



BSI Standards Publication

Safety requirements for bonded abrasive products

National foreword

This British Standard is the UK implementation of EN 12413:2019. It supersedes BS EN 12413:2007+A1:2011, which is withdrawn.

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A list of organizations represented on this committee can be obtained on request to its secretary.

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English Version

Safety requirements for bonded abrasive products

Exigences de sécurité pour les produits abrasifs
agglomérésSicherheitsanforderungen für Schleifwerkzeuge aus
gebundenem Schleifmittel

This European Standard was approved by CEN on 5 August 2019.

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European foreword

This document (EN 12413:2019) has been prepared by Technical Committee CEN/TC 143 “Machine tools — Safety”, the secretariat of which is held by SNV.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by April 2020, and conflicting national standards shall be withdrawn at the latest by April 2020.

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

This document supersedes EN 12413:2007+A1:2011.

Significant technical differences between EN 12413:2007+A1:2011 and EN 12413:2019 are as follows:

- a) Clause 3 “Terms and definitions” has been revised;
- b) several modifications throughout the document have been done due to a change of concept regarding the terms “grinding” and “cutting-off” where the expression “grinding” does not include “cutting-off” anymore;
- c) the abbreviation “RE” for the “Restrictions of use” has been deleted;
- d) the type names in Table 6 have been checked and updated (the new edition of ISO 525 that is still under preparation will also include these revised types);
- e) in Table 6, the new Types 17R, 18B, 18P and 19R have been added;
- f) 6.2 “Scope of inspection by the manufacturer” has been moved to an informative Annex F “Recommended scope of the in-process inspection”;
- g) in Annex A, requirements for safety symbols (including symbols for personal protective equipment) have been added;
- h) in Table A.2, the following ‘restrictions to use’ including safety symbols have been added: “Only for grinding at an angle greater than 10°”. For the ‘restriction to use’ “Only permitted for totally enclosed working areas”, a safety symbol has been added;
- i) a new Table A.3 with symbols for personal protective equipment and a new safety symbol for “Do not use a damaged abrasive wheel” has been added;
- j) the three point side load test in C.3 has been deleted;
- k) Bibliography has been updated.

According to the CEN-CENELEC Internal Regulations, the national standards organisations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Republic of Macedonia, Romania, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.

Introduction

This document has been prepared to provide one means of conforming with essential safety requirements, e.g. of the General Product Safety Directive and associated EFTA regulations.

This document is addressed to designers, manufacturers and suppliers of the abrasive products described in the scope. In addition, it helps designers, manufacturers and suppliers of grinding machines in the selection of abrasive products, in order to reduce the risks and achieve conformity of the respective machinery with the essential health and safety requirements of the Machinery Directive.

The extent to which hazards are covered is indicated in the scope of this document.

1 Scope

This document is applicable to rotating bonded abrasive products. It specifies requirements and/or measures for the removal or reduction of hazards resulting from the design and application of the abrasive products.

This document also contains procedures and tests for verification of compliance with the requirements as well as safety information for use, which is to be made available to the user by the manufacturer.

This document does not apply to superabrasive products and coated abrasive products.

2 Normative references

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

EN ISO 6103, *Bonded abrasive products - Permissible unbalances of grinding wheels as delivered - Static testing (ISO 6103)*

ISO 525, *Bonded abrasive products — General requirements*

ISO 13942, *Bonded abrasive products — Limit deviations and run-out tolerances*

3 Terms, definitions and symbols

For the purposes of this document, the following terms and definitions apply.

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

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

3.1 General

3.1.1

bonded abrasive product

product consisting of abrasive grains held together by a bond

EXAMPLE Typical abrasive grains are aluminium oxide or silicon carbide.

Note 1 to entry: Types of bonded abrasive products are defined in ISO 525.

3.2 Grinding and cutting-off machines

3.2.1

stationary machine

machine being fixed in position during operation

Note 1 to entry: See for example EN ISO 16089.

Note 2 to entry: Included are fixed swing frame machines and mobile machines clamped firmly in position during use.

Note 3 to entry: Transportable machines are fixed in position during operation and therefore considered to be stationary machines.

3.2.2

stationary machine with totally enclosed working area

stationary machine being protected by separating guards in such a way that machining processes are carried out inside them and persons are protected against hazards

3.2.3

mobile machine

machine not being fixed in position during operation

Note 1 to entry: Mobile machines are manually guided (but not hand-held) by the operator during use, e.g. floor grinding machines.

3.2.4

hand-held machine

machine being held in the hand during operation

Note 1 to entry: Included are machines with flexible drives.

3.3 Grinding and cutting-off methods

3.3.1

peripheral grinding

grinding with the periphery of the wheel with no or limited side loads

3.3.2

face grinding

grinding with the face of the wheel

3.3.3

cutting-off

cutting or slotting with the periphery of the cutting-off wheel

3.3.4

high pressure grinding

grinding with high contact pressure for steel conditioning

3.4 Type of application

3.4.1

mechanically guided grinding and cutting-off

process with feed movements of the abrasive product and/or the workpiece guided by mechanical means

Note 1 to entry: See Table 1.

3.4.2

manually guided grinding and cutting-off

process with feed movements of the abrasive product and/or the workpiece manually guided by the operator

Note 1 to entry: See Table 1.

3.4.3

hand-held grinding and cutting-off

process with the grinding or cutting-off machine entirely guided by the operator

Note 1 to entry: See Table 1.

Table 1 — Type of application

Type of machine	Type of application	Abrasive product	Workpiece
Stationary machines and stationary machines with totally enclosed working area	Mechanically guided grinding and cutting-off	Fixed	Mechanically guided
		Mechanically guided	Fixed
		Mechanically guided	Mechanically guided
Stationary and mobile machines	Manually guided grinding and cutting-off	Guided by the operator	Fixed
		Fixed	Guided by the operator
Hand-held machines	Hand-held grinding and cutting-off	Guided by the operator	Fixed

3.5 Symbols

For the purposes of this document, the symbols listed in Table 2 apply.

Table 2 — Symbols

Symbol	Designation	Definition	Unit
A	Impact resistance	Resistance of a rotating abrasive product to lateral impact	Nm
f_{br}	Bursting speed factor	Bursting speed divided by maximum operating speed: $f_{br} = \frac{v_{br}}{v_s}$	—
f_{pr}	Test speed factor	Safety test speed divided by maximum operating speed: $f_{pr} = \frac{v_{pr}}{v_s}$	—
F_{S1}	Single point side load	Resistance of a rotating abrasive product to lateral single point load	N
n_{ab}	Deflection speed of mounted points	Revolutions per minute at which the spindle of mounted points is deflecting under centrifugal force	1/min
n_{max}	Maximum permissible speed of rotation	Revolutions per minute of a new abrasive product at maximum operating speed	1/min

Symbol	Designation	Definition	Unit
S_{ab}	Safety factor against spindle deflection for mounted points	Deflection speed divided by maximum permissible speed of rotation: $S_{ab} = \frac{n_{ab}}{n_{max}}$	—
S_{br}	Safety factor against bursting due to centrifugal force	Bursting speed divided by maximum operating speed, all squared: $S_{br} = \left(\frac{v_{br}}{v_s} \right)^2$	—
v_s	Maximum operating speed	Maximum permissible peripheral speed of a rotating abrasive product	m/s
v_{pr}	Safety test speed	Peripheral speed at which abrasive products are tested by the manufacturer	m/s
v_{br}	Bursting speed	Peripheral speed at which an abrasive product breaks due to centrifugal force	m/s
$v_{br, min}$	Minimum bursting speed	Peripheral speed which an abrasive product shall at least reach without bursting due to centrifugal force	m/s

4 List of significant hazards

The significant hazards are listed in Table 3.

Table 3 — List of significant hazards

Hazard designation	Hazardous situation (Examples)	Relevant clauses in this standard
Ejection of parts	1. Abrasive product breakage caused by	—
	— improper design	5.1, 5.2, 5.3 and Annex C
	— manufacturing defects	5.1
	— wrong selection	5.5, Clause 7 and Annex A
	— improper handling and storage	Clause 7
	— improper use (mounting and grinding process)	5.6, Clause 7 and Annex A
	2. Grinding debris	Clause 7
Vibration	Hand arm vibration on hand-held machines caused by	—
	— manufacturing defects	5.3 and 5.4
	— improper use	Clause 7
	— incorrect mounting	Clause 7

Hazard designation	Hazardous situation (Examples)	Relevant clauses in this standard
Kickback	Kickback effect of cutting-off wheels on hand-held machines caused by:	—
	— improper use	Clause 7
	— improper design	5.1, 5.2, 5.3 and Annex C
	— manufacturing defects	5.1
	— wrong selection	5.5, Clause 7 and Annex A
	— improper handling and storage	Clause 7

5 Safety requirements

5.1 General requirements

5.1.1 General

Abrasive products shall be designed and manufactured in such a way that they resist the forces and loads that are to be expected when used as intended. They shall not present visible faults and shall comply with the requirements listed in the following clauses.

