

INTERNATIONAL STANDARD

NORME INTERNATIONALE



**Hand-held motor-operated electric tools – Safety –
Part 2-3: Particular requirements for grinders, polishers and disk-type sanders**

**Outils électroportatifs à moteur – Sécurité –
Partie 2-3: Règles particulières pour les meuleuses, lustreuses et ponceuses du
type à disque**



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INTERNATIONAL ELECTROTECHNICAL COMMISSION

**HAND-HELD MOTOR-OPERATED ELECTRIC TOOLS –
SAFETY –****Part 2-3: Particular requirements for grinders,
polishers and disk-type sanders**

FOREWORD

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This consolidated version of IEC 60745-2-3 consists of the second edition (2006) [documents 61F/624/FDIS and 61F/634/RVD], its amendment 1 (2010) [documents 116/53/FDIS and 116/56/RVD], its corrigendum of February 2011, and its amendment 2 (2012) [documents 116/89/FDIS and 116/95/RVD]. It bears the edition number 2.2.

The technical content is therefore identical to the base edition and its amendments and has been prepared for user convenience. A vertical line in the margin shows where the base publication has been modified by amendments 1 and 2. Additions and deletions are displayed in red, with deletions being struck through.

International Standard IEC 60745-2-3 has been prepared by subcommittee 61F: Safety of hand-held motor-operated electric tools, of IEC technical committee 61: Safety of household and similar electrical appliances.

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

This part 2 is to be used in conjunction with the latest edition of IEC 60745-1, *Hand-held motor-operated electric tools – Safety – Part 1: General requirements*, and its amendments. It was established on the basis of the third edition (2001) of that standard.

NOTE 1 When “Part 1” is mentioned in this standard, it refers to IEC 60745-1.

This part 2 supplements or modifies the corresponding clauses of IEC 60745-1, so as to convert that publication into the IEC standard: Safety for grinders, polishers and disk-type sanders.

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

NOTE 2 The following numbering system is used:

- subclauses, tables and figures that are numbered starting from 101 are additional to those in Part 1;
- additional annexes are lettered AA, BB, etc.

NOTE 3 In this standard, the following print types are used:

- requirements: in roman type;
- *test specifications: in italic type;*
- notes: in smaller roman type.

Words in **bold** in the text are defined in Clause 3. When a definition concerns an adjective, the adjective and the associated noun are also in bold.

IEC 60745 consists of the following parts, under the general title *Hand-held motor-operated electric tools – Safety*:

- Part 1: General requirements
- Part 2-1: Particular requirements for drills and impact drills
- Part 2-2: Particular requirements for screwdrivers and impact wrenches
- Part 2-3: Particular requirements for grinders, polishers and disk-type sanders
- Part 2-4: Particular requirements for sanders and polishers other than disk type
- Part 2-5: Particular requirements for circular saws and circular knives
- Part 2-6: Particular requirements for hammers
- Part 2-7: Particular requirements for spray guns for non-flammable liquids
- Part 2-8: Particular requirements for shears and nibblers
- Part 2-9: Particular requirements for tappers
- Part 2-11: Particular requirements for reciprocating saws (jig and sabre saws)
- Part 2-12: Particular requirements for concrete vibrators
- Part 2-13: Particular requirements for chain saws
- Part 2-14: Particular requirements for planers
- Part 2-15: Particular requirements for hedge trimmers and grass shears
- Part 2-16: Particular requirements for tackers
- Part 2-17: Particular requirements for routers and trimmers
- Part 2-18: Particular requirements for strapping tools

Part 2-19: Particular requirements for jointers

Part 2-20: Particular requirements for band saws

Part 2-21: Particular requirements for drain cleaners

The amendment modifies the present part 2-3 to ensure its conformity with the fourth edition (2006) of IEC 60745-1, *Hand-held motor-operated electric tools – Safety – Part 1: General requirements*.

