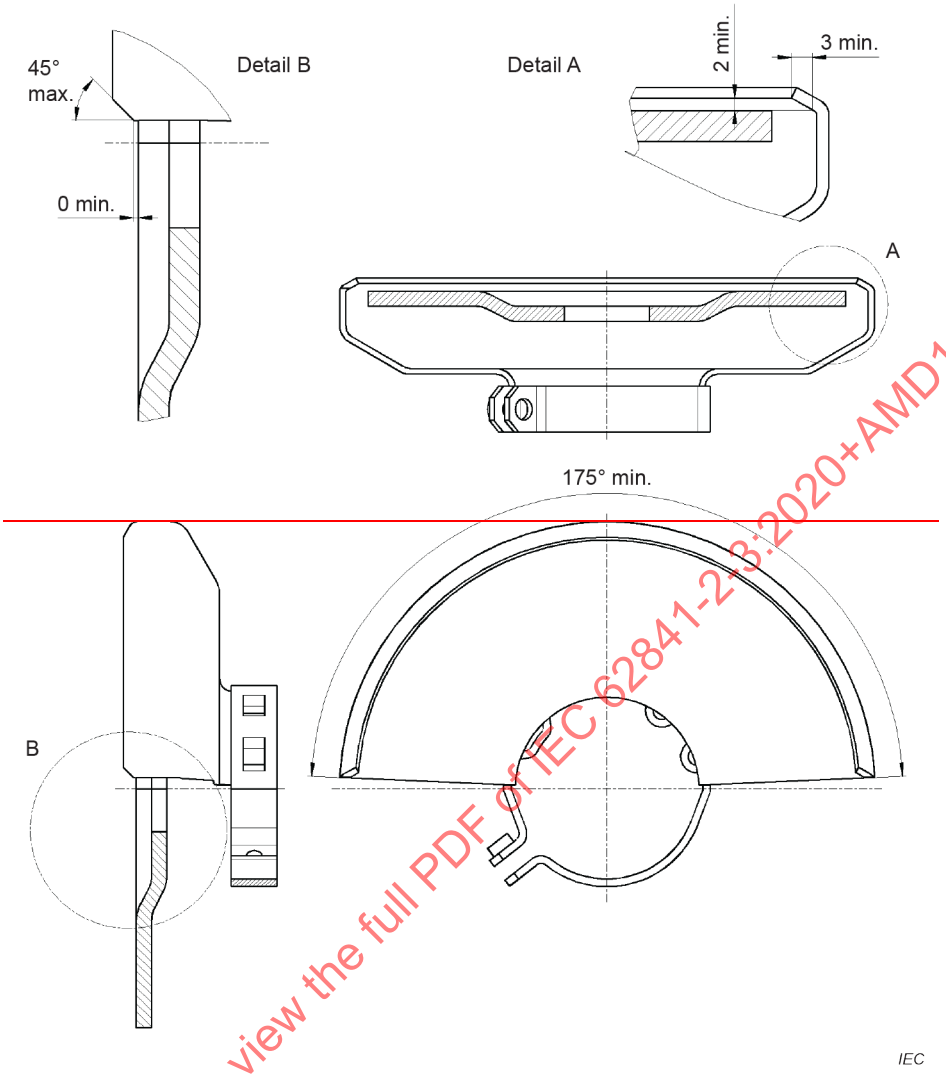
Figure AA.1 – Design example for wheel guard of Type A (cut-off wheel guard)

AA.2 Wheel guards of Type B

A **wheel guard** of Type B shall cover the abrasive wheel periphery and the **inner flange** side for at least 175°. The **wheel guard** periphery shall have a lip on the outer edge that curls inward for at least 3 mm from the intersect line of the top surface of the thickest wheel and largest wheel diameter, as specified in accordance with 8.14.2 a) 104), with the inner surface of the **wheel guard** to the inner edge of the lip, measured radially. The dimension from the grinding face of the thickest wheel as specified in accordance with 8.14.2 a) 104) to the inner edge of the lip of the guard shall be at least 2 mm ~~axially from the inner surface of the lip~~ in an axial direction (see Detail A of Figure AA.2). The ends of the lip ~~protruding the thickest wheel~~ may be chamfered by not more than 45°. See Detail B of Figure AA.2.

Compliance is checked by inspection and by measurement.

Dimensions in millimetres



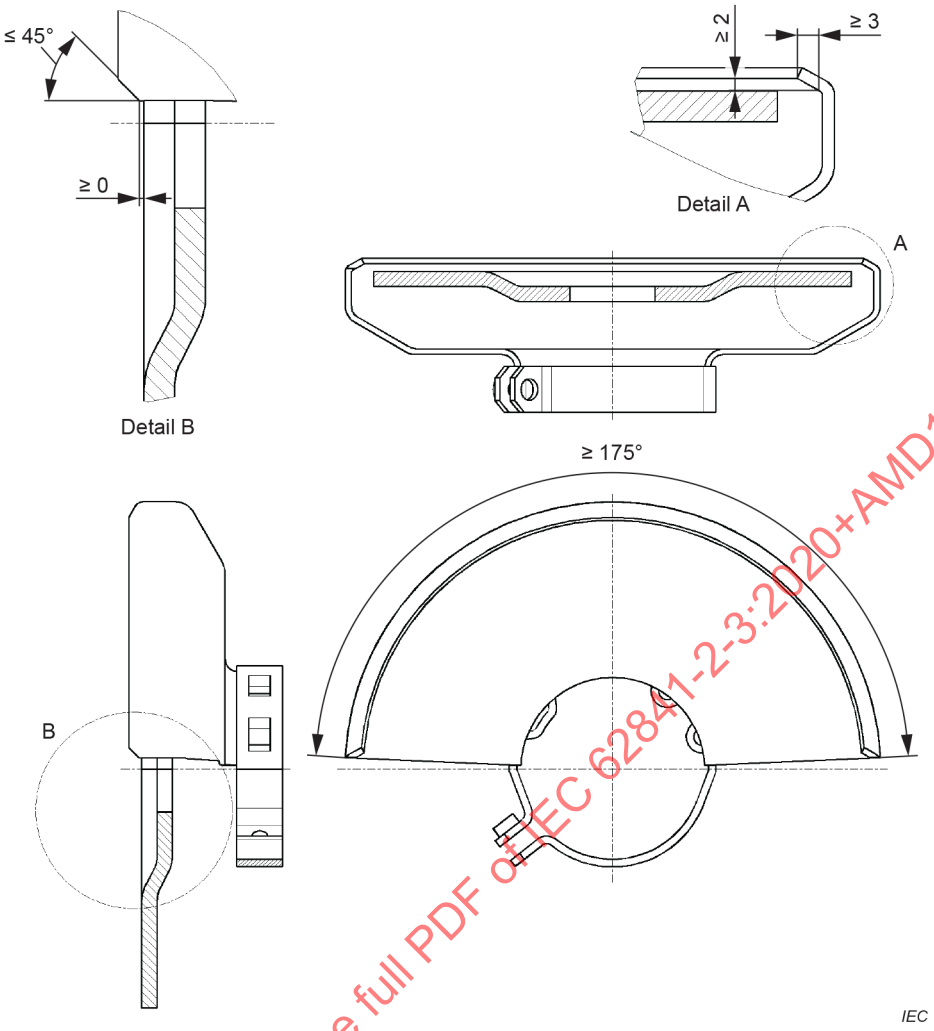
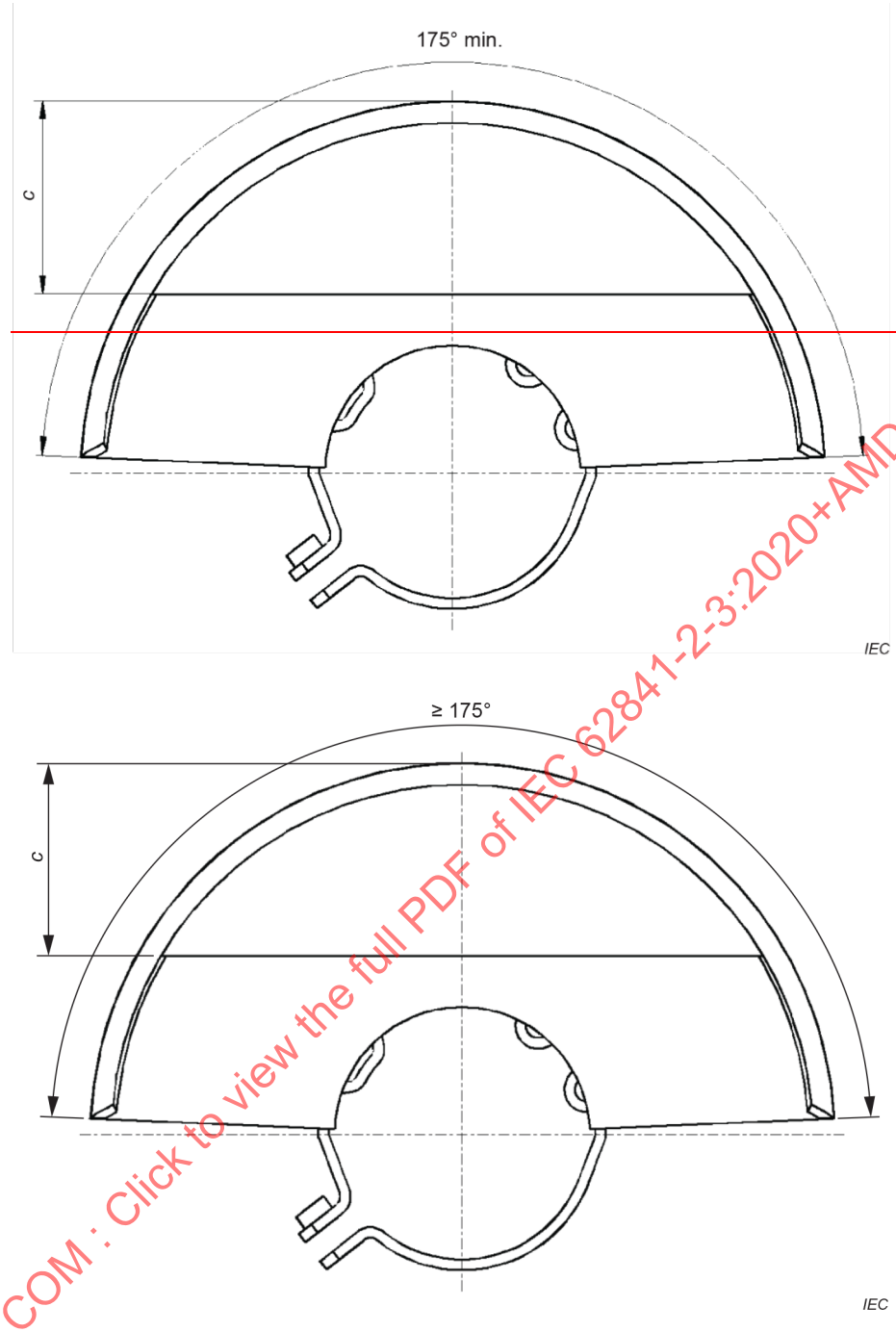


Figure AA.2 – Wheel guard of Type B (grinding wheel guard)

AA.3 Wheel guards of Type C

A **wheel guard** of Type C shall comply with the requirements for a **wheel guard** of Type B, but shall, in addition, be covered on the **outer flange** side by ~~at least~~ a front curtain with a height *c* of a minimum of 0,25 times the **rated capacity**. The front curtain may be removable, provided it requires removal with the aid of a tool or is fixed in a reliable manner in accordance with 21.22. If a **wheel guard** with a removable front curtain is provided, it shall be supplied with the front curtain assembled to the **wheel guard**. See Figure AA.3.

Compliance is checked by inspection and by measurement.



Key

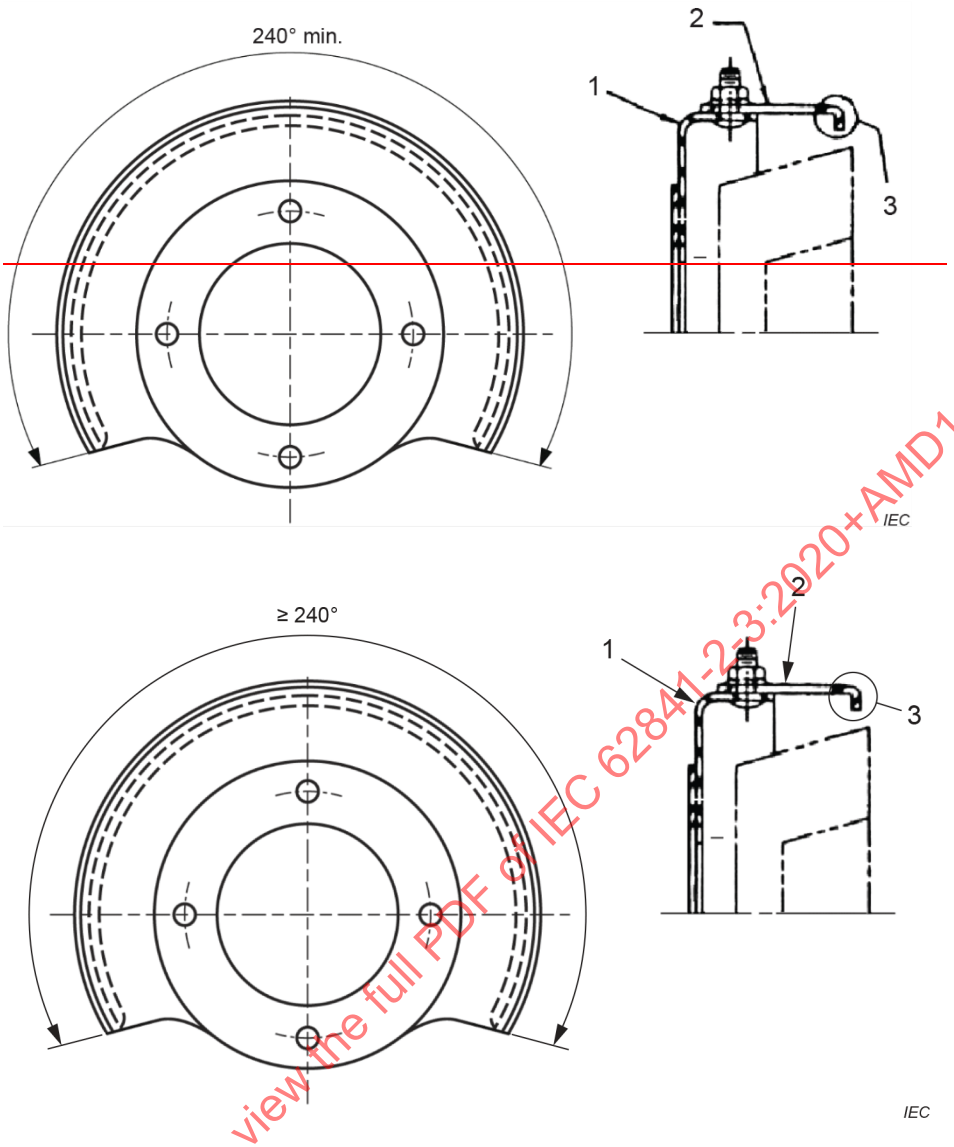
c height of the front curtain

Figure AA.3 – Wheel guard of Type C (combination wheel guard)

AA.4 Wheel guards of Type D

A **wheel guard** of Type D (see Figure AA.4) shall cover the abrasive wheel periphery and the **inner flange** side for at least 240°. The **wheel guard** shall be adjustable axially to compensate for the wear of the largest permitted wheel and restrict the axial exposure of the wheel to less than 3 mm. ~~See Figure AA.4.~~

Compliance is checked by inspection and by measurement.



Key

1 hood

2 skirt (shell)

3 lip (optional)

Figure AA.4 – Adjustable wheel guard of Type D (cup wheel guard)

AA.5 Wheel guards of Type E

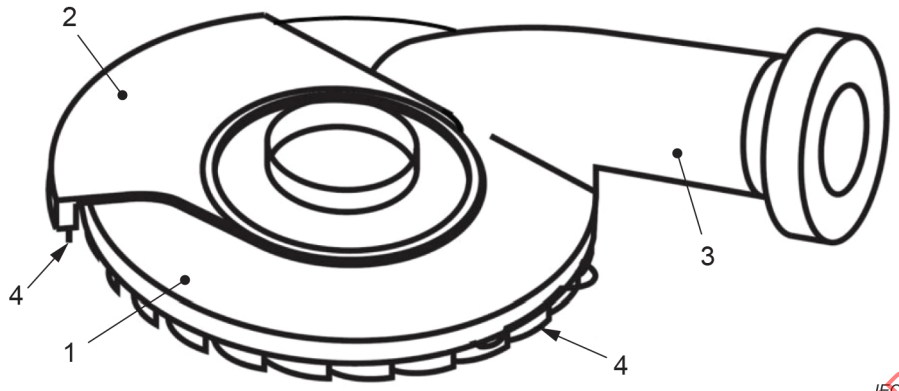
A **wheel guard** of Type E shall cover the **diamond wheel** periphery and the **inner flange** side for 360°. The peripheral part of the **wheel guard** may be flexible (e.g. rubber or brushes) in order to maintain contact with the surface to enable dust extraction. A portion corresponding to 120° may be opened in order to allow flush grinding**.** This portion

– shall be assembled to the **wheel guard** or to the tool; and

– may be removable, provided it requires removal with the aid of a tool or is fixed in a reliable manner in accordance with 21.22. If a **wheel guard** with a removable portion for flush grinding is provided, it shall be supplied with the removable portion assembled to the **wheel guard**.