5.1.2 Sequence of maximum operating speeds

Abrasive products shall be manufactured for maximum operating speeds according to the following sequence:

< 16 — 16 — 20 — 25 — 32 — 35 — 40 — 45 — 50 — 63 — 80 — 100 — 125 in m/s

The only exception to this is where the application requirements dictate an intermediate speed.

The manufacturer may select any of these speeds up to the maximum values shown in Table 6.

NOTE For conversion of peripheral speeds into speeds of rotation for different outside diameters D of the abrasive product, see Annex E.

5.2 Strength requirements

5.2.1 Safety factors

Abrasive products — with the exception of mounted points and wheels — shall have a safety factor against bursting due to centrifugal forces at their maximum operating speed as given in Table 4.

Table 4 — Safety factors

Type of machine	Type of abrasive product	Maximum operating speed v_s m/s	Safety factor S_{br}	Bursting speed factor f_{br}
Stationary machines	high pressure grinding wheels	≤ 80	3,50	1,87
	cutting-off wheels, manually guided cutting-off	≤ 100	3,50	1,87
	cutting-off wheels, only mechanically guided cutting-off	≤ 100	2,00	1,41
	all other types	all	3,00	1,73
Stationary machines totally enclosed	high pressure grinding wheels	≤ 100	3,00	1,73
	all other types	all	1,75	1,32
Mobile machines	grinding and cutting-off wheels	≤ 100	3,50	1,87
Hand-held machines	grinding wheels $D > 125$ mm	≤ 50	3,00	1,73
		$50 < v_s \leq 80$	3,50	1,87
	cutting-off wheels $D > 125$ mm	≤ 100	3,50	1,87
	all types $D \leq 125$ mm	≤ 80	3,00	1,73
		> 80	3,50	1,87

5.2.2 Safety factors for mounted points and wheels

Mounted points and wheels shall have a safety factor against bursting due to centrifugal forces of $S_{br} = 3$ at their maximum operating speed. The spindle shall have a safety factor against deflection of $S_{ab} = 1,3$. For further requirements, see Annex B.

5.2.3 Side load capacity

Depressed-centre wheels, straight cutting-off wheels and depressed-centre cutting-off wheels for the use on hand-held machines shall have a side load capacity according to Table 5.

Table 5 — Side load capacity of abrasive products for use on hand-held machines

Abrasive product	Maximum operating speed v_s m/s	Outside diameter D mm	Side load capacity	
			Single point side load F_{S1} N	Impact resistance A Nm
Depressed-centre grinding wheels (type 27 ^{a,b} and type 28 ^{a,c})	≤ 80	≥ 115	290	—
		150	290	4,5
		180	290	5,4
		230	290	6,9
Straight and depressed-centre cutting-off wheels (type 41 ^a and type 42 ^a)	≤ 80	≥ 115	40	—
		150	50	1,2
		180	50	1,5
		230	50	2,0
		300	125	5,4
		350/356	125	5,4
		400/406	125	5,4
Straight cutting-off wheels (type 41 ^a)	$80 < v_s \leq 125$	$115 < D \leq 125$	40	—
	$80 < v_s \leq 100$	300	125	5,4
		350/356	125	5,4
		400/406	125	5,4

a According to ISO 525.
b With back-up pad where intended for the type of application.
c Tested as a type 27.

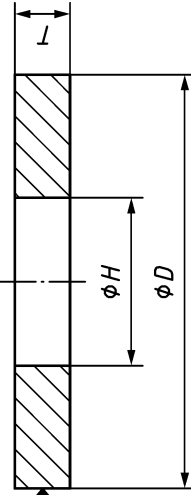
5.3 Dimensional requirements

5.3.1 Dimensional limitations and maximum operating speeds

Bonded abrasive products shall comply with the dimensional limitations and maximum operating speeds as specified in Table 6.

NOTE The arrow in the figures in Table 6 symbolizes the working face of the bonded abrasive product.

Table 6 — Dimensional limitations and maximum operating speed

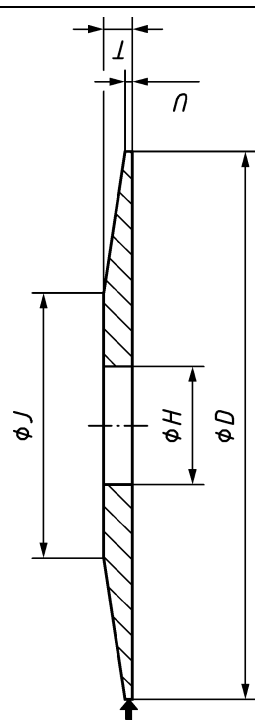
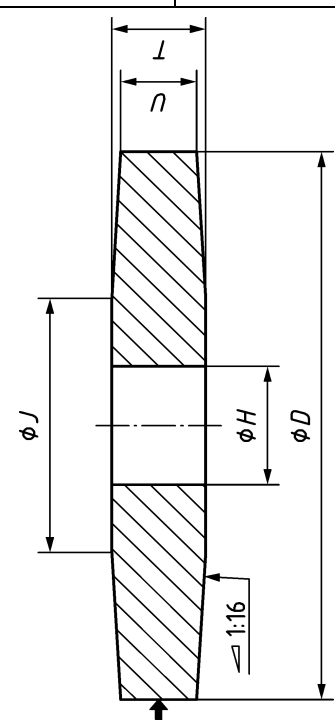
Shape, designation, dimensional letters	Type of machine ^a	Type of application ^a	Maximum operating speeds and dimensional limitations												
			Standard operating speeds					Special operating speeds							
			m/s					m/s							
Type 1 Straight grinding wheel	Stationary machines	Mechanically guided grinding	Dimensional limitations	Types of bond ^b					Dimensional limitations	Types of bond ^b					
				V	B	BF	R	RF		E	MG	PL	V	B	BF
		Mechanically guided grinding, totally enclosed	$H \leq 0,67 D$	40	50	63	50	—	40	25 ^c	50	63	63	63	63
				—	—	—	—	—	—	—	—	—	—	—	—
	Stationary machines	Mechanically guided high pressure grinding	$H \leq 0,50 D$	—	80	—	—	—	—	—	—	—	—	—	—
				—	—	—	—	—	—	—	—	—	—	—	—
$D \times T \times H^b$	Stationary and mobile machines	Manually guided grinding	$H \leq 0,67 D$	35	50	63	50	50	40	25 ^c	50	63	63	63	63
				—	—	—	—	—	—	—	—	—	—	—	—
	Hand-held machines	Hand-held grinding	$H \leq 0,25 D$	—	50	80	50	80	—	—	50	63	63	63	63

^a Definitions see 3.2 and 3.4.

^b Types of bond and designation examples see ISO 525.

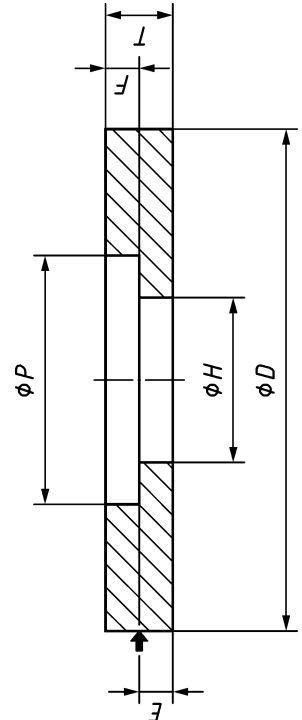
^c $D \leq 1\,000$ mm

^d $D > 1\,000$ mm

Shape, designation, dimensional letters	Type of machine ^a	Type of application ^a	Maximum operating speeds and dimensional limitations															
			Standard operating speeds					Special operating speeds										
			m/s					m/s										
	Dimensional limitations	Types of bond ^b					Dimensional limitations	Types of bond ^b										
		V	B	BF	R	RF		E	MG	PL	V	B	BF	R	RF	PL		
Type 3 Grinding wheel, tapered on one side  $D/J \times T \times H^b$	Stationary machines	Mechanically guided grinding	40	50	—	50	—	—	—	—	50	$H \leq 0,67 D$	63	63	—	63	—	63
			—	—	—	—	—	—	—	—	—	—	$H \leq 0,50 D$	—	—	—	—	—
Type 4 Grinding wheel, tapered on both sides  $D \times T \times H^b$	Stationary machines	Mechanically guided grinding	40	50	—	50	—	—	—	50	$H \leq 0,67 D$	63	63	—	63	—	63	
			—	—	—	—	—	—	—	—	—	—	$H \leq 0,50 D$	—	—	—	—	—
	Hand-held machines	Hand-held grinding	—	50	80	—	—	—	—	—	—	$D \leq 200$	—	—	—	—	—	—

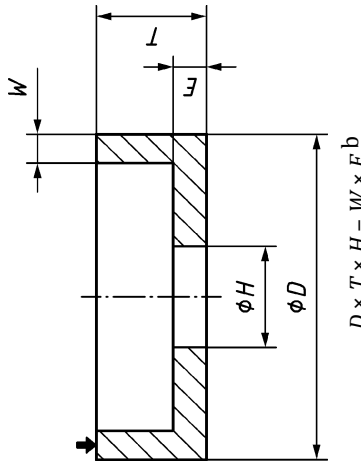
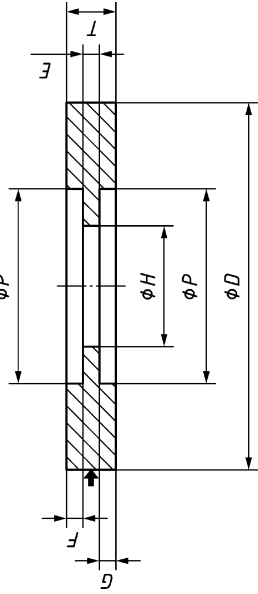
^a Definitions see 3.2 and 3.4.