The committee has decided that the contents of the base publication and its amendments will remain unchanged until the stability date indicated on the IEC web site under "<http://webstore.iec.ch>" in the data related to the specific publication. At this date, the publication will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

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HAND-HELD MOTOR-OPERATED ELECTRIC TOOLS – SAFETY –

Part 2-3: Particular requirements for grinders, polishers and disk-type sanders

1 Scope

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

~~1.1 Addition:~~

~~This standard applies to grinders, with a rated speed not exceeding a peripheral speed of the accessory of 80 m/s at rated capacity, polishers and disk-type sanders, including angle, straight and vertical. This standard applies to tools with a rated capacity not exceeding 230 mm.~~

~~This standard does not apply to random-orbit polishers and random-orbit sanders. These are covered by IEC 60745-2-4.~~

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

Addition:

This standard applies to grinders, polishers and disk-type sanders, including angle, straight and vertical tools, with a rated capacity not exceeding 230 mm. For grinders, the rated speed does not exceed a peripheral speed of the accessory of 80 m/s at rated capacity.

This standard does not apply to dedicated cut-off machines which are covered by IEC 60745-2-22.

This standard does not apply to random-orbit polishers and random-orbit sanders which are covered by IEC 60745-2-4.

This standard does not apply to die grinders utilizing collets or chucks for mounting threaded cones and mandrel mounted wheels which are covered by IEC 60745-2-23.

2 Normative references

This clause of Part 1 is applicable except as follows:

Addition:

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

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

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

~~ANSI B7.1:2000, Safety Requirements for the Use, Care and Protection of Abrasive Wheels~~

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

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

disk-type sander

tool, constructed like a grinder, intended for sanding

3.102.1

angle disk-type sander

tool with the rotating spindle at a right angle to the motor shaft, intended for lateral sanding

3.102.2

straight disk-type sander

tool with the rotating spindle in-line with the motor shaft, intended for peripheral or lateral sanding

3.102.3

vertical disk-type sander

tool with the rotating spindle in-line with the motor shaft, intended for lateral sanding

3.103

flange

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

3.103.1

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

3.103.2

recessed flange

flange fixed to the machine spindle having a recessed flat surface

3.103.3

flange outside diameter

outside diameter of the contact surface of a flange

3.103.4

backing flange

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

3.103.5

locking flange

supports the front side of the wheel and secures and clamps the wheel to the spindle and the backing flange

3.104
grinder

tool driving a rotating spindle on which a bonded abrasive product is mounted

3.104.1
angle grinder

tool with the rotating spindle at a right angle to the motor shaft, intended for peripheral and lateral grinding

3.104.2
straight grinder

tool with the rotating spindle in-line with the motor shaft, ~~either~~ equipped with an abrasive wheel intended for peripheral grinding, ~~or but not~~ equipped with a collet or chuck ~~intended for use with mounted wheels, points or burrs~~

3.104.3
vertical grinder

tool with the rotating spindle in-line with the motor shaft, intended for ~~peripheral and~~ lateral grinding

3.105
~~mounted wheels~~

~~various shapes and sizes that may be either organic or inorganic bonded abrasives and are mounted on a mandrel or threaded onto a mandrel~~

~~threaded wheels~~

~~organic or inorganic bonded abrasives of various types provided with a threaded insert for direct mounting to the grinder spindle~~

3.106
polisher

tool equipped with a rotating disk or pad intended for polishing

3.106.1
angle polisher

tool with the rotating spindle at a right angle to the motor shaft, intended for peripheral and lateral polishing

3.106.2
straight polisher

tool with the rotating spindle in-line with the motor shaft, intended for peripheral polishing

3.106.3
vertical polisher

tool with the rotating spindle in-line with the motor shaft, intended for lateral polishing

3.107
rated capacity

maximum diameter of the rotating accessory to be fitted on the tool as recommended by the manufacturer's instruction

3.108
~~rated speed~~

~~maximum attainable speed, with any recommended accessory installed, at rated voltage or at the upper limit of the rated voltage range designated by the manufacturer~~

rated speed

maximum attainable speed as designated by the manufacturer, with any recommended accessory installed, at rated voltage or at the upper limit of the rated voltage range

3.109

wheel guard

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

3.110

wheel types

wheels for different applications in accordance with ISO 603-12, ISO 603-14, ISO 603-16 or ANSI B-7.1 74.2

3.111

minor fragment

particles less than 1/16 of the mass of the abrasive wheel

4 General requirements

This clause of Part 1 is applicable.

5 General conditions for the tests

This clause of Part 1 is applicable.