The **wheel guard** shall be designed to allow dust extraction. See Figure AA.5.

Compliance is checked by inspection and by measurement.



Key

1 **wheel guard**

2 portion of the **wheel guard** that may be removed to allow flush grinding

3 means for dust extraction

4 flexible peripheral part of the **wheel guard**

Figure AA.5 – Wheel guard of Type E (diamond ~~surface~~ grinding wheel guard)

AA.6 Wheel guards of Type F

A **wheel guard** of Type F, see Figure AA.6, shall cover

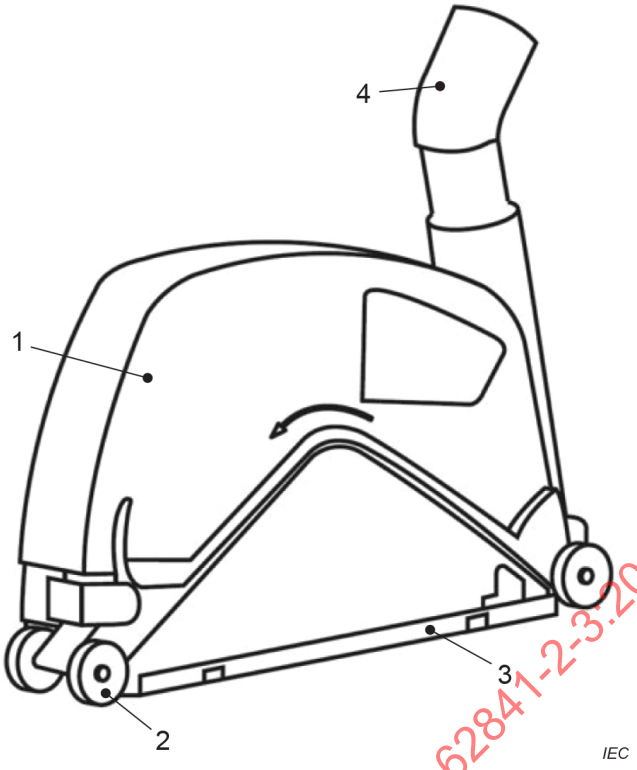
– the wheel periphery and the **inner flange** side for at least 175°; and

– at least the outer 20 % radius of a wheel with **rated capacity** on the **outer flange** side for at least 175°.

The **wheel guard** of Type F shall also be provided with a **guide plate** or **guide rollers** for assisting normal operation. The guide plate or **guide rollers** may be removable or adjustable.

The **wheel guard** of Type F shall be designed to allow dust extraction.

Compliance is checked by inspection and by measurement.



Key

1 **wheel guard**

2 **guide rollers**

3 **guide plate**

4 means for dust extraction

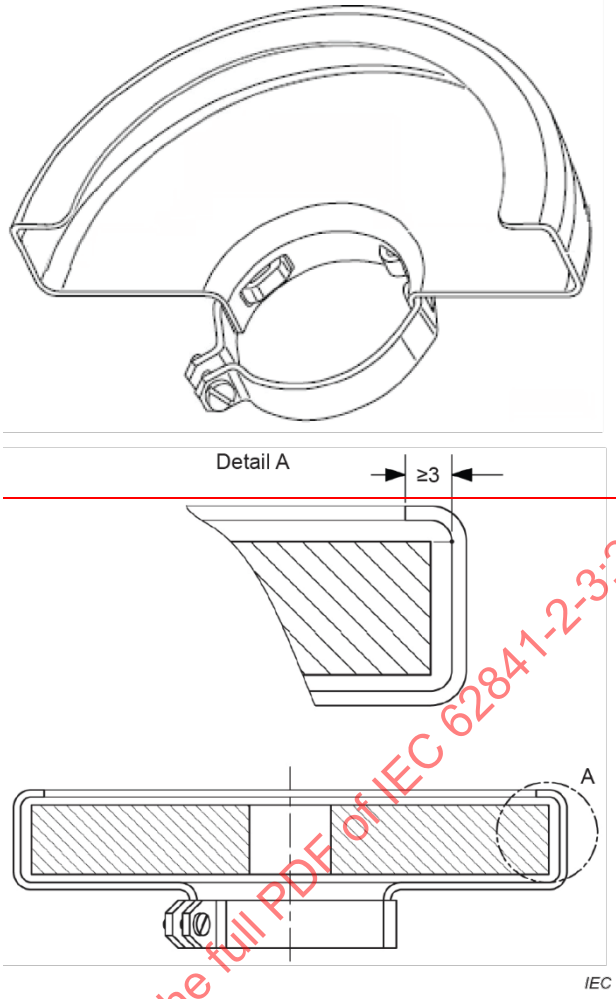
Figure AA.6 – Wheel guard of Type F (masonry cut-off wheel guard)

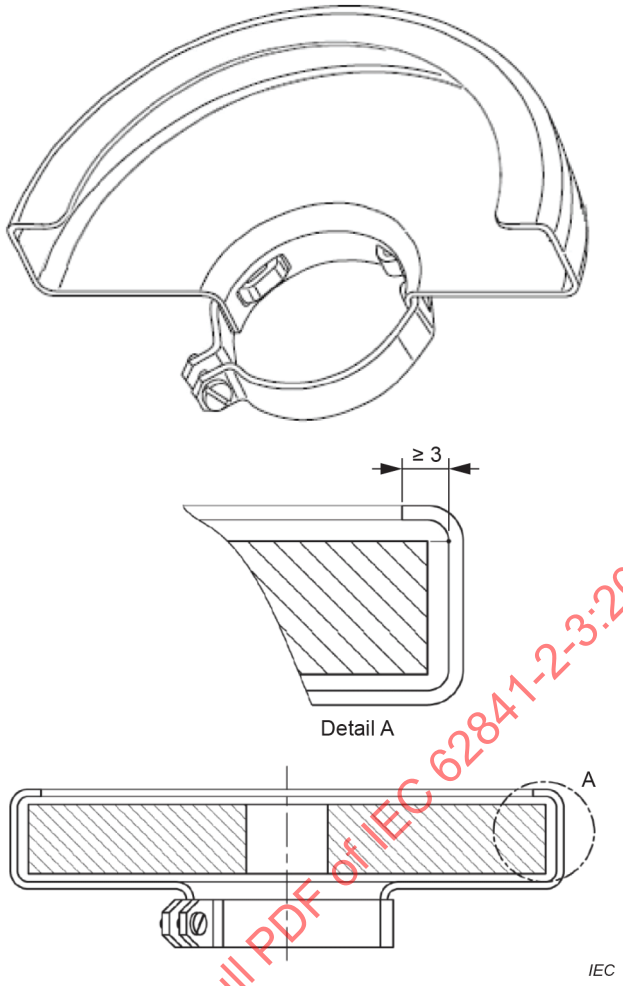
AA.7 Wheel guards of Type G

A **wheel guard** of Type G shall cover the abrasive wheel periphery and the **inner flange** side for at least 175°. The **wheel guard** periphery shall have a lip on the outer edge that curls inward for at least 3 mm from the intersect line of the top surface of the thickest wheel and largest wheel diameter, as specified in accordance with 8.14.2 a) 104), with the inner surface of the **wheel guard** to the inner edge of the lip, measured radially. This requirement may also be fulfilled by a front curtain or a combination of a front curtain and a lip, provided the front curtain is designed to facilitate replacement of the wheel without removing the **wheel guard** (e.g. a hinged front curtain). See Figure AA.7.

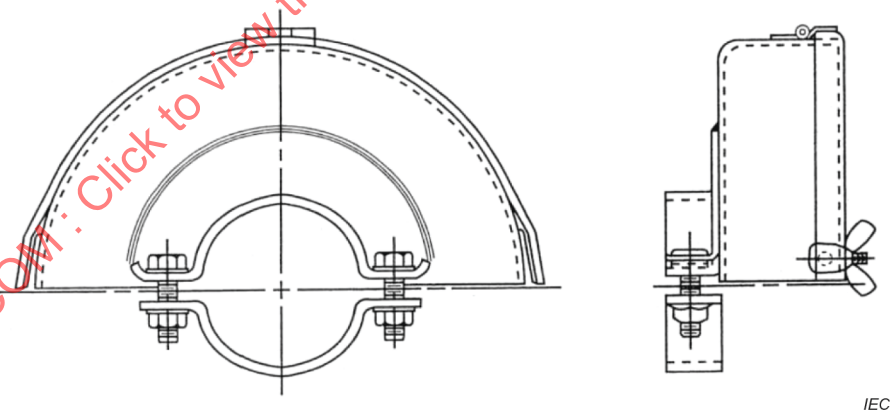
Compliance is checked by inspection and by measurement.

Dimensions in millimetres





a) Wheel guard of Type G without front curtain



b) Wheel guard of Type G with front curtain

Figure AA.7 – Wheel guard of Type G (straight grinder wheel guard)

Annex BB
(informative)

Material and thickness of wheel guards

As a guideline, the following Table BB.101 provides the recommended minimum thickness of **wheel guards**, if they are made of steel plate with a tensile strength of 270 N/mm^2 to 410 N/mm^2 and a minimum elongation of 28 % (gauge length 50 mm) or of other material with comparable characteristics.

Table BB.101 – Wheel guard thickness

Wheel diameter *D* mm	**Minimum thickness** mm
Wheel types 1, 4, 27, 28, 29, 41, 42	
55 < *D* ≤ 150	1,5
D > 150	2,0
Wheel types 6, 11	
55 < *D* ≤ 150	2,0
D > 150	2,5

Annex CC
(normative)

Wheel type specifications

CC.1 General

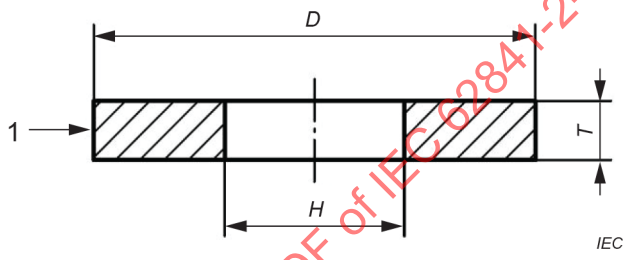
This annex provides

– type number and shape, in accordance with ISO 525:~~2013~~2020; and
– application information

for the **wheel types** referenced in this document.

CC.2 Wheel type 1

Wheel type 1 is a straight grinding wheel used for peripheral grinding. See Figure CC.1.



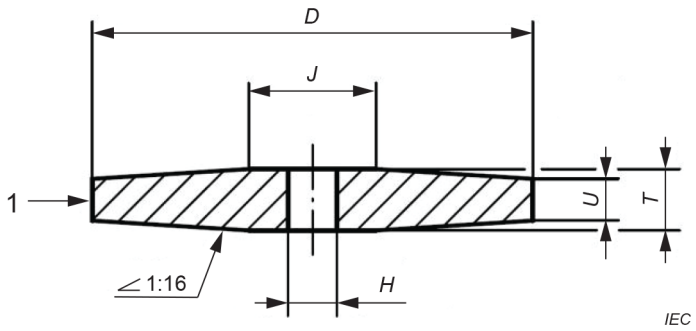
Key

1 grinding face
D outside diameter
H bore diameter
T thickness

Figure CC.1 – Wheel type 1

CC.3 Wheel type 4

Wheel type 4 is a grinding wheel tapered on both sides used for peripheral grinding. See Figure CC.2.



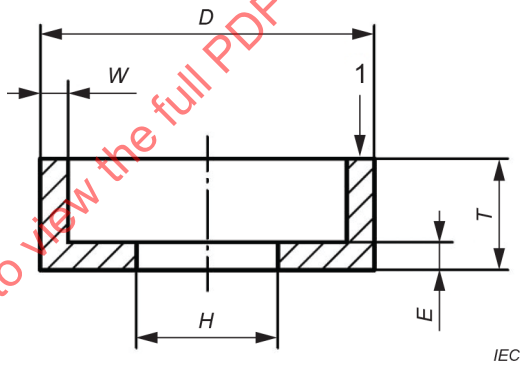
Key

1 grinding face
D outside diameter
H bore diameter
J smallest diameter of tapered wheel
U smallest thickness of tapered wheel
T thickness

Figure CC.2 – Wheel type 4

CC.4 Wheel type 6

Wheel type 6 is a straight cup wheel used for facial grinding. See Figure CC.3.



Key

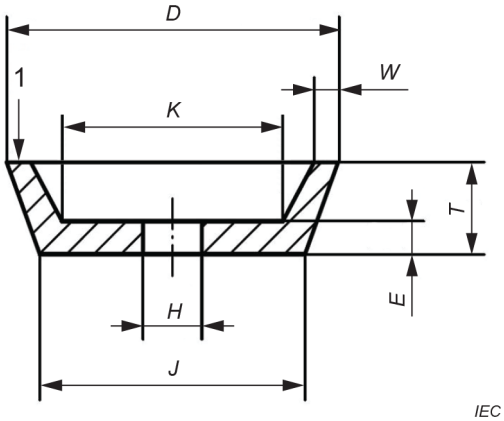
1 grinding face
D outside diameter
E thickness at bore of cup wheel
H bore diameter
T thickness
W rim width

Figure CC.3 – Wheel type 6

CC.5 Wheel type 11

Wheel type 11 is a tapered cup wheel used for facial grinding. See Figure CC.4.

NOTE **Wheel type** 11 is also known as a flaring cup wheel.



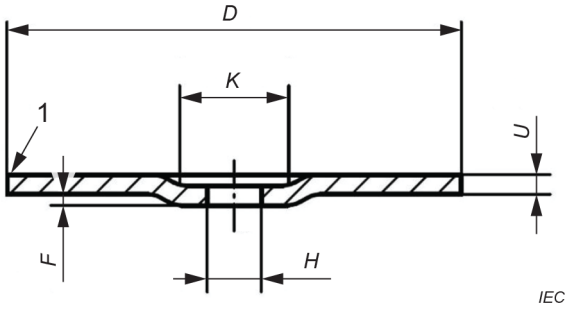
Key

1 grinding face
D outside diameter
E thickness at bore of cup wheel
H bore diameter
J smallest diameter of tapered cup wheel
K internal diameter of recess of tapered cup wheel
T thickness
W rim width

Figure CC.4 – Wheel type 11

CC.6 Wheel type 27

Wheel type 27 is a depressed centre wheel used for facial grinding. The depressed centre allows grinding on the flat surface of the wheel without interference from the flange or mounting hardware. See Figure CC.5.



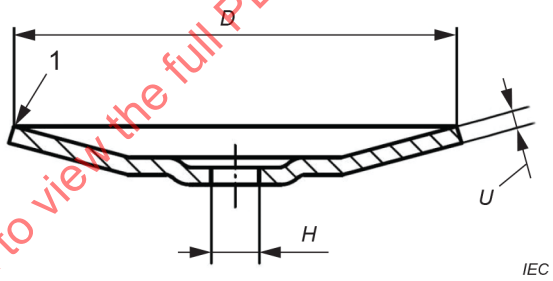
Key

1 grinding face
D outside diameter
F depth of recess
H bore diameter
K internal diameter of recess
U smallest thickness of depressed centre wheel

Figure CC.5 – Wheel type 27

CC.7 Wheel type 28

Wheel type 28 is a depressed centre wheel used for facial grinding that has a saucer-shaped grinding rim. The depressed centre allows grinding without interference from the flange or mounting hardware. See Figure CC.6.



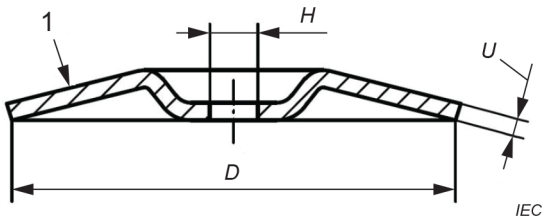
Key

1 grinding face
D outside diameter
H bore diameter
U smallest thickness of depressed centre wheel

Figure CC.6 – Wheel type 28

CC.8 Wheel type 29

Wheel type 29 is a flexible depressed centre wheel used for facial grinding that has reversed saucer-shaped grinding rims. The depressed centre allows grinding without interference from the flange or mounting hardware. See Figure CC.7.