^b Types of bond and designation examples see ISO 525.

Shape, designation, dimensional letters	Type of machine ^a	Type of application ^a	Maximum operating speeds and dimensional limitations													
			Standard operating speeds						Special operating speeds							
			m/s						m/s							
Dimensional limitations	Types of bond ^b						Dimensional limitations	Types of bond ^b								
	V	B	BF	R	RF	PL		V	B	BF	R	RF	PL			
Type 5 Grinding wheel, recessed on one side  $D \times T \times H - P \times F^b$	Stationary machines	Mechanically guided grinding	40	50	—	50	—	—	—	—	—	63	63	63	63	63
Hand-held machines	Hand-held grinding	—	50	80	50	80	—	—	—	—	50	63	—	—		

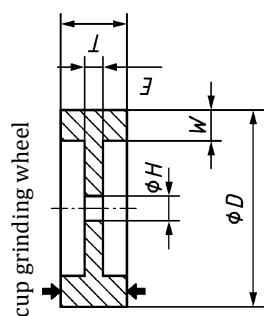
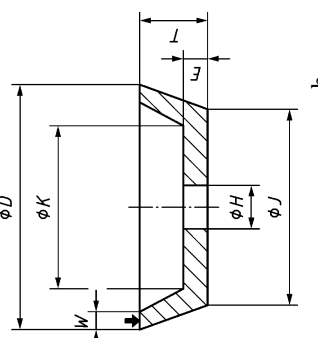
^a Definitions see 3.2 and 3.4.

^b Types of bond and designation examples see ISO 525.

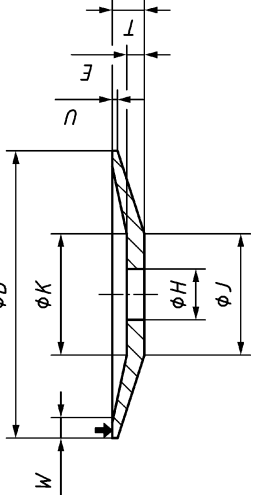
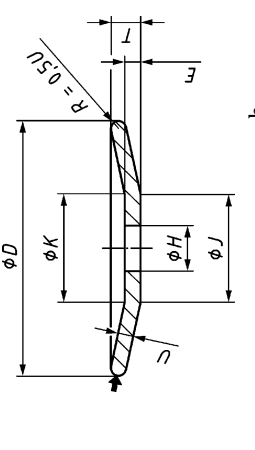
Shape, designation, dimensional letters	Type of machine ^a	Type of application ^a	Maximum operating speeds and dimensional limitations												
			Standard operating speeds					Special operating speeds							
			m/s												
Dimensional limitations	Types of bond ^b					Dimensional limitations	Types of bond ^b								
	V	B	BF	R	RF		E	MG	PL	V	B	BF	R	RF	PL
Type 6 Straight cup grinding wheel  $D \times T \times H - W \times E b$	Stationary machines	Mechanically guided grinding	32	40	—	40	—	—	40	—	—	63	63	—	—
		Mechanically guided grinding, totally enclosed	—	—	—	—	—	—	—	—	—	—	—	—	—
	Hand-held machines	Manually guided grinding	32	40	—	40	—	—	40	—	—	—	—	—	—
		Hand-held grinding	—	50	—	—	—	—	—	—	—	—	—	—	—
Type 7 Grinding wheel, recessed on both sides  $D \times T \times H - P \times F/G b$	Stationary machines	Mechanically guided grinding	40	50	—	50	—	—	50	—	—	63	63	—	63
		Mechanically guided grinding, totally enclosed	—	—	—	—	—	—	—	—	—	—	—	—	—
			—	—	—	—	—	—	—	—	—	—	—	—	—
			—	—	—	—	—	—	—	—	—	—	—	—	—

^a Definitions see 3.2 and 3.4.

^b Types of bond and designation examples see ISO 525.

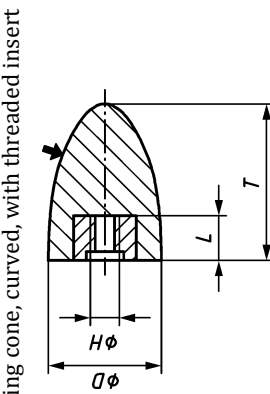
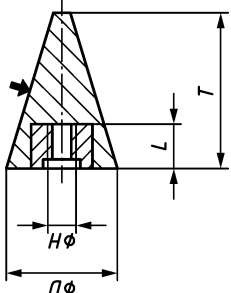
Shape, designation, dimensional letters	Type of machine ^a	Type of application ^a	Maximum operating speeds and dimensional limitations																	
			Standard operating speeds m/s						Special operating speeds m/s											
			Dimensional limitations			Types of bond ^b			Dimensional limitations			Types of bond ^b								
			V	B	BF	R	RF	E	MG	PL	V	B	BF	R	RF	PL				
Type 9 Double cup grinding wheel  $D \times T \times H - W \times E \ b$	Stationary machines	Mechanically guided grinding	$E \geq 0,2 \ T$	40	—	—	40	—	—	—	—	—	—	—	—	—	—	—	—	
			$E \geq 0,2 \ T$	32	40	40	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Type 11 Taper cup grinding wheel  $D/J \times T \times H - W \times E \ b$	Stationary machines	Mechanically guided grinding, totally enclosed	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
			$E \geq 0,2 \ T$	32	40	40	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Hand-held machines	Hand-held grinding	$E \geq 0,25 \ T$	—	50	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

a Definitions see 3.2 and 3.4.
 b Types of bond and designation examples see ISO 525.

Shape, designation, dimensional letters	Type of machine ^a	Type of application ^a	Maximum operating speeds and dimensional limitations																	
			Standard operating speeds							Special operating speeds										
			m/s							m/s										
Dimensional limitations	Types of bond ^b							Dimensional limitations	Types of bond ^b											
	V	B	BF	R	RF	E	MG		PL	V	B	BF	R	RF	PL					
Type 12 Dish grinding wheel 	Stationary machines	Mechanically guided grinding	32	40	—	40	—	—	40	—	—	—	—	—	—	50	50	—	—	—
Mechanically guided grinding, totally enclosed		—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Manually guided grinding (tool sharpening)		32	40	—	40	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Type 13 Saucer grinding wheel 	Stationary machines	Mechanically guided grinding	32	40	—	40	—	—	40	—	—	—	—	—	—	50	50	—	—	—
Mechanically guided grinding, totally enclosed		—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Manually guided grinding (tool sharpening)		32	40	—	40	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

^a Definitions see 3.2 and 3.4.

^b Types of bond and designation examples see ISO 525.

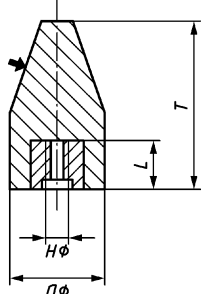
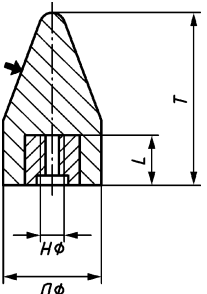
Shape, designation, dimensional letters	Type of machine ^a	Type of application ^a	Maximum operating speeds and dimensional limitations																
			Standard operating speeds				Special operating speeds												
			m/s																
			Dimensional limitations	V	B	BF	R	RF	E	MG	PL	Dimensional limitations	V	B	BF	R	RF	PL	
Cones and plugs – Examples (Types 16 to 19R): Type 16  Tapered grinding cone, curved, with threaded insert $D \times T - H \times L \text{ b}$	Hand-held machines	Hand-held grinding	$D \leq 80$ $T \leq 100$	40	50	—	—	—	—	—	—	$D \leq 80$ $T \leq 100$	50	—	—	—	—	—	
Type 17  Tapered grinding cone, flat tip, with threaded insert $D \times T - H \times L \text{ b}$	Hand-held machines	Hand-held grinding	$D \leq 80$ $T \leq 100$	40	50	—	—	—	—	—	—	$D \leq 80$ $T \leq 100$	50	—	—	—	—	—	

a Definitions see 3.2 and 3.4.
 b Types of bond and designation examples see ISO 525.