6 Void

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 speed in revolutions per minute. Tools designed for operation at more than one rated speed shall be marked with the rated speed for each of the speed settings in such a way that it is clear which speed corresponds with each of the settings;~~
- ~~— rated capacity in mm;~~
- ~~— indication of direction of rotation of the spindle. This shall be indicated by an arrow, raised or sunk, or by any other means no less visible and indelible;~~
- ~~— tools provided with a threaded spindle shall be marked with spindle thread size;~~
- ~~—  **WARNING** Always wear eye protection" or the sign M004 of ISO 7010¹.~~

8.1 Addition:

Tools shall also be marked with:

- rated speed in revolutions per minute;
- rated capacity in mm;

¹ The future safety sign M004 is currently in DIS stage as ISO 7010:2003/DAMD6.

- tools provided with a threaded spindle shall be marked with the spindle thread size;
- “ **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.

8.6 Addition:

n.....rated speed

~~8.12.1 Addition:~~

~~For the following safety instructions specified in 8.12.1.101 to 8.12.1.107, the terms like grinding/grinder, sanding/sander, wire brushing/wire brush, polishing/polisher or cutting-off/cut-off tool, are selected as recommended by the manufacturer. These terms in the warnings and headings must be consistently used or deleted based on the selected operations. The “and”/“or” conjunctions may be used as appropriate.~~

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

8.12.1 Addition:

For the following safety instructions specified in 8.12.1.101 to 8.12.1.107, terms such as grinding/grinder, sanding/sander, wire brushing/wire brush, polishing/polisher or cutting-off/cut-off tool are selected as recommended 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 recommended only for one of the listed operations, the heading of that section is to be used for all warnings.

8.12.1.101 Safety instructions for all operations

Safety Warnings Common for Grinding, Sanding, Wire Brushing, Polishing or Abrasive Cutting-Off Operations:

NOTE In the above heading, those operations not applicable may be omitted.

- This power tool is intended to function as a grinder, sander, wire brush, polisher 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 List only those operations that are recommended.

- ~~Operations such as grinding, sanding, wire brushing, polishing or cutting-off are not recommended 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 List only those operations that were not included in the first warning. If all listed operations are recommended, then this warning may be omitted but all subsequent warnings must be given without an exclusion.~~

Operations such as grinding, sanding, wire brushing, polishing or cutting-off are not recommended 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 List only those operations that were not included in the first warning. If all listed operations are recommended, then this warning may be omitted, but all subsequent warnings are to be given without exclusion.

- c) **Do not use accessories which are not specifically designed and recommended by the tool manufacturer.** *Just because the accessory can be attached to your power tool, it does not assure safe operation.*
- d) **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.*
- e) **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.*
- f) ~~The arbour size of wheels, flanges, backing pads or any other accessory must properly fit the spindle of the power tool. Accessories with arbour holes that do not match the mounting hardware of the power tool will run out of balance, vibrate excessively and may cause loss of control~~

Threaded mounting of accessories must match the grinder spindle thread. For accessories mounted by flanges, the arbour hole of the accessory must fit the locating diameter of the flange. 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.

- g) **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.*
- h) **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 operations. The dust mask or respirator must be capable of filtering particles generated by your operation. Prolonged exposure to high intensity noise may cause hearing loss.*
- i) **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.*
- j) ~~Hold 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 shock the operator.~~

NOTE—The above warning may be omitted if polishing is the only recommended operation.

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 The above warning may be omitted if polishing or sanding are the only recommended operations.

- k) **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.*
- l) **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.*
- m) **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.*

- n) **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.*
- o) **Do not operate the power tool near flammable materials.** *Sparks could ignite these materials.*
- p) **Do not use accessories that require liquid coolants.** *Using water or other liquid coolants may result in electrocution or shock.*

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

8.12.1.102 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 on the power tool and position your body and arm 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 or toothed saw blade.** *Such blades create frequent kickback and loss of control.*

8.12.1.103 Additional safety instructions for grinding and cutting-off operations

NOTE If grinding and cut-off operations are not recommended by the manufacturer, this section may be omitted.

Safety Warnings Specific for Grinding and Abrasive Cutting-Off Operations:

- a) **Use only wheel types that are recommended 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.*
- b)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 operator from broken wheel fragments and accidental contact with wheel.**~~

NOTE—The above warning may be omitted for die grinders and grinders or cut-off grinders with rated capacity of less than 55 mm.