Key

1 grinding face

D outside diameter

H bore diameter

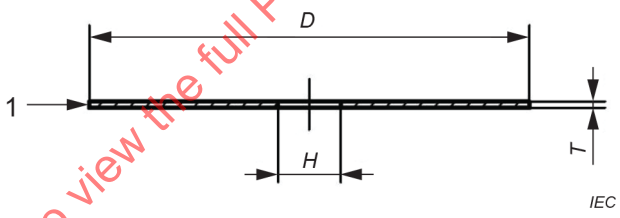
U smallest thickness of depressed centre wheel

Figure CC.7 – Wheel type 29

CC.9 Wheel type 41

Wheel type 41 is a flat wheel used for cutting-off operations. See Figure CC.8.

NOTE **Wheel type** 41 is also known as **wheel type** 1A.



Key

1 grinding face

D outside diameter

H bore diameter

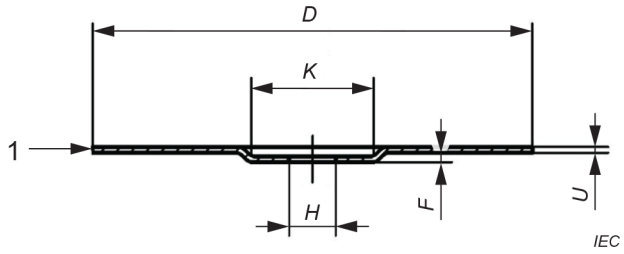
T thickness

Figure CC.8 – Wheel type 41

CC.10 Wheel type 42

Wheel type 42 is a depressed centre wheel used for cutting-off operations. The depressed centre allows grinding without interference from the flange or mounting hardware. See Figure CC.9.

NOTE **Wheel type** 42 is also known as **wheel type** 27A.



Key

1 grinding face
D outside diameter
F depth of recess
H bore diameter
K internal diameter of recess
U smallest thickness of depressed centre wheel

Figure CC.9 – Wheel type 42

Bibliography

The bibliography of Part 1 is applicable, except as follows:

Addition:

IEC 62841-1:2014, *Electric motor-operated hand-held tools, transportable tools and lawn and garden machinery – Safety – Part 1: General requirements*

IEC 62841-2-4, *Electric motor-operated hand-held tools, transportable tools and lawn and garden machinery – Safety – Part 2-4: Particular requirements for hand-held sanders and polishers other than disc type*

ISO 603-12:1999, *Bonded abrasive products – Dimensions – Part 12: Grinding wheels for deburring and fettling on a straight grinder*

ISO 603-14:~~1999~~2022, *Bonded abrasive products – Dimensions – Part 14: Grinding wheels for deburring and fettling/snagging on an angle grinder*

ISO 603-16:~~1999~~2022, *Bonded abrasive products – Dimensions – Part 16: ~~Grinding~~ Cutting-off wheels ~~for cutting-off~~ on hand held power tools*

ISO 6104:2005, *Superabrasive products – Rotating grinding tools with diamond or cubic boron nitride – General survey, designation and multilingual nomenclature*

UAMA B74.2:2003, *Specifications for Shapes and Sizes of Grinding Wheels, and for Shapes, Sizes and Identification of Mounted Wheels*

CONTENTS

INTERNATIONAL ELECTROTECHNICAL COMMISSION

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ELECTRIC MOTOR-OPERATED HAND-HELD TOOLS, TRANSPORTABLE TOOLS AND LAWN AND GARDEN MACHINERY – SAFETY –

Part 2-3: Particular requirements for hand-held grinders, disc-type polishers and disc-type sanders

FOREWORD

1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as "IEC Publication(s)"). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
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9) IEC draws attention to the possibility that the implementation of this document may involve the use of (a) patent(s). IEC takes no position concerning the evidence, validity or applicability of any claimed patent rights in respect thereof. As of the date of publication of this document, IEC had not received notice of (a) patent(s), which may be required to implement this document. However, implementers are cautioned that this may not represent the latest information, which may be obtained from the patent database available at https://patents.iec.ch. IEC shall not be held responsible for identifying any or all such patent rights.

This consolidated version of the official IEC Standard and its amendment has been prepared for user convenience.

IEC 62841-2-3 edition 1.1 contains the first edition (2020-04) [documents 116/444/FDIS and 116/454/RVD], its corrigendum 1 (2021-04) and its amendment 1 (2024-10) [documents 116/813/FDIS and 116/832/RVD].

This Final version does not show where the technical content is modified by amendment 1. A separate Redline version with all changes highlighted is available in this publication.

International Standard IEC 62841-2-3 has been prepared by IEC technical committee 116: Safety of motor-operated electric tools.

This document has been drafted in accordance with the ISO/IEC Directives, Part 2.

This Part 2-3 is to be used in conjunction with the first edition of IEC 62841-1:2014.

This Part 2-3 supplements or modifies the corresponding clauses in IEC 62841-1, so as to convert it into the IEC Standard: Particular requirements for hand-held grinders, disc-type polishers and disc-type sanders.

Where a particular subclause of Part 1 is not mentioned in this Part 2-3, that subclause applies as far as relevant. Where this standard states “addition”, “modification” or “replacement”, the relevant text in Part 1 is to be adapted accordingly.

The following print types are used:

– requirements: in roman type;
– *test specifications: in italic type;*
– notes: in small roman type.

The terms in **bold typeface** in the text are defined in Clause 3.

Subclauses, notes and figures which are additional to those in Part 1 are numbered starting from 101.

A list of all parts of the IEC 62841 series, under the general title: *Electric motor-operated hand-held tools, transportable tools and lawn and garden machinery – Safety*, can be found on the IEC website.

The committee has decided that the contents of this document and its amendment will remain unchanged until the stability date indicated on the IEC website under webstore.iec.ch in the data related to the specific document. At this date, the document will be

- reconfirmed,
- withdrawn, or
- revised.

NOTE The attention of National Committees is drawn to the fact that equipment manufacturers and testing organizations may need a transitional period following publication of a new, amended or revised IEC publication in which to make products in accordance with the new requirements and to equip themselves for conducting new or revised tests.

It is the recommendation of the committee that the content of this publication be adopted for implementation nationally not earlier than 36 months from the date of publication.

ELECTRIC MOTOR-OPERATED HAND-HELD TOOLS, TRANSPORTABLE TOOLS AND LAWN AND GARDEN MACHINERY – SAFETY –

Part 2-3: Particular requirements for hand-held grinders, disc-type polishers and disc-type sanders

1 Scope

This clause of Part 1 is applicable, except as follows:

Addition:

This document applies to hand-held **grinders**, **disc-type polishers** and **disc-type sanders**, including angle, straight and vertical tools, intended for use on various materials except magnesium, with a **rated capacity** not exceeding 230 mm. For **grinders**, the **rated no-load speed** does not exceed a peripheral speed of the **accessory** of 80 m/s at **rated capacity**.

This document also applies to **concrete surface grinders** for use on various masonry materials with a **rated capacity** not exceeding 230 mm.

This document does not apply to **grinders** intended to be fitted with an **accessory** other than a bonded abrasive product or a **diamond wheel**.

This document does not apply to **grinders** intended to be fitted with **diamond wheels** with

– peripheral gaps exceeding 10 mm; or
– a positive rake angle.

This document does not apply to dedicated cut-off machines.

NOTE 101 It is planned that a document on cut-off machines will be published.

This document does not apply to orbital polishers and orbital sanders.

NOTE 102 Orbital polishers and orbital sanders are covered by IEC 62841-2-4.

This document does not apply to die grinders.

NOTE 103 It is planned that a document on die grinders will be published.

2 Normative references

This clause of Part 1 is applicable, except as follows:

Addition:

ISO 525:2020, *Bonded abrasive products – Shape types, designation and marking*

3 Terms and definitions

This clause of Part 1 is applicable, except as follows:

3.101
blotter
thin piece of an easily compressible material, between the abrasive product and **flange**

3.102
diamond wheel
metal wheel with continuous or segmented diamond abrasives

3.102.1
diamond cutting wheel
metal wheel with the abrasives located on the periphery of the wheel

3.102.2
diamond grinding wheel
metal wheel with abrasives located on the face of the wheel

3.103
disc-type polisher
tool equipped with a rotating flexible disc or pad intended for polishing

Note 101 to entry: Polishing is an operation to produce a smooth or shiny surface.

3.104
disc-type sander
tool, constructed like a **grinder**, intended for sanding

Note 101 to entry: Sanding is an operation to remove material using flexible abrasive material, such as sandpaper.

3.105
flange
collar, disc or plate between or against which wheels are mounted

3.105.1
unrecessed (flange)
flange fixed to the machine spindle having an **unrecessed** flat surface against which a threaded hole abrasive product is screwed, e.g. a cup wheel, a cone or a plug

3.105.2
inner flange
flange which contacts and provides support to the back side of the wheel and is located on the spindle between wheel and tool

3.105.3
outer flange
flange which supports the front side of the wheel and secures and clamps the wheel to the spindle and the **inner flange**

Note 101 to entry: In Canada and the United States of America, the following additional definition applies:

3.105.UC1
adaptor backing flange
inner flange which contacts and supports in the hub area and extends past the raised portion to reduce the flexing of the wheel periphery

3.106
grinder
tool driving a rotating spindle on which a bonded abrasive product or a **diamond wheel** is mounted

3.106.1
angle grinder
grinder with the rotating spindle at an angle to the axis of the tool body which acts as a grasping surface, intended for peripheral and lateral grinding

Note 101 to entry: See Figure 101.

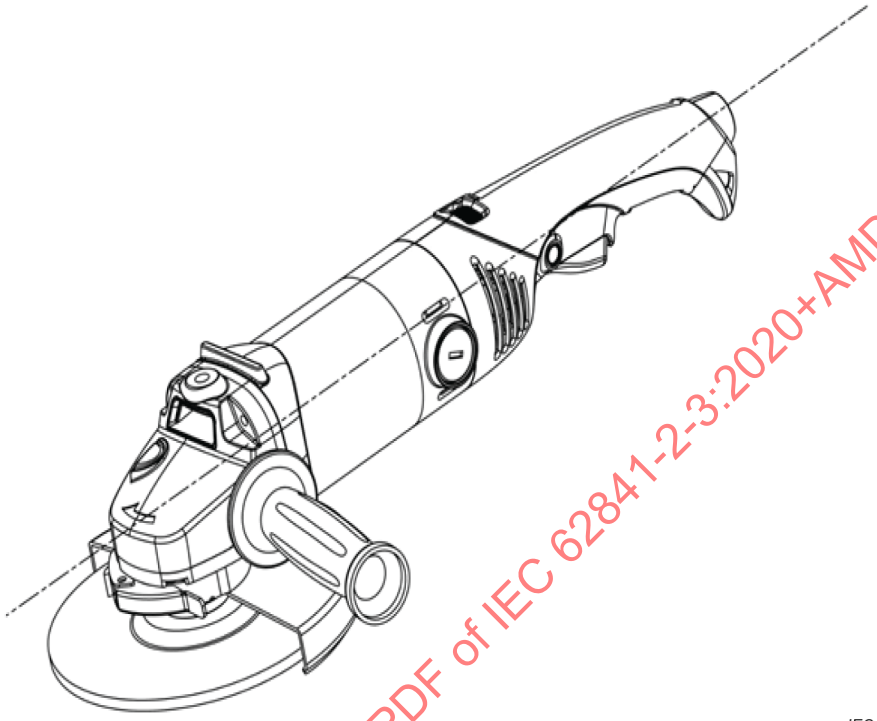


Figure 101 – Example of an angle grinder

3.106.2
straight grinder
grinder with the rotating spindle in-line with the axis of the tool body which acts as a grasping surface, intended for peripheral grinding only and not equipped with a collet or chuck

Note 101 to entry: See Figure 102.

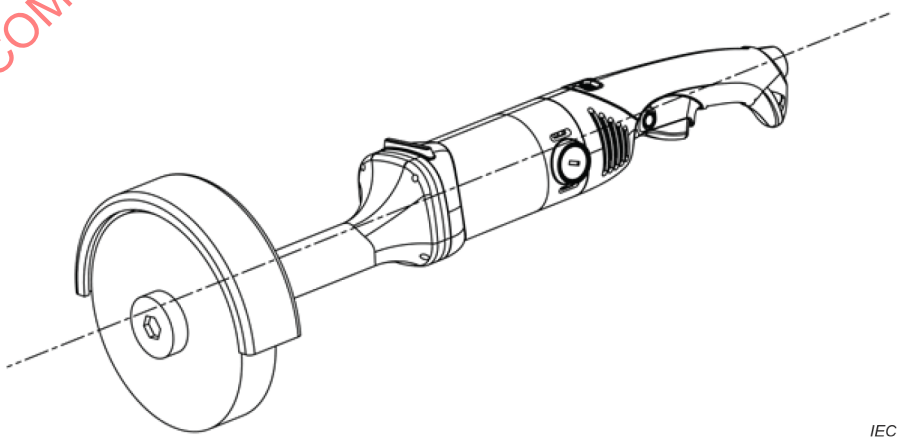


Figure 102 – Example of a straight grinder

3.106.3
vertical grinder
grinder with the rotating spindle in-line with the axis of the tool body and with handles that are substantially perpendicular to the axis of the rotating spindle, intended for peripheral and lateral grinding

Note 101 to entry: See Figure 103.

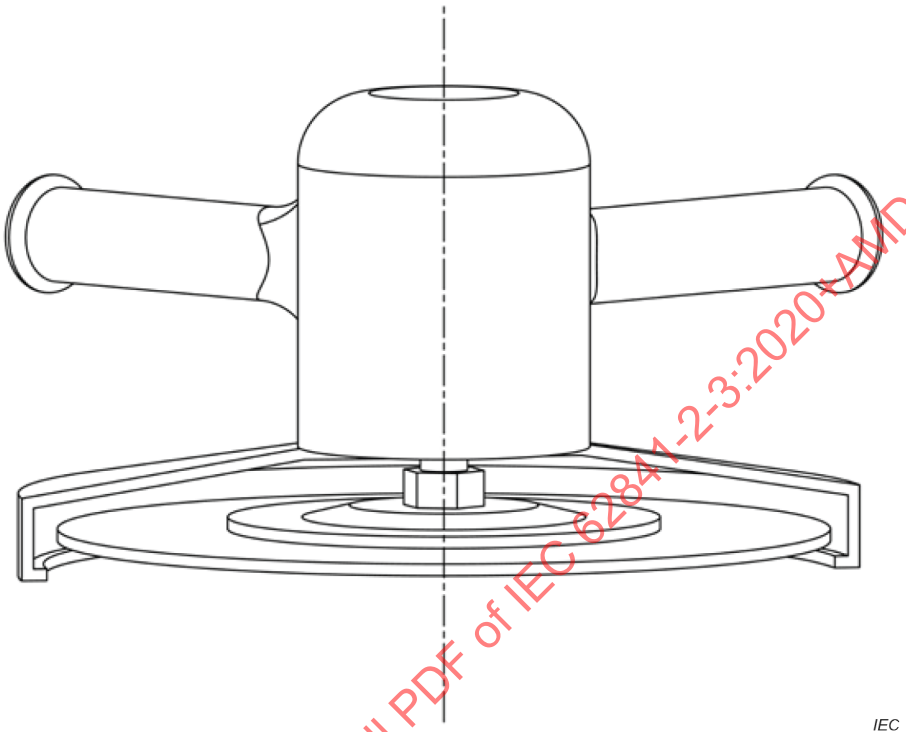


Figure 103 – Example of a vertical grinder

3.106.4
concrete surface grinder
grinder intended for facial grinding with a **diamond grinding wheel** and not intended for other grinding or cut-off operations

Note 101 to entry: See Figure 116.

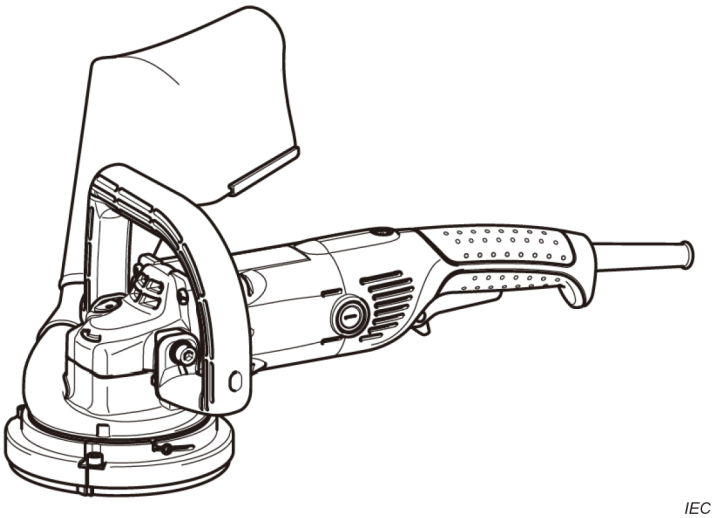


Figure 116 – Example of a concrete surface grinder

3.107
guide plate
flat plate on the machine which rests on the material to be cut

3.108
guide roller
roller on the machine which rests on the material to be cut

3.109
minor fragment
particles less than 1/16 of the mass of the abrasive wheel

3.110
rated capacity
maximum diameter of the rotating **accessory** to be fitted on the tool as specified by the manufacturer's instruction

3.111
wheel guard
device which partly encloses the abrasive wheel and gives protection to the operator

3.112
wheel types
alphanumeric designation of wheels based upon application and shape

Note 101 to entry: Shapes for **wheel types** are given in Annex CC.