Shape, designation, dimensional letters	Type of machine ^a	Type of application ^a	Maximum operating speeds and dimensional limitations													
			Standard operating speeds					Special operating speeds								
			m/s					m/s								
			Dimensional limitations			Types of bond ^b			Types of bond ^b							
			V	B	BF	R	RF	E	MG	PL	V	B	BF	R	RF	PL
<p>Type 18 Cylindrical grinding plug, with threaded insert</p> <p>$D \times T - H \times L, b$</p>	Hand-held machines	Hand-held grinding	40	50	—	—	—	—	—	—	50	—	—	—	—	—
<p>Type 18B Grinding ball, with threaded insert</p> <p>$D - H \times L, b$</p>																
<p>Type 18P Cylindrical grinding plug, curved end, pointed tip, with threaded insert</p> <p>$D \times T/T_1 - H \times L, b$</p>																
<p>Type 18R Cylindrical grinding plug, ball end, with threaded insert</p> <p>$D \times T - H \times L, b$</p>																

^a Definitions see 3.2 and 3.4.

^b Types of bond and designation examples see ISO 525.

Shape, designation, dimensional letters	Type of machine ^a	Type of application ^a	Maximum operating speeds and dimensional limitations													
			Standard operating speeds						Special operating speeds							
			Dimensional limitations		Types of bond ^b				Dimensional limitations		Types of bond ^b					
		V	B	BF	R	RF	E	MG	PL	V	B	BF	R	RF	PL	
<p>Type 19 Cylindrical grinding plug, conical end, flat tip, with threaded insert</p>  <p style="text-align: center;">$D \times T - H \times L \ b$</p>	Hand-held machines	Hand-held grinding	D ≤ 80 T ≤ 100	40	50	—	—	—	—	—	—	—	—	—	—	—
<p>Type 19R Cylindrical grinding plug, conical end, round tip, with threaded insert</p>  <p style="text-align: center;">$D \times T - H \times L \ b$</p>	Hand-held machines	Hand-held grinding	D ≤ 80 T ≤ 100	40	50	—	—	—	—	—	—	—	—	—	—	—

^a Definitions see 3.2 and 3.4.

^b Types of bond and designation examples see ISO 525.

Shape, designation, dimensional letters	Type of machine ^a	Type of application ^a	Maximum operating speeds and dimensional limitations																
			Standard operating speeds					Special operating speeds											
			m/s					m/s											
Dimensional limitations	Types of bond ^b					Dimensional limitations	Types of bond ^b												
	V	B	BF	R	RF		E	MG	PL	V	B	BF	R	RF	PL				
Type 20 Grinding wheel, relieved on one side $D \times T \times H - K \times E/N^b$	Stationary machines	Mechanically guided grinding	40	50	—	50	—	—	—	—	—	—	—	—	—	63	63	—	63
Type 21 Grinding wheel, relieved on both sides $D \times T \times H - K \times E/N^b$		Stationary machines	Mechanically guided grinding, totally enclosed	40	50	—	50	—	—	—	—	—	—	—	—	100	100	—	100
			Mechanically guided grinding	40	50	—	50	—	—	—	—	—	—	—	—	63	63	—	63
		Mechanically guided grinding, totally enclosed	40	50	—	50	—	—	—	—	—	—	—	—	80	80	—	80	
			40	50	—	50	—	—	—	—	—	—	—	—	100	100	—	100	

^a Definitions see 3.2 and 3.4.
^b Types of bond and designation examples see ISO 525.

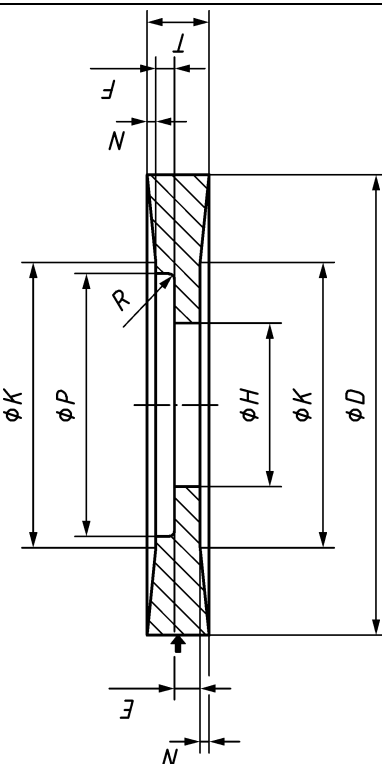
Shape, designation, dimensional letters	Type of machine ^a	Type of application ^a	Maximum operating speeds and dimensional limitations														
			Standard operating speeds					Special operating speeds									
			Dimensional limitations		Types of bond ^b			Dimensional limitations		Types of bond ^b							
		V	B	BF	R	RF	E	MG	PL	V	B	BF	R	RF	PL		
Type 22 Grinding wheel, relieved on one side, recessed on the other side $D \times T \times H - P \times F - K \times E/N^b$	Stationary machines	Mechanically guided grinding	$H \leq 0,67 D$	40	50	—	50	—	—	—	—	—	—	—	—	—	
			$E \geq 0,50 T$	40	50	—	50	—	—	—	—	—	—	—	—	—	—
Type 23 Grinding wheel, relieved and recessed on one side $D \times T \times H - P \times F - K \times E/N^b$	Stationary machines	Mechanically guided grinding	$H \leq 0,67 D$	40	50	—	50	—	—	—	—	—	—	—	—	—	
			$E \geq 0,50 T$	40	50	—	50	—	—	—	—	—	—	—	—	—	—
		Mechanically guided grinding, totally enclosed	$H \leq 0,67 D$	40	50	—	50	—	—	—	—	—	—	—	—	—	—
			$E \geq 0,50 T$	40	50	—	50	—	—	—	—	—	—	—	—	—	—

a Definitions see 3.2 and 3.4.
 b Types of bond and designation examples see ISO 525.

Shape, designation, dimensional letters	Type of machine ^a	Type of application ^a	Maximum operating speeds and dimensional limitations		Special operating speeds																								
			Standard operating speeds		m/s					m/s																			
			Dimensional limitations	Types of bond ^b	V	B	BF	R	RF	E	MG	PL	Dimensional limitations	V	B	BF	R	RF	PL										
<p>Type 24</p> <p>Grinding wheel, relieved and recessed on one side, recessed on the other side</p> <p style="text-align: center;">$D \times T \times H - P \times F/G - K \times E/N$^b</p>	Stationary machines	Mechanically guided grinding	$H \leq 0,67 D$ $E \geq 0,50 T$	40	50	—	50	—	—	—	—	—	—	—	—	—	—	—	—	—	$H \leq 0,67 D$ $E \geq 0,50 T$	63	63	—	63	—	63	—	
		Mechanically guided grinding, totally enclosed	$H \leq 0,67 D$ $E \geq 0,50 T$	40	50	—	50	—	—	—	—	—	—	—	—	—	—	—	—	—	—	$H \leq 0,50 D$ $E \geq 0,50 T$	100	100	—	100	—	100	—

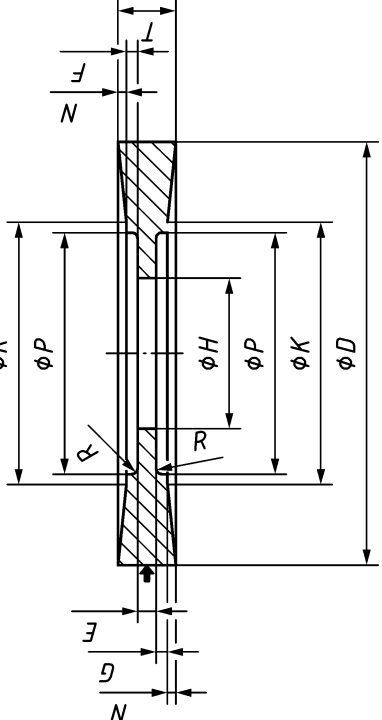
^a Definitions see 3.2 and 3.4.

^b Types of bond and designation examples see ISO 525.

Shape, designation, dimensional letters	Type of machine ^a	Type of application ^a	Maximum operating speeds and dimensional limitations														
			Standard operating speeds					Special operating speeds									
			m/s					m/s									
Type 25 Grinding wheel, relieved and recessed on one side, relieved on the other side  $D \times T \times H - P \times F - K \times E/N^b$	Stationary machines	Mechanically guided grinding	Dimensional limitations	V	B	BF	R	RF	E	MG PL	Dimensional limitations	V	B	BF	R	RF PL	
			$H \leq 0,67 D$ $E \geq 0,50 T$	40	50	—	—	—	—	—	—	50	$H \leq 0,67 D$ $E \geq 0,50 T$	63	63	—	63
		Mechanically guided grinding totally enclosed	Dimensional limitations	V	B	BF	R	RF	E	MG PL	Dimensional limitations	V	B	BF	R	RF PL	
			$H \leq 0,67 D$ $E \geq 0,50 T$	40	50	—	—	—	—	—	$H \leq 0,50 D$ $E \geq 0,50 T$	80	80	—	80	—	—
			$H \leq 0,67 D$ $E \geq 0,50 T$	40	50	—	—	—	—	—	$H \leq 0,50 D$ $E \geq 0,50 T$	100	100	—	100	—	—

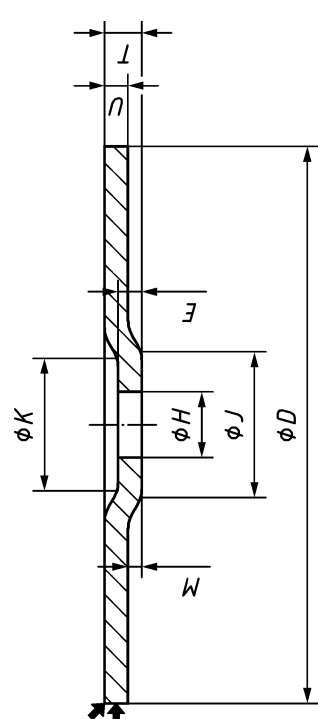
^a Definitions see 3.2 and 3.4.