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 The above warning may be omitted for grinders or cut-off grinders with a rated capacity of less than 55 mm.

- e)d) **Wheels must be used only for recommended 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.**
- d)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.**
- e)f) **Do not use worn down wheels from larger power tools. Wheel intended for larger power tool is not suitable for the higher speed of a smaller tool and may burst.**

8.12.1.104 Additional safety instructions for cutting-off operations

NOTE If cutting-off operation is not recommended by the manufacturer, this section may be omitted.

Additional Safety Warnings Specific for Abrasive 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 wheel is binding or when interrupting a cut for any reason, switch off the power tool and hold the power tool 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 reenter the cut. The wheel may bind, walk up or kickback if the power tool is restarted in the workpiece.**~~
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.**

8.12.1.105 Additional safety instructions for sanding operations

NOTE If sanding operation is not recommended by the manufacturer, this section may be omitted.

Safety Warnings Specific for Sanding Operations:

- a) **Do not use excessively oversized sanding disc paper. Follow manufacturers recommendations, when selecting sanding paper. Larger sanding paper extending beyond the sanding pad presents a laceration hazard and may cause snagging, tearing of the disc or kickback.**

8.12.1.106 Additional safety instructions for polishing operations

NOTE If polishing operation is not recommended by the manufacturer, this section may be 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.**

8.12.1.107 Additional safety instructions for wire brushing operations

NOTE If wire brushing operation is not recommended by the manufacturer, this section may be 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 recommended 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.**

8.12.2 a) Addition:

~~101) Recommended diameter of accessories for the tool~~

101) Types of accessories in accordance with 8.12.1.101 a)

102) Thickness and diameter of grinding wheels

8.12.2 b) Addition:

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

102) ~~Mounting of accessories and use of the correct flanges, use and care of the abrasive product~~

Information about the specific flanges to be used with all wheel types in accordance with 8.12.2 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) ~~Instruction for the proper type of guard for the type of wheel being used, mounting and positioning of the guard e.g. operator's position to the guard opening~~

For all wheels specified in accordance with 8.12.2 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 to the operator on the use of all the different types of wheels recommended in the instruction sheet e.g. side grinding, peripheral grinding~~

For all operations listed in accordance with 8.12.1.101 a), where the use of a guard is required, instruction for the proper type of guard to be used

105) Instruction for the mounting and securing of the guard identifying allowable adjustments to ensure maximum protection of the operator

~~105~~ 106) Instruction on proper support for the workpiece

~~106~~ 107) In case of cup-wheels, cones or plugs with a threaded hole intended to be mounted on the machine spindle, critical dimensions and other data shall be given in order to prevent the spindle end from touching the bottom of the ~~mounting~~ hole of the abrasive product

~~107~~ 108) For disk-type sanders exclusively intended for sanding wooden floors, an instruction stating how to connect the external dust collection equipment where applicable

8.12.2 c) Addition:

101) Storage and handling of recommended accessories

8.101 Tools shall also be marked with an indication of direction of rotation of the spindle. This shall be indicated by an arrow, raised or sunk, or by any other means no less visible and indelible.

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, except as follows:

12.4 Replacement:

The tool is operated at rated input or rated current for 30 min. The temperature rises are measured at the end of the 30 min.

13 Leakage current

This clause of Part 1 is applicable.

14 Moisture resistance

This clause of Part 1 is applicable.

15 Electric strength

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:

~~18.10 Addition:~~

~~During these tests, the speed of the spindle shall not exceed 120 % of the rated speed.~~

~~18.10.4 Addition:~~

~~During these tests, the speed of the spindle shall not exceed 120 % of the rated speed. The accessory in accordance with 8.12.2 a) 101) that results in the maximum speed shall be installed.~~

19 Mechanical hazards

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

19.1 Modification:

The second sentence of the second paragraph does not apply to wheel guards which are covered in 19.101.

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.