4 General requirements

This clause of Part 1 is applicable.

5 General conditions for the tests

This clause of Part 1 is applicable, except as follows:

5.17 *Addition:*

*The mass of a **grinder** includes the **wheel guard**, the **flanges** and the handles.*

*The mass of a **disc-type polisher** or **disc-type sander** includes the **flanges** and the handles.*

6 Radiation, toxicity and similar hazards

This clause of Part 1 is applicable.

7 Classification

This clause of Part 1 is applicable.

8 Marking and instructions

This clause of Part 1 is applicable, except as follows:

8.1 *Addition:*

Tools shall also be marked with:

– **rated no-load speed**;
– **rated capacity**.

NOTE 101 The requirement for marking **rated capacity** does not prohibit the additional marking of smaller permitted diameters of the rotating **accessory** other than **rated capacity** (e.g. 115 mm / 125 mm, where 125 mm is the **rated capacity**).

8.2 *Addition:*

Tools shall also be marked with:

"**WARNING** Always wear eye protection" or sign M004 of ISO 7010 or the following safety sign:

The eye protection symbol may be modified by adding other personal protective equipment such as ear protection, dust mask, etc.

Tools that require at least two handles in accordance with 19.4 shall be marked with

– "**WARNING** Always operate with two hands"; or
– the following safety sign:

NOTE In Canada and the United States of America, the following additional requirements apply:

Tools shall be marked with the following additional safety warnings:

– "WARNING – To reduce the risk of injury, use only accessories rated at least equal to the maximum speed marked on the tool."

In Canada, the equivalent French wording of the above warning is as follows: "AVERTISSEMENT – Pour réduire le risque de blessure, utiliser uniquement les accessoires convenant au moins à la vitesse maximale inscrite sur l'outil."

All **grinders** required to have a **wheel guard** by 19.101.2 shall be marked with the following warning:

– "WARNING – To reduce the risk of injury, always use proper guards when grinding."

In Canada, the equivalent French wording of the above warning is as follows: "AVERTISSEMENT – Pour réduire le risque de blessure, utiliser toujours les protecteurs appropriés pendant le meulage."

If the above cautionary markings are included as part of a list of cautionary markings, the words "WARNING – To reduce the risk of injury" need not be repeated.

8.2.101 A Type B **wheel guard** in accordance with Annex AA shall be marked with

– "**WARNING** Not for cut-off operations"; or
– the following safety sign:

8.3 *Addition:*

Tools provided with a threaded spindle intended to accept threaded **accessories** in accordance with 8.14.2 shall be marked with the spindle thread size.

The direction of rotation of the spindle shall be indicated on the tool by an arrow, raised or recessed or by any other means no less visible and indelible.

8.4 *Modification:*

The marking specified in 8.2.101 may be located on a Type B **wheel guard** that is a **detachable part**.

8.6 *Addition:*

linear dimension..... mm

always operate with two hands

do not use this type of guard for cut-off operations

8.12 *Addition:*

The safety sign required by 8.2.101 need not be in accordance with the red colour requirements of ISO 3864-2.

8.14.1 *Addition:*

The additional safety instructions as specified in 8.14.1.101 shall be given. This part may be printed separately from the "General Power Tool Safety Warnings".

In these safety instructions, terms such as grinding or **grinder**, sanding or sander, **concrete surface grinder** or concrete surface grinding, wire brushing or wire brush, polishing or polisher, or cutting-off or cut-off tool are selected as specified by the manufacturer. These terms in the warnings and headings shall be consistently used or deleted based on the selected operations. The "and"/"or" conjunctions may be used as appropriate.

If the power tool is intended only for one of the listed operations, the heading of that section is to be used for all warnings. Grinding and cutting off shall be included for **angle grinders** with a **rated capacity** exceeding 55 mm.

8.14.1.101 Safety warnings for grinders, disc-type polishers and disc-type sanders

1) Safety instructions for all operations

Safety warnings common for grinding, sanding, concrete surface grinding, wire brushing, polishing or cutting-off operations:

NOTE 101 In the above heading, those operations not applicable are omitted.

a) **This power tool is intended to function as a grinder, sander, wire brush, polisher, hole cutter or cut-off tool. Read all safety warnings, instructions, illustrations and specifications provided with this power tool**. *Failure to follow all instructions listed below may result in electric shock, fire and/or serious injury*.

NOTE 102 Only the applicable operations are listed in item 1) a) above.

b) **Operations such as grinding, sanding, wire brushing, polishing, hole cutting or cutting-off are not to be performed with this power tool**. *Operations for which the power tool was not designed may create a hazard and cause personal injury*.

NOTE 103 Only those operations that were not included in item 1) a) above are listed in item 1) b) above. If all listed operations are intended, then the warning in item 1) b) above is omitted, but all subsequent warnings are given without exclusion.

c) **Do not convert this power tool to operate in a way which is not specifically designed and specified by the tool manufacturer**. *Such a conversion may result in a loss of control and cause serious personal injury*.

d) **Do not use accessories which are not specifically designed and specified by the tool manufacturer**. *Just because the accessory can be attached to your power tool, it does not assure safe operation*.

e) **The rated speed of the accessory must be at least equal to the maximum speed marked on the power tool**. *Accessories running faster than their rated speed can break and fly apart.*

f) **The outside diameter and the thickness of your accessory must be within the capacity rating of your power tool**. *Incorrectly sized accessories cannot be adequately guarded or controlled.*

g) **The dimensions of the accessory mounting must fit the dimensions of the mounting hardware of the power tool**. *Accessories that do not match the mounting hardware of the power tool will run out of balance, vibrate excessively and may cause loss of control*.

h) **Do not use a damaged accessory. Before each use inspect the accessory such as abrasive wheels for chips and cracks, backing pad for cracks, tear or excess wear, wire brush for loose or cracked wires. If power tool or accessory is dropped, inspect for damage or install an undamaged accessory. After inspecting and installing an accessory, position yourself and bystanders away from the plane of the rotating accessory and run the power tool at maximum no-load speed. If unusual vibration is detected, turn the power tool off immediately and replace the cut-off wheel. If unusual vibration is not detected, continue to run the power tool for one minute.** *Damaged accessories will normally break apart during this test time*.

i) **Wear personal protective equipment. Use safety glasses, and, depending on the application, a face shield. As appropriate, wear breathing protection, such as a dust mask or respirator, hearing protection, gloves and workshop apron capable of stopping small abrasive or workpiece fragments**. *The eye protection must be capable of stopping flying debris generated by various applications. The dust mask or respirator must be capable of filtering particles generated by the particular application. Prolonged exposure to high intensity noise may cause hearing loss*.

j) **Keep bystanders a safe distance away from work area. Anyone entering the work area must wear personal protective equipment**. *Fragments of workpiece or of a broken accessory may fly away and cause injury beyond immediate area of operation*.

k) **Hold the power tool by insulated gripping surfaces only, when performing an operation where the cutting accessory may contact hidden wiring or its own**

cord. *Cutting accessory contacting a "live" wire may make exposed metal parts of the power tool "live" and could give the operator an electric shock*.

NOTE 104 The warning in item 1) k) above is omitted if polishing or sanding are the only intended operations.

l) **Position the cord clear of the spinning accessory**. *If you lose control, the cord may be cut or snagged and your hand or arm may be pulled into the spinning accessory*.

m) **Never lay the power tool down until the accessory has come to a complete stop**. *The spinning accessory may grab the surface and pull the power tool out of your control.*

n) **Do not run the power tool while carrying it at your side**. *Accidental contact with the spinning accessory could snag your clothing, pulling the accessory into your body.*

o) **Regularly clean the power tool's air vents**. *The motor's fan will draw the dust inside the housing and excessive accumulation of powdered metal may cause electrical hazards*.

p) **Do not operate the power tool near flammable materials.** *Sparks could ignite these materials*.

q) **Do not use accessories that require liquid coolants.** *Using water or other liquid coolants may result in electrocution or shock*.

NOTE 105 The warning in item 1) q) above does not apply for power tools specifically designed for use with a **liquid system**.

2) Further safety instructions for all operations

Kickback and related warnings

Kickback is a sudden reaction to a pinched or snagged rotating wheel, backing pad, brush or any other accessory. Pinching or snagging causes rapid stalling of the rotating accessory which in turn causes the uncontrolled power tool to be forced in the direction opposite of the accessory's rotation at the point of the binding.

For example, if an abrasive wheel is snagged or pinched by the workpiece, the edge of the wheel that is entering into the pinch point can dig into the surface of the material causing the wheel to climb out or kick out. The wheel may either jump toward or away from the operator, depending on direction of the wheel's movement at the point of pinching. Abrasive wheels may also break under these conditions.

Kickback is the result of power tool misuse and/or incorrect operating procedures or conditions and can be avoided by taking proper precautions as given below.

a) **Maintain a firm grip with both hands on the power tool and position your body and arms to allow you to resist kickback forces. Always use auxiliary handle, if provided, for maximum control over kickback or torque reaction during start-up**. *The operator can control torque reactions or kickback forces, if proper precautions are taken.*

b) **Never place your hand near the rotating accessory**. *Accessory may kickback over your hand.*

c) **Do not position your body in the area where power tool will move if kickback occurs.** *Kickback will propel the tool in direction opposite to the wheel's movement at the point of snagging.*

d) **Use special care when working corners, sharp edges, etc. Avoid bouncing and snagging the accessory**. *Corners, sharp edges or bouncing have a tendency to snag the rotating accessory and cause loss of control or kickback.*

e) **Do not attach a saw chain woodcarving blade, segmented diamond wheel with a peripheral gap greater than 10 mm or toothed saw blade.** *Such blades create frequent kickback and loss of control.*

3) Additional safety instructions for grinding and cutting-off operations

NOTE 106 If grinding and cutting-off operations are not Intended by the manufacturer, all of the verbatim text in item 3) below is omitted.

Safety warnings specific for grinding and cutting-off operations

a) **Use only wheel types that are specified for your power tool and the specific guard designed for the selected wheel.** *Wheels for which the power tool was not designed cannot be adequately guarded and are unsafe*.

b) **The grinding surface of centre depressed wheels must be mounted below the plane of the guard lip.** An improperly mounted wheel that projects through the plane of the guard lip cannot be adequately protected.

c) **The guard must be securely attached to the power tool and positioned for maximum safety, so the least amount of wheel is exposed towards the operator.** *The guard helps to protect the operator from broken wheel fragments, accidental contact with wheel and sparks that could ignite clothing.*

NOTE 107 The warning in item 3) c) above is omitted for **grinders** with a **rated capacity** of less than 55 mm.

d) **Wheels must be used only for specified applications. For example: do not grind with the side of cut-off wheel.** *Abrasive cut-off wheels are intended for peripheral grinding, side forces applied to these wheels may cause them to shatter.*

e) **Always use undamaged wheel flanges that are of correct size and shape for your selected wheel.** *Proper wheel flanges support the wheel thus reducing the possibility of wheel breakage. Flanges for cut-off wheels may be different from grinding wheel flanges*.

f) **Do not use worn down wheels from larger power tools.** *A wheel intended for larger power tool is not suitable for the higher speed of a smaller tool and may burst.*

NOTE 108 The warning in item 3) f) above does not apply for tools only designated to be used with **diamond wheels**.

g) **When using dual purpose wheels always use the correct guard for the application being performed.** *Failure to use the correct guard may not provide the desired level of guarding, which could lead to serious injury*.

4) Additional safety instructions for cutting-off operations

NOTE 109 If cutting-off operation is not intended by the manufacturer, all of the verbatim text in item 4) below is omitted.

Additional safety warnings specific for cutting-off operations:

a) **Do not "jam" the cut-off wheel or apply excessive pressure. Do not attempt to make an excessive depth of cut.** *Overstressing the wheel increases the loading and susceptibility to twisting or binding of the wheel in the cut and the possibility of kickback or wheel breakage.*

b) **Do not position your body in line with and behind the rotating wheel.** *When the wheel, at the point of operation, is moving away from your body, the possible kickback may propel the spinning wheel and the power tool directly at you.*

c) **When the wheel is binding or when interrupting a cut for any reason, switch off the power tool and hold it motionless until the wheel comes to a complete stop. Never attempt to remove the cut-off wheel from the cut while the wheel is in motion otherwise kickback may occur.** *Investigate and take corrective action to eliminate the cause of wheel binding.*

d) **Do not restart the cutting operation in the workpiece. Let the wheel reach full speed and carefully re-enter the cut.** *The wheel may bind, walk up or kickback if the power tool is restarted in the workpiece.*

e) **Support panels or any oversized workpiece to minimize the risk of wheel pinching and kickback.** *Large workpieces tend to sag under their own weight. Supports must be placed under the workpiece near the line of cut and near the edge of the workpiece on both sides of the wheel*.

f) **Use extra caution when making a "pocket cut" into existing walls or other blind areas.** *The protruding wheel may cut hidden objects that can cause kickback*.

g) **Do not attempt to do curved cutting.** *Overstressing the wheel increases the loading and susceptibility to twisting or binding of the wheel in the cut and the possibility of kickback or wheel breakage, which can lead to serious injury.*

5) Additional safety instructions for sanding operations

NOTE 110 If sanding operation is not intended by the manufacturer, all of the verbatim text in item 5) below is omitted.

Safety warnings specific for sanding operations:

a) **Use proper sized sanding disc paper. Follow the manufacturer's recommendations when selecting sanding paper**. *Larger sanding paper extending too far beyond the sanding pad presents a laceration hazard and may cause snagging, tearing of the disc or kickback*.

6) Additional safety instructions for polishing operations

NOTE 111 If polishing operation is not intended by the manufacturer, all of the verbatim text in item 6) below is omitted.

Safety warnings specific for polishing operations:

a) **Do not allow any loose portion of the polishing bonnet or its attachment strings to spin freely. Tuck away or trim any loose attachment strings.** *Loose and spinning attachment strings can entangle your fingers or snag on the workpiece.*

7) Additional safety instructions for wire brushing operations

NOTE 112 If wire brushing operation is not intended by the manufacturer, all of the verbatim text in item 7) below is omitted.

Safety warnings specific for wire brushing operations:

a) **Be aware that wire bristles are thrown by the brush even during ordinary operation. Do not overstress the wires by applying excessive load to the brush.** *The wire bristles can easily penetrate light clothing and/or skin.*

b) **If the use of a guard is specified for wire brushing, do not allow any interference of the wire wheel or brush with the guard.** *Wire wheel or brush may expand in diameter due to work load and centrifugal forces.*

8.14.2 a) *Addition:*

101) Instruction on which types of **accessories** and **guards** to be used for the intended applications of the tool in accordance with 8.14.1.101.2 a) that comply with the substance of Table 101, as applicable;

102) When using dual purpose (combined grinding and cutting-off abrasive) flange mounted wheels, instruction to only use either a Type A (cut-off) or Type C (combination) **wheel guard**;

103) Information on the risks associated with using incorrect **guards**, including

- when using a Type A (cut-off) **wheel guard** for facial grinding, the **wheel guard** may interfere with the workpiece causing poor control;
- when using a Type B (grinding) **wheel guard** for cutting-off operations with bonded abrasive wheels, there is an increased risk of exposure to emitted sparks and particles, as well as exposure to wheel fragments in the event of wheel burst;
- when using a Type A (cut-off), Type B (grinding) or Type C (combination) **wheel guard** for cutting-off and facial operations in concrete or masonry, there is an increased risk of exposure to dust and loss of control resulting in kickback;
- when using a Type A (cut-off), Type B (grinding) or Type C (combination) **wheel guard** with a wheel-type wire brush with a thickness greater than the maximum thickness as specified in 8.14.2 a) 105), the wires may catch on the guard leading to breaking of wires;