^b Types of bond and designation examples see ISO 525.

Shape, designation, dimensional letters	Type of machine ^a	Type of application ^a	Maximum operating speeds and dimensional limitations		Special operating speeds															
			Standard operating speeds		Dimensional limitations		Types of bond ^b													
			m/s		m/s		V	B	BF	R	RF	E	MG	PL	V	B	BF	R	RF	PL
Type 26 Grinding wheel, relieved and recessed on both sides  $D \times T \times H - P \times F/G - K \times E/N^b$	Stationary machines	Mechanically guided grinding	$H \leq 0,67 D$ $E \geq 0,50 T$	40 50	50	50	50	50	50	50	50	50	63	63	63	63	63	63	63	
		Mechanically guided grinding, totally enclosed	$H \leq 0,67 D$ $E \geq 0,50 T$	40 50	50	50	50	50	50	50	50	50	100 100	100	100	100	100	100	100	100

^a Definitions see 3.2 and 3.4.

^b Types of bond and designation examples see ISO 525.

Shape, designation, dimensional letters	Type of machine ^a	Type of application ^a	Maximum operating speeds and dimensional limitations															
			Standard operating speeds					Special operating speeds										
			m/s					m/s										
Type 27 Depressed centre grinding wheel for grinding or grinding/cutting-off  $D \times U \times H$	Hand-held machines	Hand-held grinding and cutting-off	Dimensional limitations	V	B	BF	R	RF	E	MG	PL	Dimensional limitations	V	B	BF	R	RF	PL
			$D \leq 230$ $H \leq 22,23$ $U \leq 10$	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

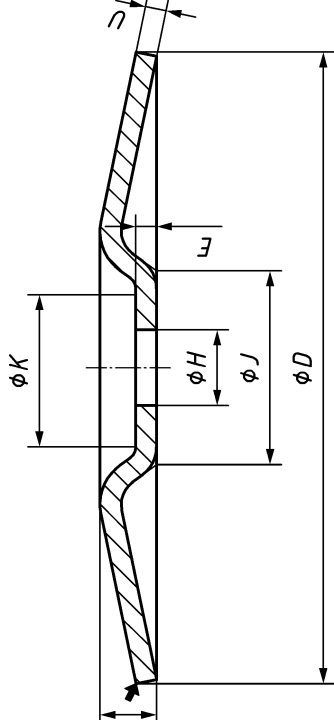
^a Definitions see 3.2 and 3.4.

^b Types of bond and designation examples see ISO 525.

Shape, designation, dimensional letters	Type of machine ^a	Type of application ^a	Maximum operating speeds and dimensional limitations											
			Standard operating speeds					Special operating speeds						
			Dimensional limitations		Types of bond ^b			Dimensional limitations		Types of bond ^b				
m/s		m/s			m/s		m/s			m/s				
V	B	BF	R	RF	E	MG	PL	V	B	BF	R	RF	PL	
Type 28 Depressed centre grinding wheel, concave shaped			Hand-held machines	Hand-held grinding	$D \leq 230$ $H \leq 22,23$ $U \leq 10$		—	—	—	—	—	—	—	—
$D \times U \times H^b$														

^a Definitions see 3.2 and 3.4.

^b Types of bond and designation examples see ISO 525.

Shape, designation, dimensional letters	Type of machine ^a	Type of application ^a	Maximum operating speeds and dimensional limitations																					
			Standard operating speeds						Special operating speeds															
			m/s						m/s															
Dimensional limitations	Types of bond ^b						Dimensional limitations	Types of bond ^b																
	V	B	BF	R	RF	E		MG	PL	V	B	BF	R	RF	PL									
<p>Type 29 Depressed centre grinding wheel, convex shaped</p>  <p style="text-align: center;">$D \times U \times H$^b</p>	Hand-held machines	Hand-held grinding																						
					80																			

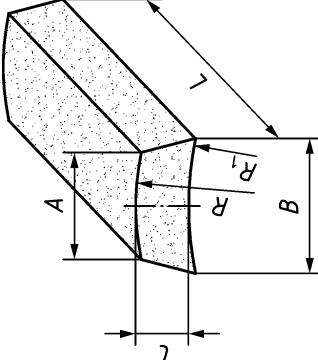
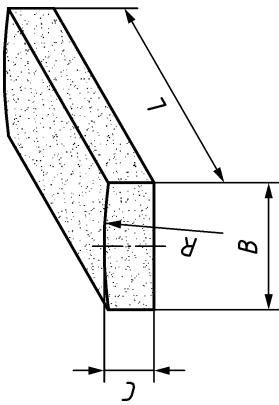
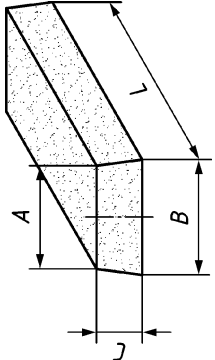
^a Definitions see 3.2 and 3.4.

^b Types of bond and designation examples see ISO 525.

Shape, designation, dimensional letters	Type of machine ^a	Type of application ^a	Maximum operating speeds and dimensional limitations																																						
			Standard operating speeds					Special operating speeds																																	
			m/s					m/s																																	
										Types of bond ^b																															
Dimensional limitations										V	B	BF	R	RF	PL																										
Grinding segments (Types 31A to 31G):																																									
Type 31A Grinding segment, rectangular shape	Stationary machines	Mechanically guided grinding	Maximum length out of clamping head $L_f \leq 1,5 C$	32	40	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—																				
Type 31B Grinding segment, trapezoidal shape, with outer radius																						40	25	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Type 31C Grinding segment, with outer radius																																									
Type 31D Grinding segment, with outer and inner radius																						40	25	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Type 31E Grinding segment, with outer radius	63	63	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—																				
Type 31F Grinding segment, with outer and inner radius																						40	25	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Type 31G Grinding segment, with outer radius	63	63	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—																				
Type 31H Grinding segment, with outer and inner radius																						40	25	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Type 31I Grinding segment, with outer radius	63	63	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—																				
Type 31J Grinding segment, with outer and inner radius																						40	25	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Type 31K Grinding segment, with outer radius	63	63	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—																				
Type 31L Grinding segment, with outer and inner radius																						40	25	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Type 31M Grinding segment, with outer radius	63	63	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—																				
Type 31N Grinding segment, with outer and inner radius																						40	25	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Type 31O Grinding segment, with outer radius	63	63	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—																				
Type 31P Grinding segment, with outer and inner radius																						40	25	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Type 31Q Grinding segment, with outer radius	63	63	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—																				
Type 31R Grinding segment, with outer and inner radius																						40	25	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Type 31S Grinding segment, with outer radius	63	63	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—																				
Type 31T Grinding segment, with outer and inner radius																						40	25	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Type 31U Grinding segment, with outer radius	63	63	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—																				
Type 31V Grinding segment, with outer and inner radius																						40	25	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Type 31W Grinding segment, with outer radius	63	63	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—																				
Type 31X Grinding segment, with outer and inner radius																						40	25	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Type 31Y Grinding segment, with outer radius	63	63	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—																				
Type 31Z Grinding segment, with outer and inner radius																						40	25	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

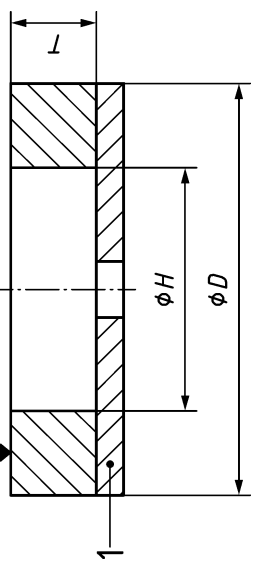
^a Definitions see 3.2 and 3.4.

^b Types of bond and designation examples see ISO 525.