~~19.101 Grinders with a rated capacity exceeding 55 mm shall be provided with a wheel guard to protect the user during normal use against:~~

- ~~— accidental contact with the abrasive product;~~
- ~~— ejection of fragments of the abrasive product;~~
- ~~— sparks and other debris.~~

~~The wheel guard (hereafter referred to as a guard) may be removable either with the aid of a tool or by fulfilling the following requirements:~~

- ~~— two separate and dissimilar actions shall be required to remove the guard, e.g. pushing a lever and turning the guard;~~
- ~~— for removal, the guard shall be turned to a position that does not occur in normal operation.~~

~~The guard shall fulfil the following requirements:~~

- ~~— be designed so that in case of a wheel burst the guard shall reduce the risk of injury to the operator and remain attached to the grinder by effective and secure means and comply with the test of 20.101;~~
- ~~— to change the abrasive wheel, it shall not be necessary to remove the guard from the tool;~~
- ~~— be designed so that the risk of an accidental contact between the operator and the wheel during normal use is minimized e.g. by a possibility of adjustment;~~

~~the clearance between the inside of the guard and the periphery of a new abrasive product with the maximum diameter as specified by the manufacturer shall be a 8 mm maximum for wheel diameters not exceeding 130 mm and shall be a 10 mm maximum for wheel diameters exceeding 130 mm.~~

~~For wheel Type 1 (grinding wheels) and wheel Types 41 and 42 (cutting-off wheels), the guard shall cover at least 175° of the abrasive wheel periphery and both sides of the wheel. The front curtain shall be designed to facilitate easy replacement of the wheel. Enclosure of the spindle end, nut and the locking flange is not required. See Figure 101.~~

~~For wheel Types 27, 28 and 29, the guard shall cover at least 175° of the abrasive wheel periphery and shall have a front lip of at least 3 mm from inner surface measured radially. The face of the thickest recommended wheel shall be at least 2 mm axially from the inner surface of the lip. The ends of the lip protruding the thickest recommended wheel may be chamfered by not more than 45°. See Figure 102.~~

~~For wheel Types 6 and 11 (straight and flaring cup wheels), the guard shall cover at least 240° of the abrasive wheel periphery, see Figure 103. The guard shall be continuously adjustable to compensate for the wear of the wheel and to restrict the exposure of the wheel to a minimum.~~

~~Compliance is checked by inspection and by measurement.~~

~~**19.102** The tool shall be designed so as to prevent the abrasive product coming loose under normal use.~~

~~Grinding wheels shall be mounted to the spindle of the grinder between flanges that meet the requirements of 19.104 and 19.105, unless the wheels are of one of the following designs:~~

- ~~— organic or inorganic bonded wheels secured to plain or threaded mandrels;~~
- ~~— non-reusable plate mount or threaded nut affixed to the wheel by the manufacturer;~~
- ~~— threaded hole or modified cup wheels.~~

~~Compliance is checked by inspection.~~

~~**19.103** Spindles shall be designed so that they provide for or aid in securing and driving the abrasive products designed for the tool.~~

~~The direction of spindle threads or the design of an equivalent securing means shall be such that any clamping device, collet or wheel with threaded hole tends to tighten during working.~~

~~Compliance is checked by inspection.~~

~~In order to limit vibration due to unbalance of the abrasive product, the total possible eccentricity of the parts locating the abrasive product against the true running centre of the spindle shall be less than 0,3 mm.~~

~~The total eccentricity may be influenced by the eccentricity of the spindle and by the dimension tolerances for the spindle diameter, the diameter of the flange bore and the diameter of the part of the flange which locates and guides the abrasive product.~~

~~Compliance is checked by measurement.~~

~~**19.104** Flanges required by 19.102 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 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 and 19.104.2 and illustrated in Figure 104, where D is the outside diameter and H the bore diameter of the abrasive wheel. 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 backing and the locking flange shall have the same diameter D_f or the overlap of the backing and locking flange bearing surfaces shall be at least equal to dimension C .~~

~~In order to prevent interference, the locking flange and/or nut shall not extend beyond the plane defined by the lip of the guard when mounted with the thickest recommended Type 27, 28 or 29 wheel.~~

~~19.104.1 The flange dimensions for wheel Type 1 shall be:~~

~~$$D_f \geq 0,33 D$$~~

~~The flange diameter for wheel Types 6, 11, 27, 28, 29, 41 and 42 shall be:~~

~~$$D_f = (20 \pm 1) \text{ mm} \text{ for } 55 \text{ mm} \leq D < 80 \text{ mm}$$~~

~~$$D_f = (20 \pm 1) \text{ mm} \text{ for } 80 \text{ mm} \leq D < 105 \text{ mm for wheels with a bore diameter of } 10 \text{ mm (3/8 in UNC)}$$~~