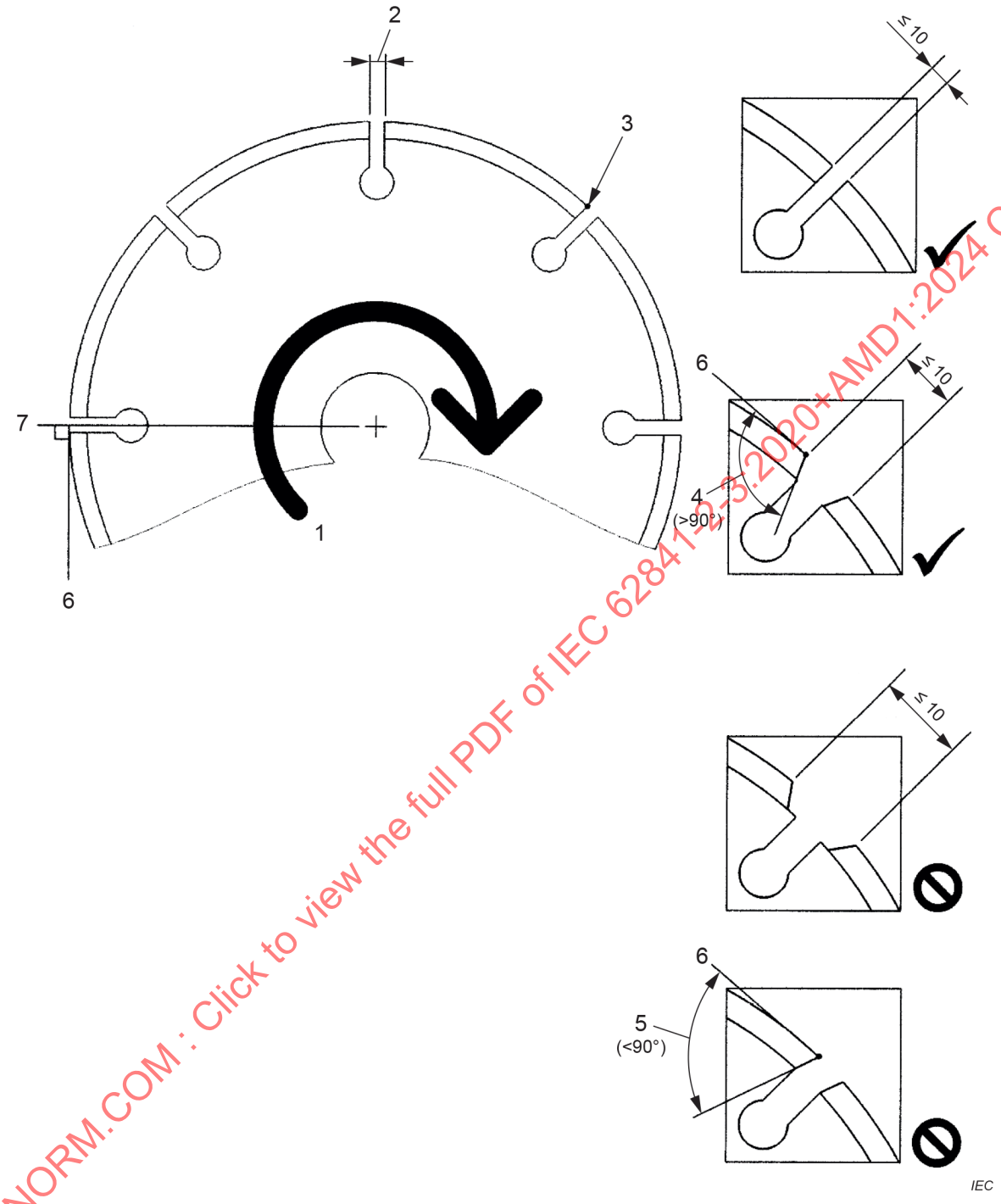
104) Information about the permitted thickness and diameter of grinding wheels;

105) Information about the maximum diameter of wheel-type wire brushes;

106) Information about the permitted construction of cutting-off wheels (**diamond cutting wheel** or bonded reinforced wheel), including the permitted wheel diameter and thickness. If a **diamond cutting wheel** is segmented, instruction that the maximum peripheral gap between segments is 10 mm with no positive rake angle.

NOTE 101 An example of a segmented **diamond cutting wheel** construction is shown in Figure 104.

Dimensions in millimetres



Key

1	direction of rotation	5	positive rake angle
2	gap	6	line tangent to the periphery of the diamond cutting wheel and perpendicular to the centreline of the diamond cutting wheel and gap
3	leading tip of segment	7	centreline of the diamond cutting wheel and gap
4	negative rake angle		

Figure 104 – Examples of segmented diamond cutting wheel constructions

8.14.2 b) *Addition*:

101) Instruction on the proper use of **blotters**, when they are provided with the bonded abrasive product;

102) Information about the specific **flanges** to be used with all **wheel types** in accordance with 8.14.2 a) 101). Instruction on the mounting of **accessories** and the use of the correct **flanges**. For reversible **flanges**, instruction on the correct method of fitting the **flanges**;

103) For all **accessories** specified in accordance with 8.14.2 a) 101), instruction on their proper use. For grinding and cut-off wheels, instruction on their use for side grinding and peripheral grinding applications, and for Type 27 and 28 wheels, the recommended angle to the work surface;

104) Instruction for mounting and securing of the **wheel guard** identifying allowable adjustments to ensure maximum protection of the operator;

105) Instruction on proper support for the workpiece;

106) In case of cup-wheels, cones or plugs with a threaded hole intended to be mounted on the machine spindle, information about critical dimensions and other data in order to prevent the spindle end from touching the bottom of the mounting hole of the abrasive product;

107) For **disc-type sanders** exclusively intended for sanding wooden floors, instruction how to connect the external dust collection equipment, where applicable;

108) For **grinders** intended to be used with a **wheel guard** of Type E or Type F, instruction how to connect the external dust collection equipment, where applicable.

8.14.2 c) *Addition*:

101) Instruction on storage and handling of specified **accessories**.

9 Protection against access to live parts

This clause of Part 1 is applicable.

10 Starting

This clause of Part 1 is applicable.

11 Input and current

This clause of Part 1 is applicable.

12 Heating

This clause of Part 1 is applicable.

13 Resistance to heat and fire

This clause of Part 1 is applicable.

14 Moisture resistance

This clause of Part 1 is applicable.

15 Resistance to rusting

This clause of Part 1 is applicable.

16 Overload protection of transformers and associated circuits

This clause of Part 1 is applicable.

17 Endurance

This clause of Part 1 is applicable.

18 Abnormal operation

This clause of Part 1 is applicable, except as follows:

18.8 *Replacement of Table 4*:

Table 4 – Required performance levels

Type and purpose of SCF	Minimum performance level (PL)
Power switch – prevent unwanted switch-on for **grinders** with a **rated capacity** exceeding 55 mm	*Shall be evaluated using the fault conditions of 18.6.1 without the loss of this **SCF***
Power switch – prevent unwanted switch-on for **grinders** with a **rated capacity** up to and including 55 mm	c
Power switch – prevent unwanted switch-on for disc-type sanders and **disc-type polishers**	b
Power switch – provide desired switch-off for **grinders** with a **rated capacity** exceeding 55 mm	c
Power switch – provide desired switch-off for **grinders** with a **rated capacity** up to and including 55 mm, **disc-type sanders** and **disc-type polishers**	b
Provide desired direction of rotation for **grinders**	c
Provide desired direction of rotation for **disc-type polishers** and **disc-type sanders**	Not an **SCF**
Any electronic control to pass the test of 18.3	c
Prevent output speed from exceeding 120 % of **rated no-load speed** without **accessories** mounted for **grinders** and **disc-type sanders**	c
Prevent output speed from exceeding 130 % of **rated no-load speed** without accessories mounted for **disc-type polishers**	b
Prevent exceeding thermal limits as in 18.4 and 18.5.3	a
Prevent unwanted lock-on of the **power switch** function	b
Restart prevention as required by 21.18.1.1	b
Lock-off function as required by 21.18.1.2	c
Prevent self-resetting as required in 23.3	c

19 Mechanical hazards

This clause of Part 1 is applicable, except as follows:

19.1 *Replacement of the first and second paragraph:*

Moving and other dangerous parts other than the spindle, the **accessory** and the **flanges** shall be so positioned or enclosed to provide adequate protection against personal injury. The guarding of the **accessory** is covered by 19.101.

Protective enclosures, covers, **guards** and the like shall have adequate mechanical strength for their intended purpose. Except for the **wheel guard** as required by 19.101.2, they shall not be removable without the aid of a tool.

19.3 *Addition:*

The requirements of this subclause are not applicable for the dust collection ports on **wheel guards**, if any.

19.4 *Addition:*

Tools with a **rated capacity** exceeding 100 mm shall have at least two handles. One of the handles may be the body of the tool if suitably shaped.

Compliance is checked by inspection.

NOTE 101 In Japan, the following requirements apply:

Tools with a **rated capacity** exceeding 105 mm shall have at least two handles. One of the handles may be the body of the tool if suitably shaped.

Compliance is checked by inspection.

19.6 *Replacement:*

For **grinders** and **disc-type sanders**, the no-load speed of the spindle at **rated voltage** shall not exceed the **rated no-load speed**.

*Compliance is checked by measuring the speed of the spindle after the tool has been operating for 5 min at no-load. During the test, the **accessory** in accordance with 8.14.2 a) 101) that produces the maximum speed shall be installed.*

For **disc-type polishers**, the no-load speed of the spindle at **rated voltage** shall not exceed 110 % of the **rated no-load speed**.

*Compliance is checked by measuring the speed of the spindle after the tool has been operating for 5 min at no-load. During the test, separable **accessories** are not mounted.*

19.101 Wheel guard

19.101.1 General requirements

The **wheel guard** shall protect the user during operation of the tool against:

– accidental contact with the abrasive product;
– ejection of fragments of the abrasive product;
– sparks and other debris.

Wheel guard types are specified in Annex AA.

The **wheel guard** may be removable either with the aid of a tool or by requiring two separate and dissimilar actions to remove the entire **wheel guard** from the tool, e.g. pushing a lever and moving the **wheel guard**.

The **wheel guard** shall also:

– facilitate the change of the abrasive wheel without the need to remove the **wheel guard**, except for **wheel guards** of Type F;

– be designed so that the risk of an accidental contact between the operator and the wheel is minimized e.g. by a possibility of adjustment.

For **wheel guards** of Type A, Type B, Type C, Type D or Type G, in order to prevent the installation of an oversized wheel, the clearance between the inside of the **wheel guard** and the periphery of a new abrasive product of **rated capacity** in accordance with 8.14.2 a) 101) shall, in at least one location, be

– for **wheel guards** of Type A, Type B, Type C or Type G, 8 mm maximum for tools with a **rated capacity** not exceeding 130 mm and 10 mm maximum for tools with a **rated capacity** exceeding 130 mm; and

– for **wheel guards** of Type D, 11 mm maximum.

Compliance is checked by inspection and by measurement.

19.101.2 Supply of wheel guards

Grinders with a **rated capacity** up to and including 55 mm, **disc-type sanders** and **disc-type polishers** need not be supplied with a **wheel guard**.

Angle grinders with a **rated capacity** exceeding 55 mm shall be supplied with at least either

– both a **wheel guard** of Type A (cut-off) and of Type B (grinding); or

NOTE 101 In Japan, the above dash is replaced by the following:

- a **wheel guard** of Type B (grinding); or

– a **wheel guard** of Type B (grinding) and additional elements that can be fixed to the **wheel guard** Type B (grinding) in order to convert it into a **wheel guard** of Type A (cut-off); or

– a **wheel guard** of Type C (combination).

Straight grinders with a **rated capacity** exceeding 55 mm shall be supplied with a Type G **wheel guard**.

For tools with a **rated capacity** exceeding 55 mm, **wheel guards** as specified in Table 101 for the intended applications and **accessory** types of the tool in accordance with 8.14.2 a) 101) shall

– be supplied with the tool for any **accessory** type supplied with the tool;

– be available from the manufacturer and be listed in the instructions in accordance with 8.14.2 c) 3); and

– comply with all applicable requirements of 19.101, Clause 20 and Annex AA.

Concrete surface grinders shall be supplied with a Type E **wheel guard**.

Compliance is checked by inspection, by measurement and by relevant tests.

Table 101 – Accessories and guards for various applications

Application	Accessory types	Guard types
Facial grinding	**Wheel types** 27, 28, 29	Type B or Type C (grinding or combination **wheel guard**)
	Wheel types 6, 11	Type D (cup **wheel guard**)
	Diamond grinding wheels for masonry/concrete	Type E (diamond surface grinding **wheel guard**)
Peripheral grinding	**Wheel type** 1, 4	Type G (straight grinder **wheel guard**)
	Cones, plugs	None
Cutting-off	**Wheel types** 41 (1A), 42 (27A) for metal	Type A or Type C (cut-off or combination **wheel guard**)
	Wheel types 41 (1A), 42 (27A) for masonry/concrete	Type A or Type F (cut-off or masonry/concrete cut-off **wheel guard**)
	Diamond cutting wheel for metal	Type A or Type C (cut-off or combination **wheel guard**)
	Diamond cutting wheel for masonry/concrete	Type A or Type F (cut-off or masonry/concrete cut-off **wheel guard**)
	Abrasive wheels for materials other than metal or masonry/concrete	Type A or Type C (cut-off or combination **wheel guard**)
Dual purpose (combined cut-off and grinding)	Dual purpose abrasive wheel	Type A or Type C (cut-off or combination **wheel guard**)
Hole cutting	Diamond hole cutters	None
Wire brushing	Wheel-type wire brush	Type A or Type B or Type C (cut-off or grinding or combination **wheel guard**)
	Cup-type wire brush	None
Sanding	Flap disc	Type B or Type C (grinding or combination **wheel guard**)
	Flexible abrasive (e.g. sanding paper) supported by a flexible backing pad	None
	Hard metal wheel (sanding of materials other than metal or masonry/concrete)	None
Polishing	Polishing **accessory**	None
Any operation	**Accessory** with a diameter up to and including 55 mm	None

19.102 Spindles

Spindles shall be designed so that they provide for or aid in securing and driving the abrasive products designed for the tool.

Either the direction of spindle threads or the design of an equivalent securing means shall be such that any clamping device or wheel with threaded hole tends to tighten during working, or the **outer flange** shall have positive locking to the spindle.

Compliance is checked by inspection.

In order to limit the unbalance of any rotating **accessory**, the eccentricity of the spindle shall be less than 0,1 mm.

For tools that provide for mounting of the **accessory** through the **flange** or similar clamping and locating device, the total eccentricity of the combination of the spindle, the diameter of the **flange** bore and the diameter of the part of the **flange** which locates and guides the **accessory** shall be less than:

– 0,30 mm for **rated no-load speeds** less than 15 000 min^{-1} ·
– 0,15 mm for **rated no-load speeds** from 15 000 min^{-1} to less than 25 000 min^{-1} ·
– 0,10 mm for **rated no-load speeds** equal 25 000 min^{-1} and higher.

Compliance is checked by measurement. The eccentricity is measured as the difference between the minimum and the maximum reading of the indicator.

*For tools with **flanges**, the eccentricity of the **flange** in the worst off-centre position allowed by the mounting procedure is measured.*

19.103 Flanges

The tool shall be designed so as to prevent the abrasive product coming loose under **normal use**.

Grinders shall be provided with at least **inner flange**(s) and **outer flange**(s) for mounting the type of grinding wheels that are intended to be used with the **wheel guard(s)** supplied with the **grinder**. The **flanges** shall meet the requirements of 19.104 and 19.105.

Flanges are not required to be provided if the tool is designed to only accept wheels with

– a non-reusable plate mount or other non-threaded mounting affixed to the wheel, provided the requirements of 19.106 are fulfilled; or
– threaded inserts or projecting studs.

Compliance is checked by inspection.

19.104 Flange dimensions

19.104.1 **Flanges** required by 19.103 shall be designed so that they secure and locate the abrasive products to the **grinder**. At least one of the **flanges** shall be keyed, screwed, shrunk-on or otherwise secured to prevent rotation relative to the tool spindle.

The **flanges** shall be flat and have no sharp edges.

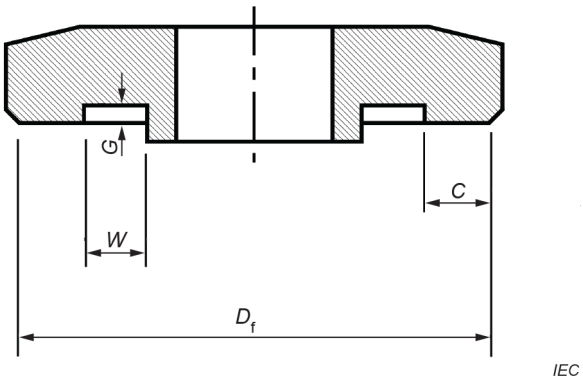
The **flanges** shall have the dimensions specified in 19.104.2 and 19.104.3 as illustrated in Figure 105 or the dimensions specified in 19.104.4 as illustrated in Figure 106, where D is the outside diameter of the abrasive wheel, G and W are the dimensions of the recess and D_f is the outside diameter of the **flange** clamping surface.

Flanges for wheels under 55 mm diameter may be **unrecessed**.

The **inner flange** and the **outer flange** shall have the same diameter D_f or the overlap of the **inner flange** and **outer flange** bearing surfaces shall be at least equal to dimension C.

In order to prevent interference, the **outer flange** and/or nut shall not extend beyond the plane defined by the lip of the **wheel guard** when mounted with the thickest Type 27, 28 or 29 wheel as specified in accordance with 8.14.2 a) 104).

Compliance is checked by inspection and by measurement.