Shape, designation, dimensional letters	Type of machine ^a	Type of application ^a	Maximum operating speeds and dimensional limitations													
			Standard operating speeds					Special operating speeds								
			Dimensional limitations		Types of bond ^b			Dimensional limitations		Types of bond ^b						
				V	B	BF	R	RF	PL	V	B	BF	R	RF	PL	
<p>Type 31E Grinding segment, trapezoidal shape, with outer and inner radius</p>  <p>Type 31F Grinding segment, rectangular shape, with outer radius</p>  <p>$B \times C \times L$ b</p>	Stationary machines	Mechanically guided grinding														
<p>Type 31G Grinding segment, trapezoidal shape</p>  <p>$B/A \times C \times L$ b</p>																
		Manually guided grinding														

a Definitions see 3.2 and 3.4.

b Types of bond and designation examples see ISO 525.

Shape, designation, dimensional letters	Type of machine ^a	Type of application ^a	Maximum operating speeds and dimensional limitations																
			Standard operating speeds							Special operating speeds									
			m/s							m/s									
Type 35 Disc grinding wheel, cemented or clamped to a back-plate 	Stationary machines	Mechanically guided grinding	Dimensional limitations	V	B	BF	R	RF	E	MG	PL	Dimensional limitations	V	B	BF	R	RF	PL	
			$H \leq 0,67 D$	32	50	—	—	—	—	—	25	40	$H \leq 0,67 D$	63	63	—	—	—	—
		Manually guided grinding	$H \leq 0,67 D$	32	50	—	—	—	—	—	40	—	—	—	—	—	—	—	—

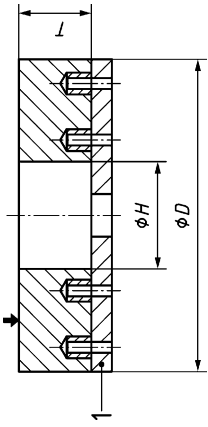
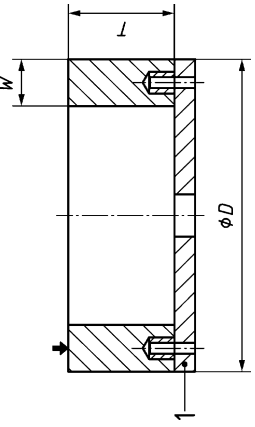
Key

1 back-plate

$$D \times T \times H^b$$

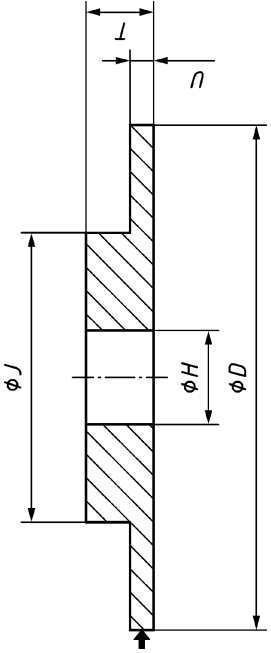
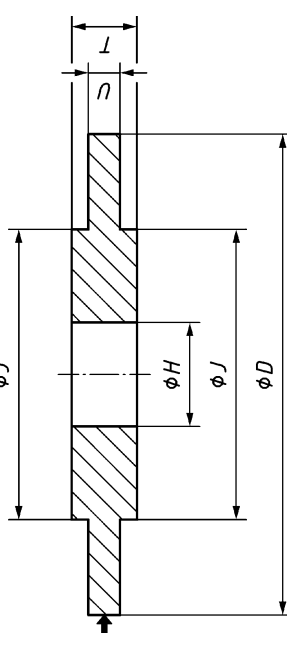
^a Definitions see 3.2 and 3.4.

^b Types of bond and designation examples see ISO 525.

Shape, designation, dimensional letters	Type of machine ^a	Type of application ^a	Maximum operating speeds and dimensional limitations													
			Standard operating speeds					Special operating speeds								
			Dimensional limitations		Types of bond ^b			Dimensional limitations		Types of bond ^b						
		V	B	BF	R	RF	E	MG	PL	V	B	BF	R	RF	PL	
Type 36 Disc grinding wheel with threaded inserts, fixed to a back-plate  Key 1 back-plate $D \times T \times H^b$	Stationary machines	Mechanically guided grinding	32	50	—	—	—	—	—	—	63	63	—	—	—	50
		Manually guided grinding							40							
Type 37 Cylinder grinding wheel with threaded inserts, fixed to a back-plate  Key 1 back-plate $D \times T \times W^b$	Stationary machines	Mechanically guided grinding	32	50	—	—	—	—	—	—	63	63	—	—	—	50
		Manually guided grinding							40							

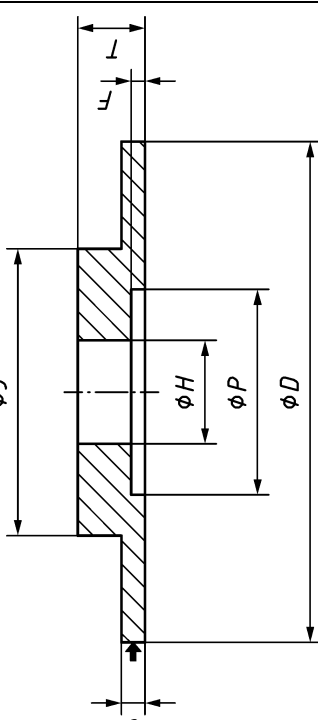
a Definitions see 3.2 and 3.4.

b Types of bond and designation examples see ISO 525.

Shape, designation, dimensional letters	Type of machine ^a	Type of application ^a	Maximum operating speeds and dimensional limitations												
			Standard operating speeds					Special operating speeds							
			Dimensional limitations		Types of bond ^b			Dimensional limitations		Types of bond ^b					
m/s		V	B	BF	R	RF	E	MG	PL	V	B	BF	R	RF	PL
Type 38 Single hubbed grinding wheel  $D/J \times T/U \times H^b$	Stationary machines	Mechanically guided grinding	40	50	—	50	—	—	—	50	63	—	—	—	—
		Mechanically guided grinding, totally enclosed	$H \leq 0,67 D$ $U \geq 0,025 D$		—	—	—	—	—	—	—	—	—	—	—
Type 39 Double hubbed grinding wheel  $D/J \times T/U \times H^b$	Stationary machines	Mechanically guided grinding	40	50	—	50	—	—	—	50	63	—	—	—	—
		Mechanically guided grinding, totally enclosed	$H \leq 0,67 D$ $U \geq 0,025 D$		—	—	—	—	—	—	—	—	—	—	—

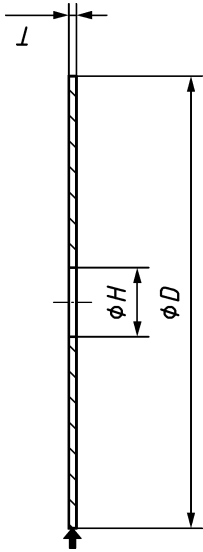
^a Definitions see 3.2 and 3.4.

^b Types of bond and designation examples see ISO 525.

Shape, designation, dimensional letters	Type of machine ^a	Type of application ^a	Maximum operating speeds and dimensional limitations												
			Standard operating speeds					Special operating speeds							
			m/s												
Dimensional limitations	Types of bond ^b					Dimensional limitations	Types of bond ^b								
	V	B	BF	R	RF		E	MG	PL	V	B	BF	R	RF	PL
Type 40 Grinding wheel, hubbed on one side, recessed on the other side  $D/J \times T/U \times H - P \times F^b$	Stationary machines	Mechanically guided grinding Mechanically guided grinding totally enclosed	$H \leq 0,67 D$ $U \geq 0,025 D$	40	50	—	50	—	—	—	—	—	—	—	—
			$H \leq 0,67 D$ $U \geq 0,005 D$	63	63	—	63	—	—	—	—	—	—	—	—
			$H \leq 0,5 D$ $U \geq 0,005 D$	80	80	—	80	—	—	—	—	—	—	—	—
			$H \leq 0,5 D$ $U \geq 0,005 D$	125	100	—	100	—	—	—	—	—	—	—	—

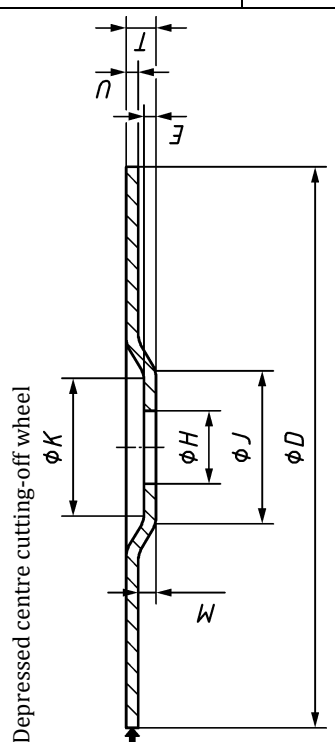
^a Definitions see 3.2 and 3.4.

^b Types of bond and designation examples see ISO 525.