~~$$D_f = (29 \pm 1) \text{ mm} \text{ for } 80 \text{ mm} \leq D < 105 \text{ mm for wheels with a bore diameter of } 16 \text{ mm (5/8 in UNC)}$$~~

~~$$D_f = (41 \pm 1) \text{ mm} \text{ for } 105 \text{ mm} \leq D \leq 230 \text{ mm}$$~~

~~For wheel Type 41, the D_f dimension may exceed the above values.~~

~~19.104.2 The dimensions C and G in Figure 104 of flanges for all wheel types shall be:~~

~~$$3 \text{ mm} \leq C \leq \frac{D_f - H - 2G}{2}$$~~

~~NOTE The formula is based on the concept that the radial clearance of the recess is at least equal to its depth.~~

~~$$G \geq 1 \text{ mm} \text{ for } D_f < 50 \text{ mm}$$~~

~~$$G \geq 1,5 \text{ mm} \text{ for } D_f \geq 50 \text{ mm}$$~~

~~For wheel Type 41, the C dimension may exceed the above values.~~

~~19.104.3 An adaptor backing flange designed in accordance with Figure 105 may be used in place of the backing 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 and shall contact the wheel by the bearing surface at C and the bearing surface at the periphery of the flange C_1 . The adaptors are exempt from the flange strength test specified in 19.105.~~

19.101 Grinders with a rated capacity exceeding 55 mm shall be provided with at least one wheel guard to protect the user during normal use against:

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

If the tool is supplied with one or more accessories, the wheel guard(s) supplied shall be appropriate for the supplied accessory(ies). The wheel guard (hereafter referred to as a guard) may be removable either with the aid of a tool or by fulfilling the following requirements:

- two separate and dissimilar actions shall be required to remove the guard, e.g. pushing a lever and turning the guard;
- for removal, the guard shall be turned to a position that does not occur in normal operation.

The guard shall also fulfil the following requirements:

- be designed so that, in case of a wheel burst, the guard reduces the risk of injury to the operator, remains attached to the grinder by effective and secure means and complies with the test of 20.101;
- facilitate the change of the abrasive wheel without the need to remove the guard;
- be designed so that the risk of an accidental contact between the operator and the wheel during normal use is minimized e.g. by a possibility of adjustment.

To prevent the installation of an oversized wheel, the clearance between the inside of the guard and the periphery of a new abrasive product in accordance with 8.12.2 a) 101) shall, in at least one location, be 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.

For wheel Type 1 (grinding wheels) and wheel Types 41 and 42 (cutting-off wheels), the guard shall cover at least 175° of the abrasive wheel periphery and both sides of the wheel. The front curtain shall be designed to facilitate easy replacement of the wheel. Enclosure of the spindle end, nut and the locking flange is not required. See Figure 101.

For wheel Types 27, 28 and 29, the guard shall cover the abrasive wheel periphery and the backing flange side for at least 175°. The 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 8.12.2 a) 102), with the inner surface of the guard to the inner edge of the lip, measured radially. The face of the thickest recommended wheel shall be at least 2 mm axially from the inner surface of the lip. The ends of the lip protruding the thickest recommended wheel may be chamfered by not more than 45°. See Figure 102.

For diamond cutting-off wheels, either one of the two guards above is acceptable.

For wheel Types 6 and 11 (straight and flaring cup wheels), the guard shall cover at least 240° of the abrasive wheel periphery, see Figure 103. The 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.

Compliance is checked by inspection and by measurement. The guard coverage angle is measured with the vertex at the centre of the spindle and extended to the guard periphery.

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

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

Flanges are not required with the following designs:

- non-reusable plate mount or threaded nut affixed to the wheel by the manufacturer;
- threaded hole or modified cup wheels.

Compliance is checked by inspection.

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

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.

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 speeds less than 15 000 min⁻¹;
- 0,15 mm for rated speeds from 15 000 min⁻¹ to less than 25 000 min⁻¹;
- 0,10 mm for rated speeds 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.

19.104 Flanges required by 19.102 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 and 19.104.2 and illustrated in Figure 104, 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. If the clamping surface of the locking 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.

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 backing and the locking flange shall have the same diameter D_f or the overlap of the backing and locking flange bearing surfaces shall be at least equal to dimension C .