Key

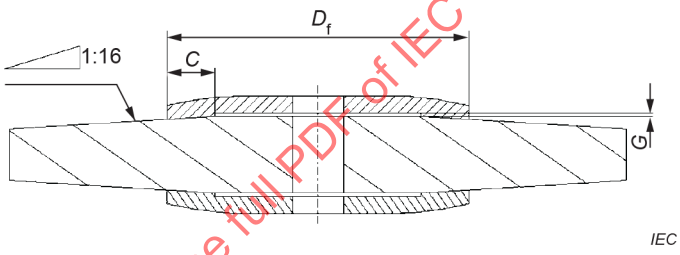
C radial width of the clamping surface

D_f outside diameter of the **flange** clamping surface

G depth of recess

W width of recess

Figure 105 – Principal dimensions of flanges for wheels other than Type 4



Key

C radial width of the clamping surface

D_f outside diameter of the **flange** clamping surface

G depth of recess

Figure 106 – Principal dimensions of flanges for wheels type 4

19.104.2 The **flange** diameter for **wheel type** 1 that are thicker than 5 mm shall be:

$D_f \geq 0{,}33D$

The **flange** diameter for **wheel type** 1 that are 5 mm and thinner and **wheel types** 6, 11, 27, 28, 29, 41 and 42 shall be:

$D_f = (20 \pm 1)$ mm	for 55 mm ≤ D < 80 mm
$D_f = (20 \pm 1)$ mm	for 80 mm ≤ D ≤ 105 mm for wheels with a bore diameter of 10 mm (3/8 inch UNC)
$D_f = (29 \pm 1)$ mm	for 80 mm ≤ D ≤ 105 mm for wheels with a bore diameter of 16 mm (5/8 inch UNC)
$D_f = (41 \pm 1)$ mm	for 105 mm < D ≤ 230 mm

For **wheel type** 41 and **diamond wheels**, the D_f dimension may exceed the above values for **inner flanges** and **outer flanges**. For all other **wheel types**, the diameter D_f may exceed the above values for **inner flanges** only.

If the clamping surface of the **outer flange** is chamfered, the bevel angle, measured from the clamping surface, shall be at least 45° and the non-clamping surface outside diameter of the **flange** may be increased by not more than 4 mm.

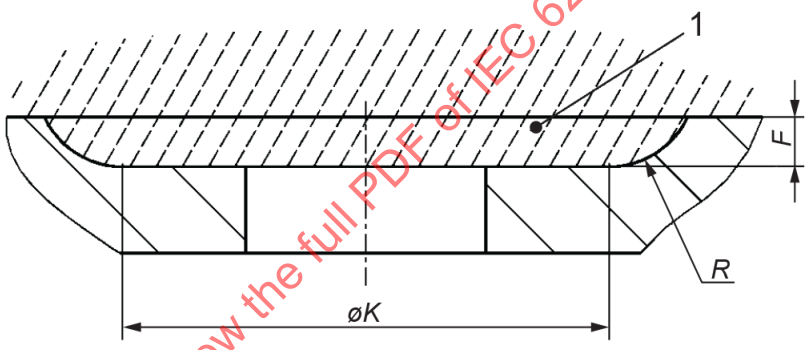
Compliance is checked by measurement.

NOTE 101 In Europe (EN 62841-2-3), the above paragraph is replaced by the following:

For **wheel types** 27, 28 and 42: The outer dimensions of the **outer flange** shall be limited so that there is no interference with the depressed centre of wheels in accordance with ISO 603-14:2022 and ISO 603-16:2022 as illustrated in Figure Z101 with the dimensions *ØK, R* and *F* as specified in Table Z101.

Table Z101 – Dimensions of depressed centre wheels

Outside diameter of the abrasive wheel *D* mm	***ØK*** mm	**Radius *R*** mm	***F*** mm
≤ 80	23	6	4
> 80 and ≤ 100	35,5	6	4
> 100 and ≤ 230	45	8	4,6



IEC

Key

1 area without interference

ØK diameter of the depressed centre bottom

R radius

F height of the depressed centre

Figure Z101 – Depressed centre of abrasive wheels

19.104.3 The dimensions *C*, *G and W* in Figure 105 shall be:

$C \geq 3$ mm

$W \geq 1$ mm, $G \geq 0{,}5$ mm for $D_f < 50$ mm

$W \geq 1{,}5$ mm, $G \geq 1{,}0$ mm for $D_f \geq 50$ mm

The cross-section of the recess need not be rectangular.

Compliance is checked by inspection and by measurement.

19.104.4 Flanges for **wheel type** 4 as illustrated in Figure 106 shall have minimum dimensions in accordance with Table 102.

NOTE 101 In Canada and the United States of America, this subclause is not applicable.

Table 102 – Minimum flange dimensions for wheel type 4

Outside diameter of the abrasive wheel *D* mm	Outside diameter of the flange clamping surface D_f mm	Radial width of the clamping surface *C* mm	Depth of recess *G* mm
≤ 100	50	8	1,0
> 100 and ≤ 125	63	10	1,0
> 125 and ≤ 150	75	13	1,0
> 150 and ≤ 175	88	14	1,0
> 175 and ≤ 200	100	16	2,0

Compliance is checked by measurement.

NOTE 102 In Canada and the United States of America, this following additional subclause applies.

19.104.UC1 An **adaptor backing flange** may be used in place of the **inner flange** to mount **wheel types** 27, 28 and 29 with a diameter greater than 155 mm. The **adaptor backing flange** shall extend beyond the central hub, or raised portion, of the wheel. The adaptors are exempt from the **flange** strength test specified in 19.105.

19.105 Strength of flanges

Flanges required by 19.103 shall be designed so that they are of adequate strength.

Compliance is checked by the following test.

*The **grinder** is fitted with a steel disc having any one of the thicknesses between the **flange** clamping surfaces of the abrasive product specified in accordance with 8.14.2 a) 104) or 8.14.2 a) 106), as applicable.*

*The clamping nut is tightened with a first test torque according to Table 103. A feeler gauge of a thickness of 0,05 mm is used to test whether the **flanges** are in contact with the disc all around the circumference. The test is satisfactory if at no place the feeler gauge can be pushed underneath the **flanges**.*

*The clamping nut is further tightened to the second test torque according to Table 103. A feeler gauge of a thickness of 0,05 mm is used to test the deflection of the **flanges**. The result is satisfactory if at no place the feeler gauge can be pushed underneath the **flanges** by more than 1 mm.*

Table 103 – Torques for testing flanges

Thread		First test torque	Second test torque
Metric	UNC	Nm	Nm
5		0,5	2
6		1	4
8	2	2	8
10	3/8	4	15
12	½	7,5	30
14		11	45
16	5/8	17,5	70
> 16	> ¾	35	140

19.106 A non-reusable plate mount or other non-threaded mounting affixed to the wheel in accordance with 19.103, if any, shall be designed in such a manner as to ensure that there is no damage to the mounting means under a stalled condition.

Compliance is checked by inspection and by the following test.

The tool is fitted with a steel test disc with

- *a thickness of at least 2 mm, except as needed to be compatible with the tool mounting means; and*
- *the largest diameter in accordance with 8.14.2 a) 101); and*
- *an attachment point which may be a hole or other means located at a radial distance of (20 ± 1) mm from the outer periphery of the steel test disc for applying the test forces.*

The tool spindle is locked during the application of the test forces. A force in N equal to 1,1 times the diameter of the steel disc in mm is applied to the attachment point in a direction

- *tangential to the periphery of the steel disc for 1 min; and*
- *perpendicular to the plane of the steel disc for 1 min.*

The tool is then operated at no-load for 30 s. During the test, the steel test disc shall not disengage from the tool mounting. After the test, the tool mounting shall not be damaged.

20 Mechanical strength

This clause of Part 1 is applicable, except as follows:

20.1 *Replacement of the fifth paragraph:*

*Deformation of a **wheel guard** is acceptable. If there is any mechanical damage to other parts of the tool that is likely to compromise compliance with a relevant requirement of Clause 19, the requirement in Clause 19 shall be re-evaluated.*

NOTE 1 The strength of the **wheel guard** is evaluated in 20.101, 20.102 or 20.103.

NOTE 2 See Annex BB for the recommended minimum thickness of wheel guards.

20.5 *Modification:*

This subclause is not applicable for **disc-type polishers** and **disc-type sanders**, provided these tools are not intended to be used as a **grinder** as specified in the instructions in accordance with 8.14.1.101.2 a).

20.101 Strength of wheel guards of Types A, B, C and D

20.101.1 **Wheel guards** of Types A, B, C and D specified in accordance with 8.14.2 a) 101) shall have sufficient mechanical strength to prevent the wheel fragments from being ejected towards the operator in the event of the wheel breakage.

*Compliance is checked by subjecting three samples of each **wheel guard** type to the test specified in 20.101.2 to 20.101.5. At the manufacturer's discretion, the test may be conducted with less than three separate **grinders** for each **wheel guard** type.*

*The test is conducted with the thickest bonded reinforced wheel that may be used with the **wheel guard** in accordance with 8.14.2 a) 101).*

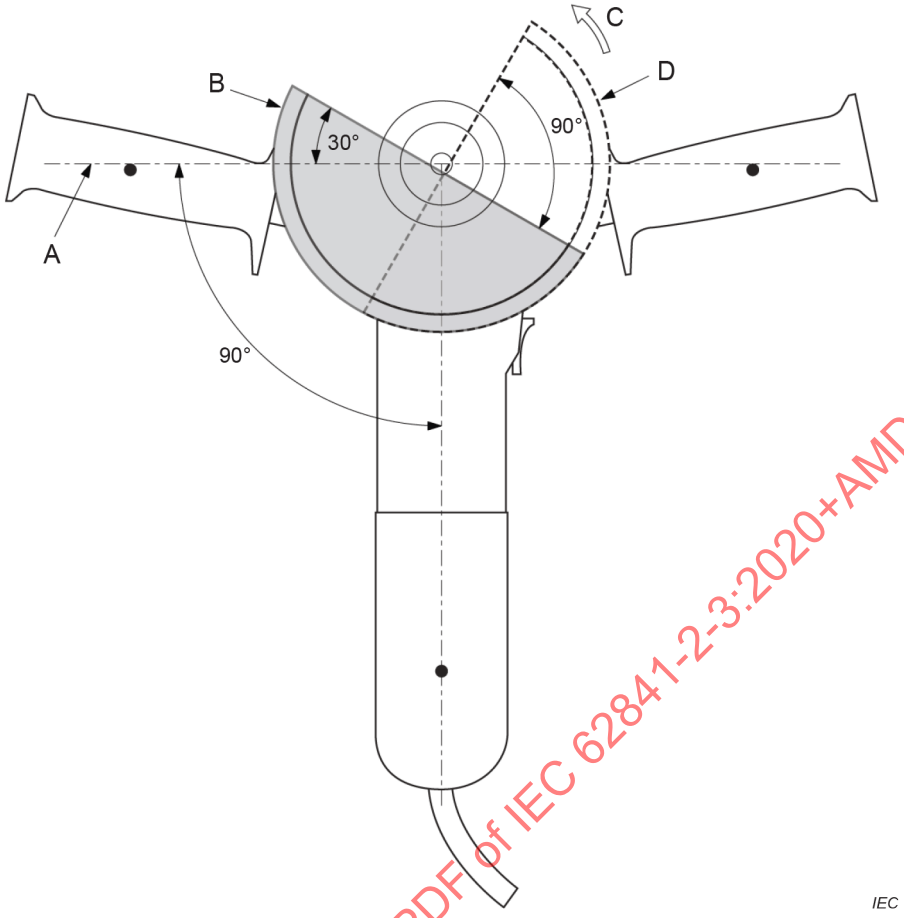
After the test, the tool shall meet the acceptance criteria of 20.101.6.

*For **wheel guards** intended only for **diamond wheels** or flap discs, compliance is checked either by:*

– *submitting three samples of the **wheel guard** to the test specified in 20.102.2 to 20.102.5, also using bonded reinforced wheels with a minimum thickness of 2,5 mm and a diameter approximately equal to the diameter of the **diamond wheels** or flap discs in accordance with 8.14.2 a) 101). After the test, the tool shall meet the acceptance criteria of 20.102.6; or*

– *meeting the design requirements in Table 105.*

20.101.2 *The **wheel guard** is mounted and securely fixed to the **grinder** in accordance with the instructions of 8.14.2 b) 104). If the **wheel guard** is adjustable, it is positioned as close as possible to 30° from the neutral or the symmetrical wheel covering position against the direction of the wheel's rotation. See Figures 107 a) and 107 b). For **wheel guards** of Type D, the axial adjustment is such that the lower edge of the **wheel guard** extends beyond the grinding surface of the wheel by not more than 1,0 mm.*



Key

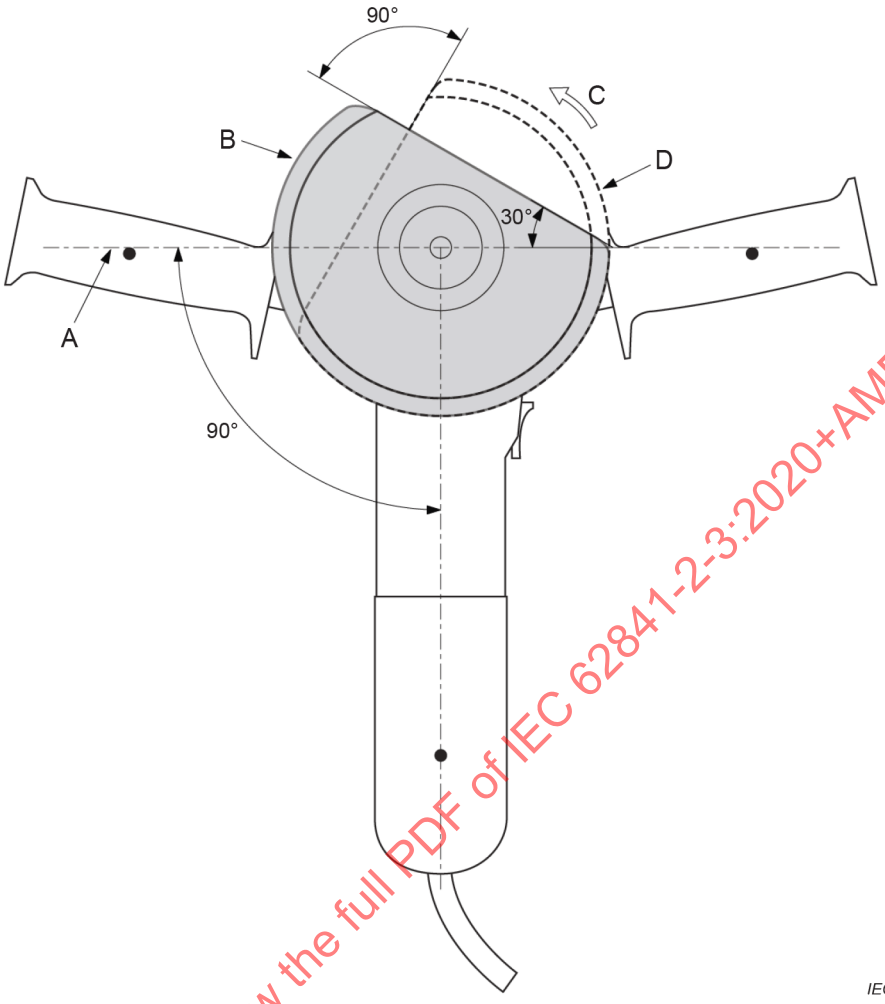
A neutral **wheel guard** position

B initial **wheel guard** position (**wheel guard** turned 30° from neutral position against the direction of wheel rotation)

C direction of the wheel rotation

D maximum permissible **wheel guard** position after the test (90° from initial position in the direction of the wheel rotation)

a) Wheel guard strength test: wheel guard positions for wheel types 1, 27, 28, 29, 41 and 42



Key

A neutral **wheel guard** position

B initial **wheel guard** position (**wheel guard** turned 30° from neutral position against the direction of wheel rotation)