Shape, designation, dimensional letters	Type of machine ^a	Type of application ^a	Maximum operating speeds and dimensional limitations														
			Standard operating speeds					Special operating speeds									
			m/s														
Type 41 Flat cutting-off wheel  $D \times T \times H$	Stationary machines	Mechanically guided cutting-off	Dimensional limitations	Types of bond ^b					Dimensional limitations	Types of bond ^b							
			$T \leq 0,02 D$ $H \leq 0,33 D$	V	B	BF	R	RF	E	MG	PL	V	B	BF	R	RF	PL
				—	80	100	63	80	63	—	—	—	—	—	—	—	80
Mobile machines	Mechanically guided cutting-off, totally enclosed	Dimensional limitations	Types of bond ^b					Dimensional limitations	Types of bond ^b								
		$T \leq 0,02 D$ $H \leq 0,33 D$	V	B	BF	R	RF	E	MG	PL	V	B	BF	R	RF	PL	
			—	80	100	63	80	63	—	—	—	—	—	—	—	—	—
Hand-held machines	Hand-held cutting-off	Dimensional limitations	Types of bond ^b					Dimensional limitations	Types of bond ^b								
		$D \leq 230$ $T < 4,0$ $H \leq 22,23$	V	B	BF	R	RF	E	MG	PL	V	B	BF	R	RF	PL	
			—	80	—	—	—	—	—	—	—	—	80	—	—	—	—
Hand-held machines	Hand-held cutting-off	Dimensional limitations	Types of bond ^b					Dimensional limitations	Types of bond ^b								
		$D = 300$ to 406 $T \leq 0,015 D$ $H \leq 0,25 D$	V	B	BF	R	RF	E	MG	PL	V	B	BF	R	RF	PL	
			—	80	—	—	—	—	—	—	—	—	80	—	—	—	—

^a Definitions see 3.2 and 3.4.

^b Types of bond and designation examples see ISO 525.

Shape, designation, dimensional letters	Type of machine ^a	Type of application ^a	Maximum operating speeds and dimensional limitations												
			Standard operating speeds					Special operating speeds							
			m/s					m/s							
Dimensional limitations	Types of bond ^b					Dimensional limitations	Types of bond ^b								
	V	B	BF	R	RF		E	MG	PL	V	B	BF	R	RF	PL
Type 42 Depressed centre cutting-off wheel  $D \times U \times H^b$	Stationary machines	Mechanically guided cutting-off	—	100	—	80	—	—	—	—	—	—	—	—	—
		Manually guided cutting-off	—	100	—	80	—	—	—	—	—	—	—	—	—
	Mobile machines	Mechanically guided cutting-off, totally enclosed	—	100	—	80	—	—	—	—	—	—	—	—	—
Hand-held machines	Mobile machines	Manually guided cutting-off	—	80	—	80	—	—	—	—	—	—	—	—	—
	Hand-held machines	Hand-held cutting-off	—	80	—	80	—	—	—	—	—	—	—	—	—

^a Definitions see 3.2 and 3.4.

^b Types of bond and designation examples see ISO 525.

Shape, designation, dimensional letters	Type of machine ^a	Type of application ^a	Maximum operating speeds and dimensional limitations													
			Standard operating speeds					Special operating speeds								
			m/s					m/s								
	Dimensional limitations	Types of bond ^b					Dimensional limitations	Types of bond ^b								
		V	B	BF	R	RF		E	MG	PL	V	B	BF	R	RF	PL
<p>Type 52</p> <p>Mounted points and wheels^c</p>	<p>$D \leq 80$ $T \leq 80$</p>	Mechanically guided grinding (internal grinding)	40	50	—	50	—	—	—	—	—	63	63	—	—	—
<p>$D \times T \times S_d$^b</p>	<p>$D \leq 80$ $T \leq 80$</p>	Hand-held grinding	50	50	—	50	—	—	—	—	—	—	63	—	—	—

^a Definitions see 3.2 and 3.4.

^b Types of bond and designation examples see ISO 525.

^c For maximum permissible speeds according to shape, dimensions and overhang length, see Annex B.

5.3.2 Limit deviations and run-out tolerances

All products shall conform to the values specified in ISO 13942 as far as they are listed therein.

5.4 Admissible unbalance

All products for the use on hand-held machines shall conform to the values specified in EN ISO 6103 as far as they are listed therein.

5.5 Marking

Abrasive products shall be marked according to Annex A.

5.6 Blotters

Blotters shall be supplied by the manufacturer, supplier or importer where these are required for a safe mounting and use of the abrasive product.

Blotters shall be made of suitable compressible material. Shape, dimensions and material shall be adapted to application and intended use. When water-based coolants are used the blotter material shall not be affected in the way that it loses its compressibility and physical function.

Blotters can serve as a label for the marking provided the marking requirements of this standard are met and the blotter is firmly attached to the wheel.

6 Verification of the safety requirements

6.1 Verification of the general requirements

6.1.1 General

Abrasive products shall be tested at a level sufficient to confirm consistent conformance to the requirements of the standard (example see Annex F).

6.1.2 Visual inspection

Abrasive products shall be inspected for visual defects. Damaged abrasive products shall be destroyed.

6.1.3 Ring test

The ring test shall be performed on vitrified abrasive products with $D > 80$ mm, with the exception of cemented and nut inserted abrasive products.

In the ring test the abrasive products are tapped with a non-metallic object. An undamaged abrasive product produces a clear tone, a damaged abrasive product a dull or rattling tone.

6.1.4 Safety speed test

The safety speed test serves for the identification of faults with significant effects on the strength of the abrasive product. In the safety speed test the bonded abrasive product is mounted in a clamping device on a suitable test rig and loaded with an increasing number of revolutions up to the test speed. For calculating the test speed, see Table 2. For abrasive products with safety factor 1,75 and 2 according to Table 4 the test speed factor is 1,1. For all others products the test speed factor is 1,2.

6.2 Verification of the strength requirements

6.2.1 Verification of the safety factor

Compliance with the safety factor is checked by a centrifugal force test. The abrasive product mounted in a clamping device on a suitable test rig is loaded with steadily increasing speed of rotation by

centrifugal forces up to the minimum bursting speed. The speed of rotation shall be measured with an uncertainty of $\pm 1\%$. The speed of the abrasive product shall be detected and recorded by a suitable device.

For mounted points, the verification is carried out with an overhang length of the spindle of $L_0 = 0$ mm.

The bonded abrasive product passes the test if it reaches the minimum bursting speed without breaking. The bonded abrasive products subjected to the test shall be destroyed.

Verification of the safety factor against deflection of the spindle of mounted points is carried out with the maximum overhang length of the spindle indicated by the manufacturer or, if there is no such indication, with a clamping length of the spindle of 10 mm (calculation according to Annex B).

6.2.2 Verification of side load capacity

Method, see Annex C.

6.3 Verification of the dimensional requirements

Compliance is checked on the basis of the dimensional data and the data in the drawings using suitable measuring means e.g. limit gauge, calliper gauges, electronic measuring machines.

6.4 Verification of the admissible unbalance

Verification by using the methods in EN ISO 6103.

6.5 Verification of the marking

Verification of the marking data is effected by visual inspection.

6.6 Verification of the requirements for blotters

Verification is effected by dimensional and visual inspection.

7 Information for use

The manufacturer, supplier or importer of abrasive products shall bring information on safe application and safety recommendations for correct use of the products to the notice of the user. The information shall contain safety recommendations as follows:

- a) general information about the abrasive products and their properties,
- b) handling and storage,
- c) selection of products for safe and correct use,
- d) conditions to be fulfilled before use of abrasive products,
- e) mounting instructions,
- f) grinding and cutting operations:
 - conditions to avoid,
 - malpractice and incorrect use.
- g) content and meaning of marking and supplied information,
- h) restrictions to use.

Annex A (normative)

Marking

A.1 Content of marking

A.1.1 Marking requirements

In Table A.1 the marking requirements applying for the different abrasive products are indicated with “X”.

Table A.1 — Marking of abrasive products

Designation	Specification								
	1	2	3	4	5	6	7	8	9
	Manufacturer, supplier, importer, trade-mark	Nominal dimensions mm	Specification mark	Maximum operating speed ^a m/s	Maximum permissible speed of rotation of the unused abrasive product 1/min or rpm	Declaration of conformity	Restrictions to use	Traceability code	Safety symbols
Abrasive wheels types 27, 28, 29, 41 and 42 for use on hand-held machines	X	X	X	X	X	X	X	X	X
Segments	X	X	X	—	—	X	—	X	—
Mounted points and wheels	X	X	X	—	X	X	—	X	—
Cones and plugs	X	X	X	X	X	X	—	X	—
Abrasive products with magnesite bond	X	X	X	X	X	X	—	X	—
All others	X	X	X	X	X	X	X	X	—
^a Option: Additional marking with colour code in accordance with Annex D.									

To specification 1

Instead of the name of the manufacturer, supplier or importer, their registered trademark may be shown.