In order to prevent interference, the locking flange and/or nut shall not extend beyond the plane defined by the lip of the guard when mounted with the thickest recommended Type 27, 28 or 29 wheel.

19.104.1 The flange dimensions for wheel Type 1 shall be:

$$D_f \geq 0,33 D$$

The flange diameter for wheel Types 6, 11, 27, 28, 29, 41 and 42 shall be:

$$D_f = (20 \pm 1) \text{ mm} \quad \text{for } 55 \text{ mm} \leq D < 80 \text{ mm}$$

$$D_f = (20 \pm 1) \text{ mm} \quad \text{for } 80 \text{ mm} \leq D < 105 \text{ mm for wheels with a bore diameter of } 10 \text{ mm (3/8" in UNC)}$$

$$D_f = (29 \pm 1) \text{ mm} \quad \text{for } 80 \text{ mm} \leq D < 105 \text{ mm for wheels with a bore diameter of } 16 \text{ mm (5/8" in UNC)}$$

$$D_f = (41 \pm 1) \text{ mm} \quad \text{for } 105 \text{ mm} \leq D \leq 230 \text{ mm}$$

For wheel Type 41, the D_f dimension may exceed the above values for backing and locking flanges. For all other wheel types, the diameter D_f may exceed the above values for backing flanges only.

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

The flange dimensions for wheel Type 1 that are thicker than 5 mm shall be:

$$D_f \geq 0,33 D$$

The flange diameter for wheels Type 1 that are 5 mm and thinner and Types, 6, 11, 27, 28, 29, 41, and 42 (27A) shall be:

$$D_f = (20 \pm 1) \text{ mm for } 55 \text{ mm} \leq D < 80 \text{ mm}$$

$$D_f = (20 \pm 1) \text{ mm for } 80 \text{ mm} \leq D < 105 \text{ mm for wheels with a bore diameter of } 10 \text{ mm (3/8 in UNC)}$$

$$D_f = (29 \pm 1) \text{ mm for } 80 \text{ mm} \leq D < 105 \text{ mm for wheels with a bore diameter of } 16 \text{ mm (5/8 in UNC)}$$

$$D_f = (41 \pm 1) \text{ mm for } 105 \text{ mm} \leq D \leq 230 \text{ mm}$$

For wheel Types 1 and 41, the D_f dimension may exceed the above values for backing and locking flanges. For all other wheel types the diameter D_f may exceed the above values for backing flanges only.

19.104.2 The dimensions C , G and W in Figure 104 shall be:

$$C \geq 3 \text{ mm}$$

$$W \geq 1 \text{ mm}, G \geq 1 \text{ mm} \quad \text{for } D_f < 50 \text{ mm}$$

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

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

Compliance of the requirements in 19.104, 19.104.1 and 19.104.2 is checked by measurement.

19.105 Flanges required by 19.102 shall be designed so that they are of adequate strength.

Compliance is checked by the following test.

The grinder shall be fitted with a steel disc having an equal thickness and shape as the abrasive product.

The clamping nut shall be tightened with a first test torque according to Table 101. A feeler gauge of a thickness of 0,05 mm shall be 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 shall be further tightened to the second test torque according to Table 101. A feeler gauge of a thickness of 0,05 mm shall be 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 101 – Torques for testing flanges

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

~~19.106 The tool shall be designed so as to prevent excessive speed under normal use.~~

~~The speed of the tool shall not exceed 110 % of the rated speed under any operating condition.~~

~~Compliance is checked by inspection and by measuring the speed after the tool is operated for a period of 5 min. The recommended accessory that produces the maximum speed shall be installed.~~

~~If the tool is provided with a load sensitive speed control, then an accessory need not be installed to load the tool to find maximum speed.~~

19.6 Replacement:

The tool shall be designed so as to prevent excessive speed under normal use. The speed of the tool shall not exceed the rated speed under any operating condition.

Compliance is checked by inspection and by measuring the speed after the tool is operated for a period of 5 min. The recommended accessory that produces the maximum speed shall be installed.

If the tool is provided with a load sensitive speed control, then an accessory need not be installed to load the tool to find maximum speed.