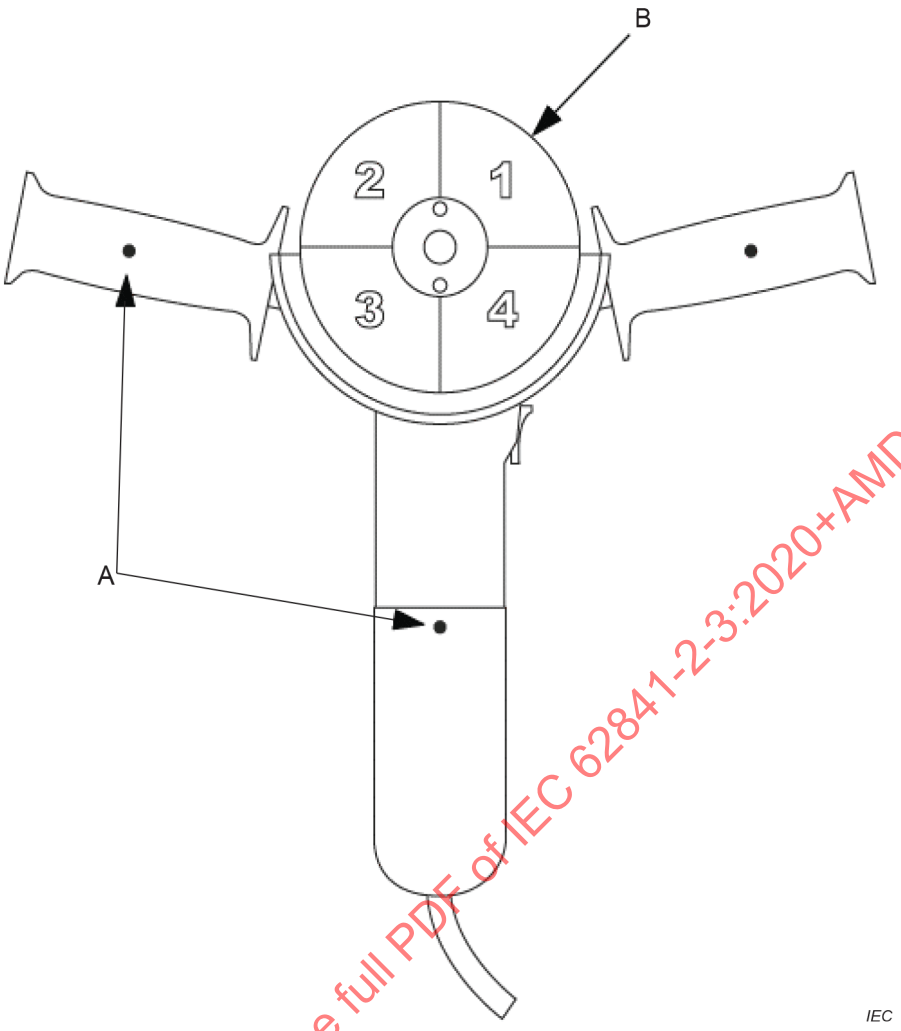
C direction of the wheel rotation

D maximum permissible **wheel guard** position after the test (90° from initial position in the direction of the wheel rotation)

b) Wheel guard strength test: wheel guard positions for cup wheel types 6 and 11

Figure 107 – Wheel guard strength test: explanation of wheel guard positions

*The maximum thickness grinding wheel in accordance with 8.14.2 a) 104) with a diameter equal to the **rated capacity** of the **grinder** shall be notched into four equal segments (quadrants). The width of each notch shall not exceed 2,5 mm. For **wheel types** 1, 27, 28, 29, 41, 42 and dual purpose wheels, the cut is directed from the outer edge radially towards the centre (see Figure 108). For **wheel types** 6 and 11, the cut starts across the working surface towards the mounting end (see Figure 109).*

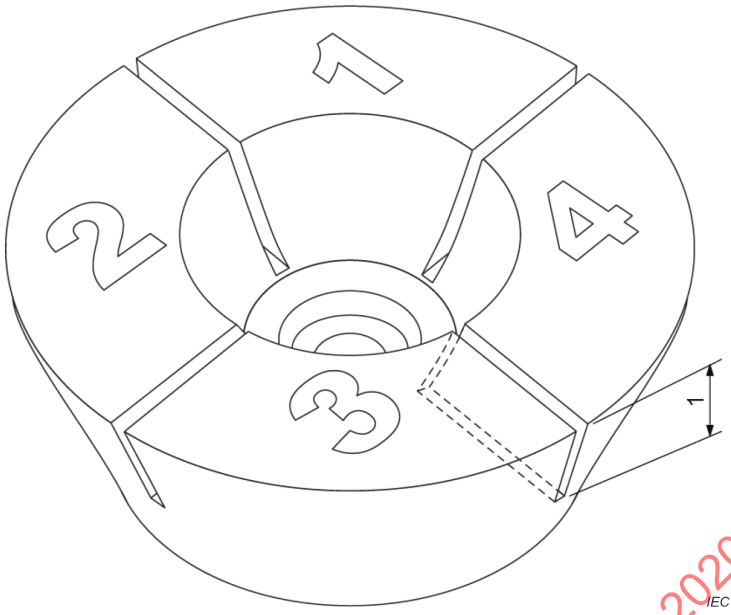


Key

A midpoints of the gripping zone

B grinding wheel quadrant

Figure 108 – Wheel guard strength test: preparation of the grinder



Key

1 cut

Figure 109 – Wheel guard strength test: preparation of cup wheel types 6 and 11

*The notched grinding wheel is mounted to the spindle with any mounting means that will allow for the centrifugal forces to cause the wheel to disintegrate at a speed equal to or greater than 90 % of the **rated no-load speed** of the **grinder**. The mounting means shall position the wheel at the same location relative to the **wheel guard** as would occur with the **flanges** recommended in accordance with the instructions in 8.14.2 b) 102).*

20.101.3 Table 104 provides typical pre-cut length ranges for standard wheel dimensions.

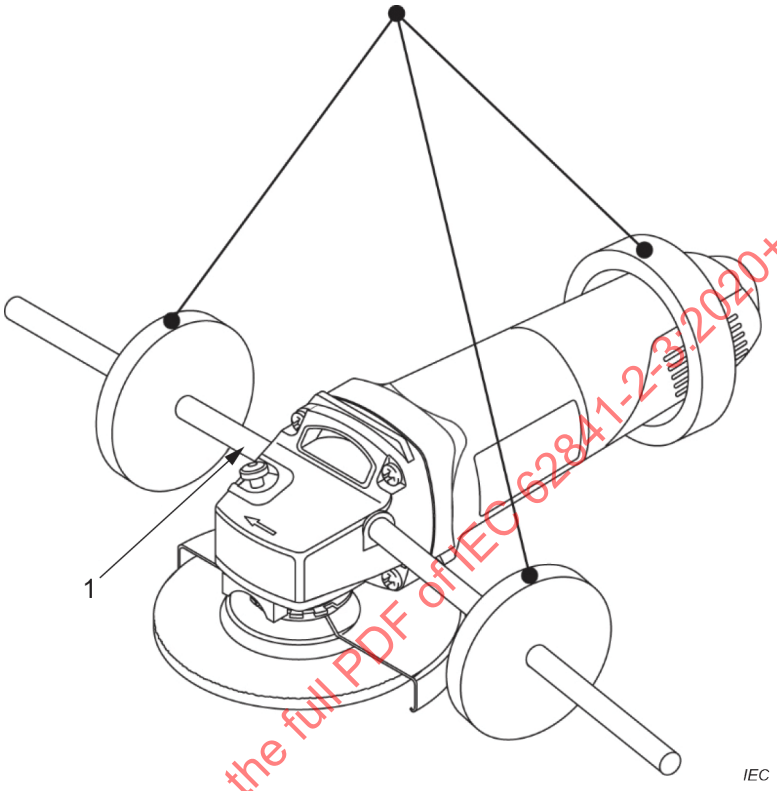
Table 104 – Typical pre-cut length ranges for standard wheel dimensions

Wheel type	Wheel dimensions (diameter × thickness × bore diameter) mm	Average burst speed min^{-1}	Pre-cut length range mm
Type 27	115 × 6 × 22,23	10 200	37,6 to 39,6
	125 × 6 × 22,23	9 800	42,7 to 45,7
	180 × 6 × 22,23	5 900	67,3 to 72,1
	230 × 6 × 22,23	5 700	83,3 to 93,5
Type 11	125 × 50 × 22,23	6 150	28
	150 × 50 × 22,23	5 400	30
Type 1	125 × 25 × 16	6 950	46
	155 × 25 × 16	5 800	57 to 60

20.101.4 *For **angle grinders** and **vertical grinders** with side handles, a mass of 1 kg is mounted at the midpoint of the **power switch** handle and a mass of 0,5 kg is mounted at the midpoint of a side handle installed on each side of the **grinder** (see Figure 108). Using a flexible nylon braided rope, the **grinder** is suspended at the midpoint of the gripping zone on each side handle and at the midpoint of the **power switch** handle.*

NOTE 101 The above test requires a second side handle or adaptor.

*For **angle grinders** and **vertical grinders** without side handles, a mass of 1 kg is attached at the midpoint of the **power switch** handle. An adaptor with simulated side handles as means of suspension and weight attachment of 0,5 kg at each side is to be provided for the test (see Figure 110). The adaptor shall have a mass as small as possible and be located at less than half the **rated capacity** distance behind the output spindle for **angle grinders** and **vertical grinders**. The suspension point and weight attachment on the left and right side of the tool are located at a distance from the centre of the spindle which is equivalent to **rated capacity** and at 90° to the centre line through the length of the tool.*



Key

1 adaptor

Figure 110 – Wheel guard strength test: angle grinders and vertical grinders without side handles

*The three suspension ropes are anchored to a single point and the tool is positioned inside a test box (see Figure 111). For **wheel guards** of Type D that cover 360° of the wheel's periphery, it is not required to position the tool inside the test box of Figure 111. In this case, the tool should be positioned inside a suitable enclosure for test operator safety.*

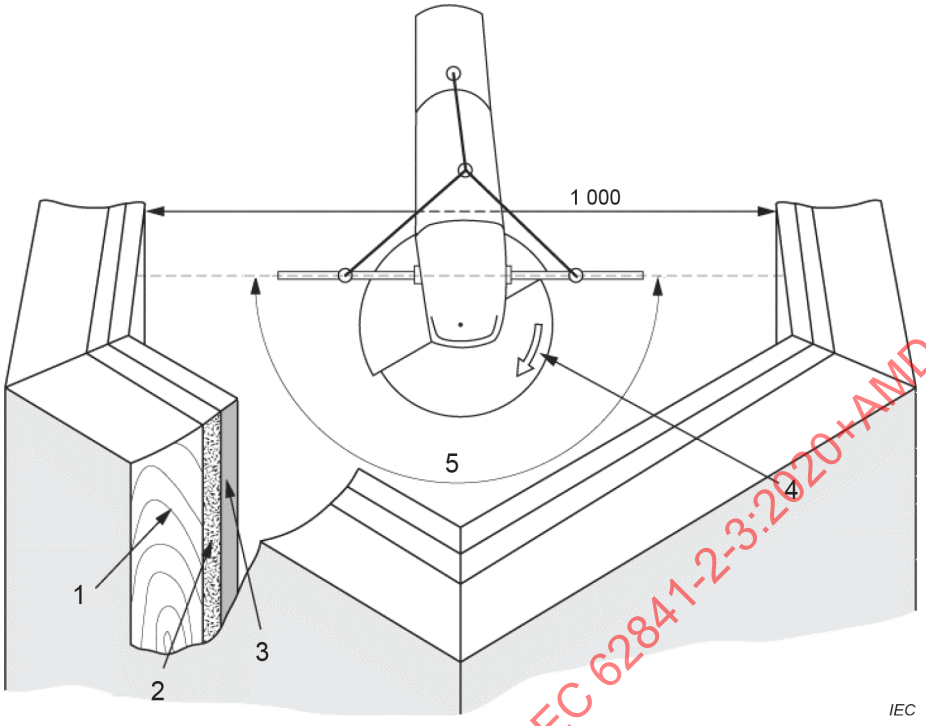
The test box, preferably with a hexagonal, octagonal or round shape, approximately 1 m in interior diameter and approximately 1 m deep, shall have an outer shell capable of restraining the disintegrating wheel segments and the interior surfaces, lined with material able to absorb and retain the wheel segments or the impression of the impacting segments (see Figure 111).

NOTE 102 An example of a material for the lining is a 25 mm to 35 mm thick layer of modelling clay, backed by an additional 25 mm to 35 mm thick layer of cork.

*An **angle grinder** or a **vertical grinder** with the mounted **wheel guard** and the notched wheel facing down in the horizontal plane is positioned with the wheel approximately in the centre and 300 mm from the bottom of the box (see Figure 111). To align the **grinder** inside the box and to prevent the **grinder** from twisting during the wheel's acceleration, the two side handles are secured to the box with a force less than 5 N.*

NOTE 103 One possible method to achieve the force necessary is the use of permanent magnets.

Dimensions in millimetres



Key

1 outer shell

2 cork

3 liner material

4 direction of the wheel rotation

5 fragment zone defined by midpoints of handles

Figure 111 – Wheel guard strength test box

As an alternative method, the use of a high-speed camera is allowed to fix the position of the tool just prior to the wheel burst.

20.101.5 *While monitoring the wheel speed with a tachometer, the speed of the tool is gradually increased until 90 % of the **rated no-load speed** of the **grinder** is achieved.*

If the wheel does not disintegrate at this specified speed,

– *stop the **grinder**, increase the length of the pre-cuts and repeat the test above; or*

– *at the manufacturer's option, continue increasing the wheel speed beyond the specified speed*

until the wheel bursts.

*Dust, **minor fragments** and segments remaining in the **wheel guard** are ignored. Most of the four major segments will be captured by the liner material wall. If any of the major segments rebound from the liner material, the segment's impression is to be identified. Afterward, the segments of the wheel in the liner material wall are removed.*

NOTE 101 Typically, the wheel will burst within 5 min.

20.101.6 *The **wheel guard** complies with the requirements of 20.101 if the following results a) to d) have been achieved:*

a) The speed of the wheel just prior to the wheel bursting is at least the speed specified in 20.101.5.

*b) The **wheel guard** and the fasteners or the **wheel guard's** mounting hardware shall remain mounted. Deformation, hairline cracks or scratches and gouges to the **wheel guard** and mounting hardware are acceptable.*

*c) The impression of the impact in the wall from the major wheel segments shall be within the fragment zone. The fragment zone is defined by extending a straight line through the midpoints of the two side handles onto the wall facing the unguarded wheel in the position of the **grinder** just prior to the wheel bursting (see Figure 111). For **wheel guards** of Type D that cover 360° of the wheel's periphery, this requirement is not applicable.*

*d) The **wheel guard** shall not have rotated in the direction of the wheel rotation by more than 90° (see Figures 107 a) and 107 b). If the **wheel guard** covers 360° of the wheel's periphery, the 90° limitation on the **wheel guard's** rotation is not applicable.*

NOTE 101 An example of a method to measure the rotation of the **wheel guard** is the use of a high-speed camera.

*If the **wheel guard** has failed any of the requirements in b) to d) above at a wheel burst speed that is above the speed specified in 20.101.5, the test shall be repeated using the method of increasing the length of the pre-cut segments.*

20.102 Strength of wheel guards of Type F

20.102.1 A **wheel guard** of Type F shall have sufficient mechanical strength to withstand a wheel breakage.

*For **wheel guards** intended for bonded reinforced wheels or intended for both **diamond cutting wheels** and bonded reinforced wheels, compliance is checked by submitting three samples of any recommended Type F **wheel guard** to the test specified in 20.102.2 to 20.102.5. At the manufacturer's discretion, the test may be conducted with three **wheel guards** but less than three separate **grinders**. After the test, the tool shall meet the acceptance criteria of 20.102.6.*

*For **wheel guards** intended only for **diamond cutting wheels**, compliance is checked either by:*

- *submitting three samples of the **wheel guard** to the test specified in 20.102.2 to 20.102.5, also using bonded reinforced wheels with a minimum thickness of 2,5 mm and a diameter approximately equal to the diameter of the **diamond cutting wheels** in accordance with 8.14.2 a) 101). After the test, the tool shall meet the acceptance criteria of 20.102.6; or*
- *meeting the design requirements in Table 105.*

Table 105 – Guard thickness for diamond cutting wheels

Material of wheel guard	Ultimate tensile strength N/mm^2	Minimum fracture elongation	Minimum thickness mm	
			Peripheral part	Side part
Metal	≥ 380	-	1,25	0,75
Metal	≥ 350 and < 380	-	1,50	1,00
Metal	≥ 200 and < 350	-	2,00	1,50
Metal	≥ 160 and < 200	-	2,50	1,75
Polycarbonate	60	80 %	3,00	2,00

20.102.2 *The **wheel guard** is mounted and securely fixed to the **grinder** in accordance with the instructions of 8.14.2 b) 104).*

*Regardless the intended wheel construction, a bonded reinforced wheel with the maximum thickness recommended in 8.14.2 a) 104) and with a diameter equal to the **rated capacity** of the **grinder** is mounted to the spindle in accordance with the instructions.*

*The **grinder** is operated at **rated voltage** for a minimum of 5 min. The speed of the wheel is measured and recorded.*

20.102.3 *The wheel as specified in 20.102.2 is notched into four equal segments (quadrants). The cut is directed from the outer edge radially towards the centre (see Figure 108). The width of each notch shall not exceed 2,5 mm. The extent of the notches shall allow for the centrifugal forces to cause the wheel to disintegrate at 90 % of the **rated no-load speed** of the **grinder**.*

*The notched grinding wheel is mounted to the spindle with any mounting means that will allow for the centrifugal forces to cause the wheel to disintegrate. The mounting means shall position the wheel at the same location relative to the **wheel guard** as would occur with the **flanges** recommended in accordance with 8.14.2 b) 102).*

20.102.4 *For **grinders** with side handles, a mass of 1 kg is mounted at the midpoint of the **power switch** handle and a mass of 0,5 kg is mounted at the midpoint of a side handle installed on each side of the **grinder**. Using a flexible nylon braided rope, the **grinder** is suspended at the midpoint of the gripping zone on each side handle and at the midpoint of the **power switch** handle.*

NOTE 101 The above test requires a second side handle or adaptor.