~~19.107 Grinders with a rated capacity of 55 mm or more shall have only one rated speed.~~

~~Compliance is checked by inspection.~~

20 Mechanical strength

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

20.5 All wheel guards specified in accordance with 8.12.2 b) 104) shall have sufficient mechanical strength to prevent the wheel fragments from being ejected towards the operator in the event of the wheel breakage.

20.101 All wheel guards ~~recommended by the manufacturer specified in accordance with 8.12.2 b) 104~~ 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 guard to the test specified in 20.101.1 to 20.101.4. At the manufacturer's discretion, the test may be conducted with three guards but less than three separate grinders. After the test, the tool shall meet the acceptance criteria of 20.101.5.

~~20.101.1 The guard shall be securely mounted to the grinder in accordance with the instructions. If the guard is adjustable, it shall be positioned as close as possible to 30° (in a range of ±10°) from the neutral or the symmetrical wheel covering position against the direction of the wheel's rotation or to its maximum setting if the adjustable range is less than 30°. A fixed guard shall remain in the neutral position. See Figures 106a and 106b.~~

~~The maximum thickness grinding wheel recommended by the manufacturer with a diameter equal to the rated capacity of the grinder shall be mounted to the spindle in accordance with the instructions.~~

~~The grinder shall be operated at rated voltage and no-load for a minimum of 5 min. The speed of the wheel is measured and recorded.~~

~~20.101.1 The guard shall be mounted and securely fixed to the grinder in accordance with the instructions of 8.12.2 b) 105). If the guard is adjustable, it shall be positioned as close as possible to 30° (in a range of ±10°) from the neutral or the symmetrical wheel covering position against the direction of the wheel's rotation or to its maximum setting if the adjustable range is less than 30°. See Figures 106a and 106b.~~

~~The maximum thickness grinding wheel recommended by the manufacturer with a diameter equal to the rated capacity of the grinder shall be mounted to the spindle in accordance with the instructions.~~

~~The grinder shall be operated at rated voltage and no-load for a minimum of 5 min. The speed of the wheel is measured and recorded.~~

20.101.2 A wheel as specified in 20.101.1 shall be notched into four equal segments (quadrants). For wheel Types 1, 27, 28, 29, 41 and 42, the cut is directed from the outer edge radially towards the centre (see Figure 107). For wheel Types 6 and Type 11, the cut starts across the working surface towards the mounting end (see Figure 108).

The width of each notch shall not exceed 2,5 mm. The extend 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 20.101.1 or 90 % of the rated speed of the grinder, whichever is higher. The notched grinding wheel is mounted to the spindle in accordance with the instructions.

NOTE The following Table 102 provides typical pre-cut length ranges for standard wheel dimensions.

Table 102 – Typical pre-cut length ranges for standard wheel dimensions

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

~~20.101.3 At the midpoint of the side handle on each side of the grinder a mass of 0,5 kg and at the midpoint of switch handle a mass of 1 kg shall be attached. Figure 107 shows the midpoint on the handles of angle grinders, Figure 109 illustrates how to fix the masses to a straight 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 switch handle.~~

~~For grinders with a rated capacity of 100 mm or less and without side handle, adequate means of suspension and weight attachment shall be provided. The suspension point and weight attachment on the left and right side of the tool shall be 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 and the tool is positioned inside a test box (see Figures 110a and 110b).~~

~~The test box, preferably a hexagonal, octagonal or round, 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 walls, lined with 25 mm to 35 mm of modelling clay, backed by additional 25 mm to 35 mm thick layer of cork (see Figures 110a and 110b). The function of the modelling clay and cork is to absorb and retain the wheel segments or the impression of the impacting segments. The modelling clay and cork may be replaced by other materials performing the same function. Prior to the test the clay walls shall be free of any wheel segment impressions.~~

~~The grinder with the mounted guard and the segmented wheel facing down in the horizontal plane is positioned approximately 300 mm from the bottom of the box. To align the grinder inside the box and to prevent the grinder from twisting during the wheel's acceleration, the two side handles are anchored to the box with a force between 1 N and 2 N, e.g. by using permanent magnets capable of lifting this force.~~

~~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.~~

~~20.101.3 For grinders with side handles, a mass of 1 kg shall be mounted at the midpoint of the switch handle and a mass of 0,5 kg shall be mounted at the midpoint of a side handle installed on each side of the grinder (see Figure 107). 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 switch handle.~~

NOTE 1 The above test requires a second side handle or adaptor.