*The tool is suspended such that the foot of the **wheel guard** is facing downwards. The test is set up such that the operator is protected and so that any rebounding fragments do not affect the test result.*

20.102.5 *While monitoring the wheel speed with a tachometer, the speed of the tool is gradually increased until 90 % of the **rated no-load speed** of the **grinder** is achieved.*

If the wheel does not disintegrate,

- *stop the **grinder**, increase the length of the pre-cuts and repeat the test above; or*
- *at the manufacturer's option, continue increasing the wheel speed*

until the wheel bursts.

NOTE 101 Typically, the wheel will burst within 5 min.

20.102.6 *The **wheel guard** and the fasteners or the **wheel guard's** mounting hardware shall remain in place. Deformation, hairline cracks or scratches and gouges to the **wheel guard** and mounting hardware are acceptable.*

20.103 Strength of wheel guards of Type G

20.103.1 All **wheel guards** for **straight grinders** specified in accordance with 8.14.2 a) 101) shall have sufficient mechanical strength to prevent the wheel fragments from being ejected towards the operator in the event of the wheel breakage.

*Compliance is checked by submitting three samples of any recommended **wheel guard** to the test specified in 20.103.2 to 20.103.4. At the manufacturer's discretion, the test may be conducted with three **wheel guards** but less than three separate **grinders**. After the test, the tool shall meet the acceptance criteria of 20.103.5.*

20.103.2 *The **wheel guard** is mounted and securely fixed to the **grinder** in accordance with 8.14.2 b) 104). If the **wheel guard** is adjustable, it is positioned horizontal to the floor.*

*The maximum thickness grinding wheel in accordance with 8.14.2 a) 104) with a diameter equal to the **rated capacity** of the **grinder** is notched into four equal segments (quadrants). The width of each notch shall not exceed 2,5 mm. For **wheel type** 1, the cut is directed from the outer edge radially towards the centre (see Figure 108). For **straight grinders** intended to be used only with **wheel type** 4, the test is conducted with a **wheel type** 1 that has at least the same thickness as the thickest **wheel type** 4 in accordance with 8.14.2 a) 104) for that tool, measured in the centre of the wheel.*

*The notched grinding wheel is mounted to the spindle with any mounting means that will allow for the centrifugal forces to cause the wheel to disintegrate at a speed equal to or greater than 90 % of the **rated no-load speed** of the **grinder**. The mounting means shall position the wheel at the same location relative to the **wheel guard** as would occur with the **flanges** recommended in accordance with in 8.14.2 b) 102).*

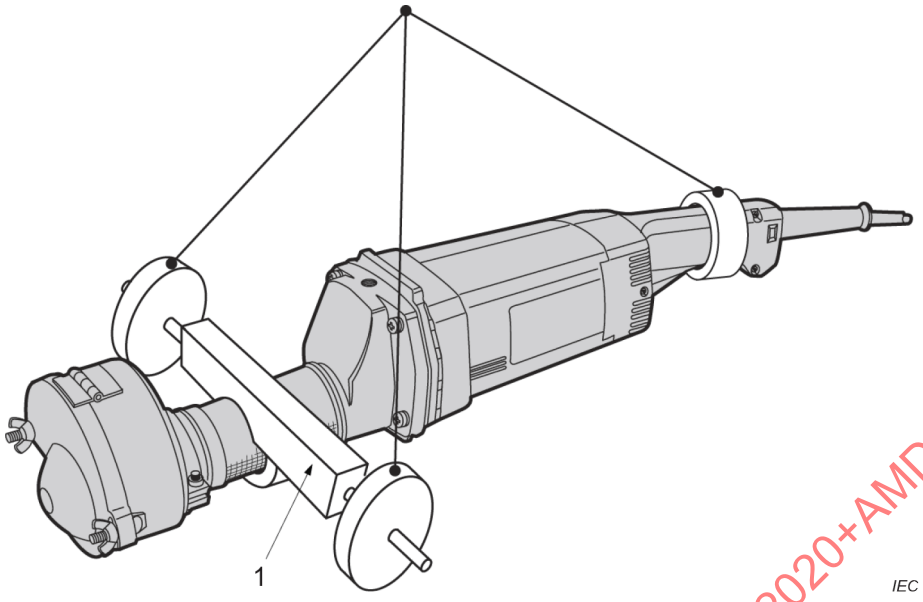
Table 106 provides typical pre-cut length ranges for standard wheel dimensions.

Table 106 –Typical pre-cut length ranges for standard wheel dimensions

Wheel type	Wheel dimensions (diameter × thickness × bore diameter) mm	Average burst speed min^{-1}	Pre-cut length range mm
Type 1	125 × 25 × 16	6 950	46
	155 × 25 × 16	5 800	57 to 60

20.103.3 *A mass of 1 kg is attached. An adaptor with means of suspension and weight attachment of 0,5 kg at each side is provided for the test (see Figure 112). The adaptor shall have a mass as small as possible and is located at the midpoint of the front gripping zone and less than half the **rated capacity** distance behind the output spindle. The suspension point and weight attachment on the left and right side of the tool is located at a distance from the centre of the spindle which is equivalent to **rated capacity** and at 90° to the centre line through the length of the tool.*

The three suspension ropes are anchored to a single point.



Key

1 adaptor

Figure 112 – Wheel guard strength test: straight grinder with additional masses

20.103.4 *While monitoring the wheel speed with a tachometer, the speed of the tool is gradually increased until 90 % of the **rated no-load speed** of the **grinder** is achieved. If the wheel does not disintegrate at this specified speed, stop the **grinder**, increase the length of the pre-cuts and repeat the test above until the wheel disintegrates. At the manufacturer's option, in place of stopping the **grinder** and increasing the length of the pre-cut segments, the wheel speed can be increased beyond the specified speed in order to cause the wheel to disintegrate.*

NOTE 101 Typically, the wheel will burst within 5 min.

20.103.5 *The **wheel guard** complies with the requirements of 20.103 if the following results a) to b) have been achieved:*

*a) the speed of the wheel just prior to the wheel bursting is at least 90 % of the **rated no-load speed**;*

*b) the **wheel guard** and the fasteners or the guard's mounting hardware shall remain mounted. Deformation, hairline cracks or scratches and gouges to the guard and mounting hardware are acceptable.*

*If the **wheel guard** has failed requirement b) at a wheel burst speed that was above the speed specified by in 20.103.2, the test shall be repeated using the method of increasing the length of the pre-cut segments.*

21 Construction

This clause of Part 1 is applicable, except as follows:

21.18.1 *Addition:*

For **angle grinders** and **vertical grinders** with a **rated capacity** not exceeding 100 mm and **straight grinders** with a **rated capacity** not exceeding 55 mm, **power switches** other than **momentary power switches** are permitted.

NOTE 101 In Japan, the following requirements apply:

21.18.1 *Addition:*

For **angle grinders** and **vertical grinders** with a **rated capacity** not exceeding 105 mm and **straight grinders** with a **rated capacity** not exceeding 55 mm, **power switches** other than **momentary power switches** are permitted.

21.18.1.1 *Replacement:*

For tools that are required to be fitted with a **momentary power switch** in accordance with 21.18.1, a lock-on device is allowed provided that two dissimilar actions are necessary to lock the **power switch** in the "on" position. In addition, only a single motion to the switch shall be required to automatically return to the "off" position.

For tools with both a lock-off and lock-on function, it shall not be possible to actuate both the

– lock-off function; and the
– lock-on function

with a single direction of motion, unless a distinct change in the direction of the motion is required to continue to the lock-on position

– after actuating the lock-off function; and
– before actuating the lock-on function.

NOTE An example of a design that fulfils this requirement is a slide-style **power switch** with integrated lock-off and lock-on features such that release of lock-off is achieved through an initial pressing or rocking motion, followed by a forward sliding motion that turns on the tool and permitting a lock-on function through a pressing or rocking motion near the end of the sliding action.

For mains-operated **grinders**, either

– the **power switch** shall automatically switch off the motor as soon as the actuating member of the switch is released and shall have no locking arrangement in the "on" position,

or

– the tool incorporates a lock-on device and shall not restart after an interruption of the mains supply without releasing the lock-on device and re-actuating the **power switch**.

*Compliance is checked by inspection, by manual test and for mains-operated **grinders** incorporating a lock-on device, by the following test.*

*The **grinder** is operated with the lock-on device engaged. The **grinder** is then disconnected from the mains for at least 2 s. The **grinder** is then reconnected to the mains. The tool shall not operate without releasing the lock-on device and re-actuating the **power switch**.*

21.18.1.2 *Replacement:*

For **grinders** and **disc-type sanders** with a **rated capacity** greater than 55 mm, **power switches** shall be so located or designed that inadvertent operation is unlikely to occur during lifting, carrying or when the tool is resting on a flat surface.

For all tools,

– it shall not be possible to start the tool when a sphere with a diameter of (100 ± 1) mm is applied to the **power switch** perpendicularly to the tool's surface where the switch is mounted with a lock off device engaged, if any; and

either

– the gripping length *L* of the grasping surface identified in accordance with 8.14.2 b) 6) immediately in front of or behind the **power switch** actuating member shall be a minimum of 70 mm. This length *L* includes

  - the straight line distance of any portion of the grasping surface that is straight or curved at a radius of greater than 100 mm; plus
  - the straight line distance of the length(s) *A* where the radius of the grasping surface is 10 mm to 100 mm, but each length *A* shall not exceed 10 mm. See Figures 113 and 114.

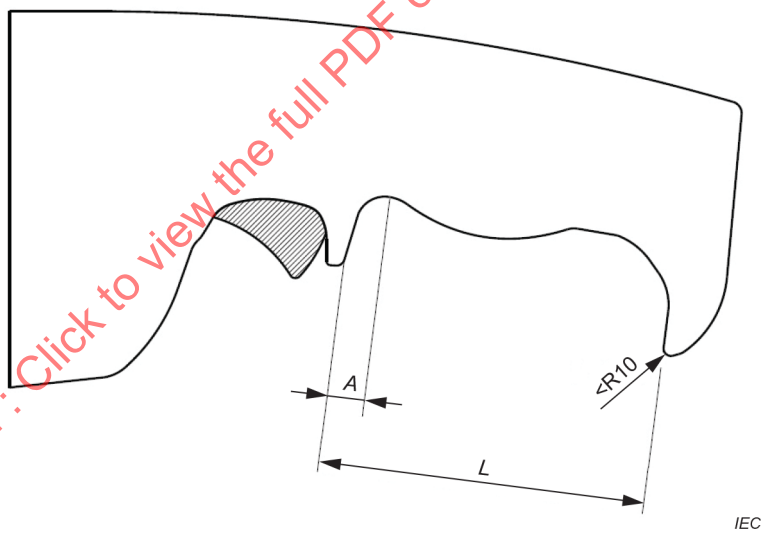
  If there are finger grips or similar superimposed profiles, the radius of the grasping surface shall not be measured along the surface, but only the arc(s) or straight line distance of the grasping surface, as applicable, shall be taken into account. See Figure 115;

or

– if the tool has a gripping length *L* less than 70 mm, it shall be provided with a lock-off device, where

  - two separate and dissimilar actions shall be necessary before the motor is switched on (e.g. a **power switch** which needs to be pushed in before it can be moved laterally to close the contacts to start the motor); and
  - it shall not be possible to achieve these two actions with a single grasping motion or a straight line motion; and
  - the lock-off device shall not be activated when the tool is in a stable resting position on a flat surface such that the **power switch** actuator is facing upwards.

Compliance is checked by inspection and by manual test.

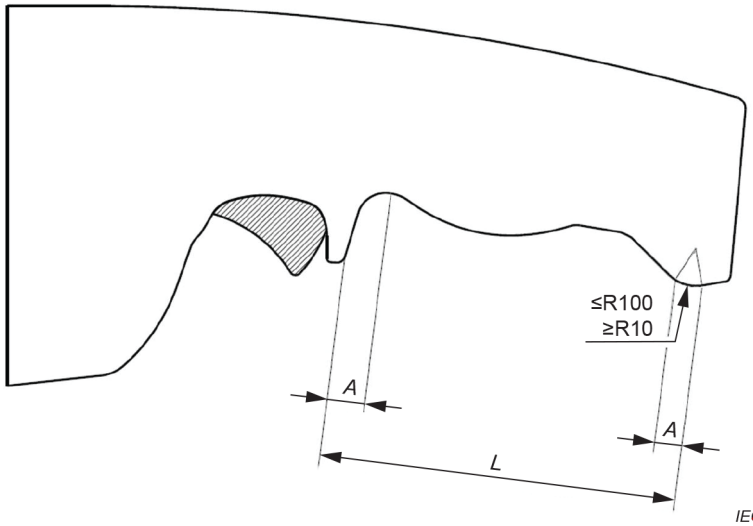


Key

L gripping length

A straight line distance of the length(s) where the radius of the grasping surface is 10 mm to 100 mm

Figure 113 – Measurement of handle gripping length

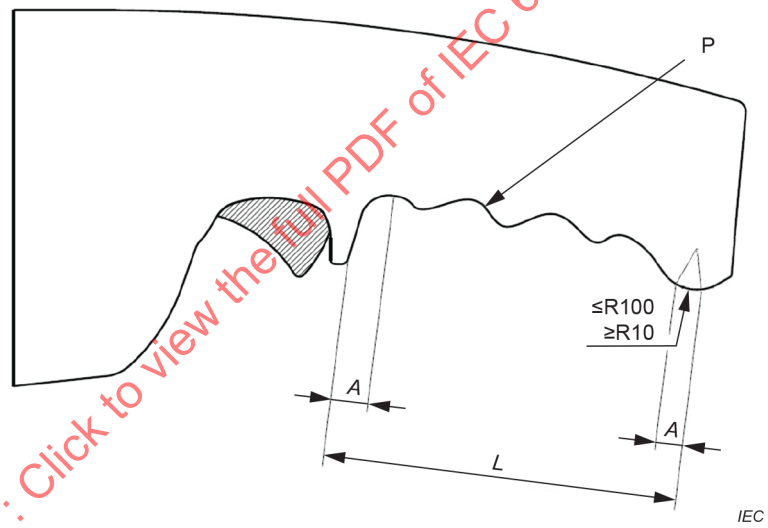


Key

L gripping length

A straight line distance of the length(s) where the radius of the grasping surface is 10 mm to 100 mm

Figure 114 – Measurement of handle gripping length



Key

L gripping length

A straight line distance of the length(s) where the radius of the grasping surface is 10 mm to 100 mm

P finger grips or similar superimposed profiles

Figure 115 – Measurement of handle gripping length for a handle with finger grips or similar superimposed profiles

21.30 *Modification:*

This subclause is not applicable for **disc-type polishers** and **disc-type sanders**, provided these tools are not intended to be used as a **grinder** as specified in the instructions in accordance with 8.14.1.101.2 a).

21.35 *Modification:*

This subclause is applicable only for

– **disc-type sanders** used exclusively for sanding wooden floors in accordance with 8.14.2 b) 107); and
– **grinders** intended to be used with a **wheel guard** of Type E or Type F in accordance with 8.14.2 a) 101).

22 Internal wiring

This clause of Part 1 is applicable.

23 Components

This clause of Part 1 is applicable, except as follows:

23.3 *Replacement of the first paragraph:*

Protection devices or circuits shall be of the non-self-resetting type unless the tool is equipped with a **momentary power switch** with no provision for being locked in the "on" position.

24 Supply connection and external flexible cords

This clause of Part 1 is applicable, except as follows:

24.4 *Replacement of the first paragraph:*

For **angle grinders** and **vertical grinders** with a **rated capacity** greater than 155 mm and for **straight grinders** with a **rated capacity** greater than 130 mm, the **supply cords** shall be not lighter than heavy polychloroprene-sheathed flexible cable (code designation 60245 IEC 66) or equivalent.

NOTE 101 In Europe (EN 62841-2-3), the following conditions apply:

For tools with a **rated capacity** greater than 155 mm, the **supply cord** shall be not lighter than heavy polychloroprene or PUR sheathed flexible cord (code designation 60245 IEC 66, H07RN-F or H07BQ-F) or equivalent.

NOTE 102 In the United States of America, the following conditions apply:

For tools with a **rated capacity** greater than 155 mm, the **supply cords** shall be oil, weather and water resistant hard service cord in accordance with the National Electrical Code, NFPA 70, such as SOOW or STOOW,

Attachment plugs and **supply cords** shall be equal to or greater than the rating of the tool.

NOTE 103 In Canada, the following conditions apply:

For tools with a **rated capacity** greater than 155 mm, the **supply cords** shall be oil, weather and water resistant extra hard usage cord in accordance with the Canadian Electrical Code, Part 1, such as SOOW or STOOW.

Attachment plugs and **supply cords** shall be equal to or greater than the rating of the tool.

25 Terminals for external conductors

This clause of Part 1 is applicable.