To specification 2

Abrasive products	— nominal dimensions in particular the diameter of the bore (e.g. $H = 22,23$ mm for abrasive products to use on hand-held machines) in accordance with ISO 525
Mounted points and wheels	— nominal dimensions, diameter of the spindle and minimum clamping length
Cones and plugs	— nominal dimensions, thread diameter and length of insert
Segments, disc wheels, cylindrical wheels cemented, bolted or clamped to a support plate	— manufacturer's code e.g. drawing number

To specification 3

Specification mark in accordance with ISO 525. Minimum information required: Abrasive type, grain size, grade or hardness, type of bond and use of reinforcement e.g. A46KV, A24SBF.

To specification 5

The speed of rotation marked on the abrasive product should be according to Annex E.

For mounted points and wheels, the maximum permissible speed of rotation as a function of the relevant overhang and the minimum length of spindle within the collet shall be given. An example for a calculation method for the determination of the permissible speeds of rotation is given in Annex B.

To specification 6

For declaration of conformity with the requirements of this standard, the abrasive products shall be marked with:

EN 12413

To specification 7

Abrasive products for which certain grinding procedures, grinding machines and certain applications have to be obeyed shall be marked with the corresponding restrictions to use according to Table A.2.

The restrictions to use shall be given in full length (see Table A.2, column 1) or in the form of a symbol (see Table A.2, column 3).

To specification 8

To ensure traceability and identification, the abrasive products shall be marked with a traceability code which enables to link an individual product to a limited production quantity. The traceability code may be expressed by e.g. a production/batch number, expiry date or series number.

To specification 9

The safety symbols shall be in accordance with EN ISO 7010. See Table A.3.

Table A.2 — Restrictions to use













Restriction to use	Description	Safety symbol
Do not use with hand-held machine	<p>Abrasive product only for use on machines that are not hand-held</p> <p>NOTE This restriction only applies to abrasive products not for use on hand-held machines but capable of being mounted on such machines.</p>	
Do not use for wet grinding and cutting-off	<p>Abrasive product only suitable for dry grinding and cutting-off</p>	
Do not use for grinding	<p>Abrasive product only for cutting-off</p> <p>NOTE This restriction only applies to abrasive products for use on hand-held machines.</p>	
Only permitted for totally enclosed working area	<p>Abrasive product only for use on stationary machines the guarding of which is accepted as TOTALLY ENCLOSED WORKING AREA</p> <p>NOTE See 3.2.2.</p>	
Only permitted with back-up pad	<p>Abrasive product only for use with additional appropriate back-up pad</p>	
Only permitted for grinding at an angle greater than 10°	<p>Not to be used for grinding at an angle less than 10°</p>	
<p>NOTE Colour design of the symbols in accordance with EN ISO 7010 and ISO 3864-2, wherever possible.</p>		

Table A.3 — Safety symbols

Description	Safety symbol
Refer to instruction manual/booklet ^a	
Wear ear protection	
Wear eye protection	
Wear a mask	
Wear protective gloves	
Do not use a damaged abrasive wheel	
NOTE Colour design of the symbols in accordance with EN ISO 7010 and ISO 3864-2, wherever possible.	
^a This safety symbol is recommended but not mandatory.	

A.1.2 Additional inscriptions

A.1.2.1 General

Additional inscriptions on the abrasive products such as ISO type number and manufacturer's product name is permitted provided legibility of the data required according to Table A.1 is not impaired.

A.1.2.2 Abrasive products for hand-held machines

Abrasive products with type of bond B and BF for use on hand-held machines (except mounted points and wheels, plugs and cones) shall be marked with a date of expiry. The date of expiry shall be within 3 years from the date of manufacture. It is expressed as month and year e.g. V04/2021.

Abrasive products for the use on hand-held machines may in addition be marked with information on the type of workable material.

A.1.2.3 Oriented wheels

If wheels need to be mounted in a specific position on the spindle, they shall be marked in such a way as to clearly indicate in this position.

A.1.2.4 Multiple or gang mounted wheels

Wheels to be multiple or gang mounted shall be marked in a manner to ensure they are correctly mounted on the machine spindle, additionally each wheel shall be identified as being part of that set.

A.1.2.5 Magnesite bond

Abrasive products with magnesite bond shall be marked with a date of expiry.

The date of expiry shall be within 1 year from the date of manufacture. It is expressed as month and year e.g. V04/2021.

A.2 Execution of marking

The marking shall be indelible and legible as long as possible.

The marking shall be on the product itself, on a fixed blotter or on a fixed label.

For products with an outside diameter of $D > 80$ mm, when it is not possible to give all specified information on the abrasive product, blotter or label, the abrasive product itself shall at least be marked with the maximum operating speed in so far as the surface and shape of the abrasive product permits.

For products with an outside diameter of $D \leq 80$ mm, and for mounted points and wheels and segments, the specified information may appear on a label fixed to the smallest packaging unit.

Annex B
(informative)

Mounted points and wheels

B.1 Example of calculation of the maximum permissible speed of rotation

According to 5.2.2 mounted points and wheels shall have a safety factor against deflection of the spindle of $S_{ab} = 1,3$. The deflection speed of rotation of the spindle strongly depends on the unsupported overhang of the mounted point. In order to ensure compliance with the safety factor for every length of spindle within the collet the maximum permissible speed of rotation shall be given as a function of the unsupported overhang, see A.1.1, "To specification 5".

The maximum permissible speed of rotation as a function of the unsupported overhang may be determined by calculation, with the following relations (used symbols, see Table B.2):

$$S_{ab} = \frac{n_{ab}}{n_{max}} \text{ with } S_{ab} = 1,3 \quad (B.1)$$

and

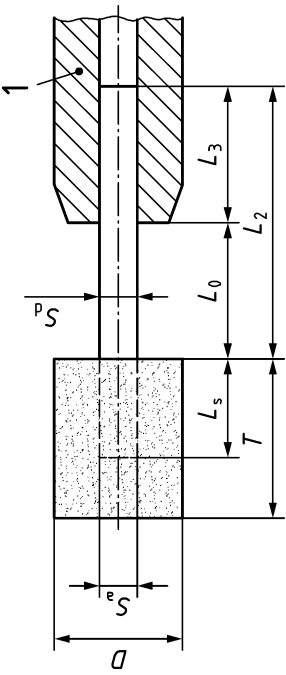
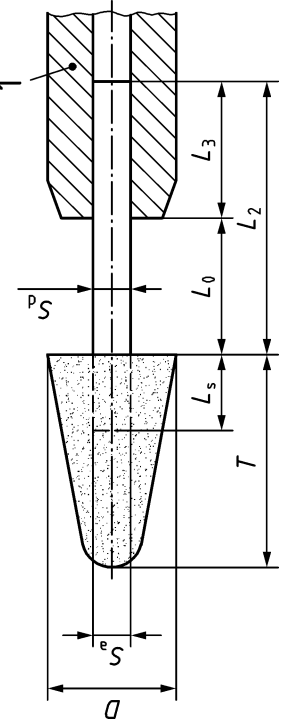
$$n_{ab} = \frac{30}{\pi} \sqrt{\frac{10^6}{\frac{e \cdot M \cdot L_M}{W \cdot R_e} + \frac{M \cdot L_M^3}{3 \cdot E \cdot l}}} \quad (B.2)$$

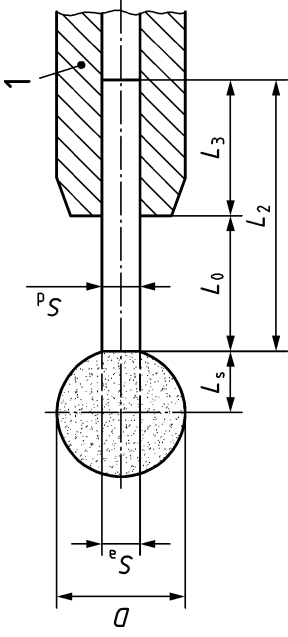
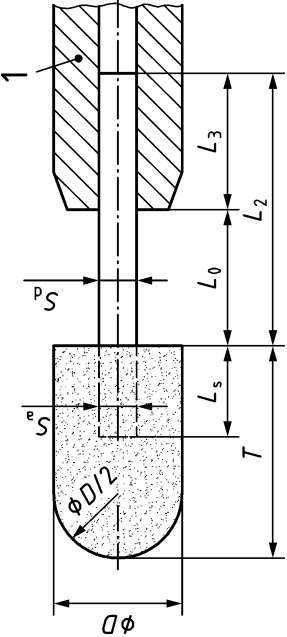
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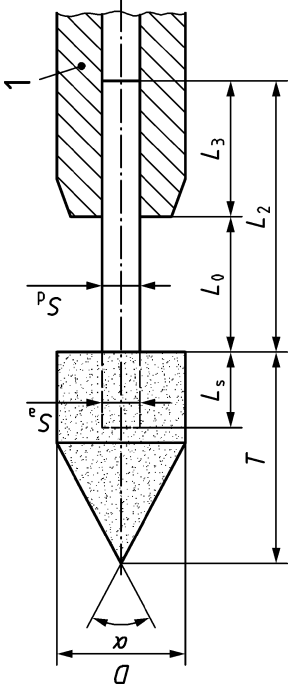
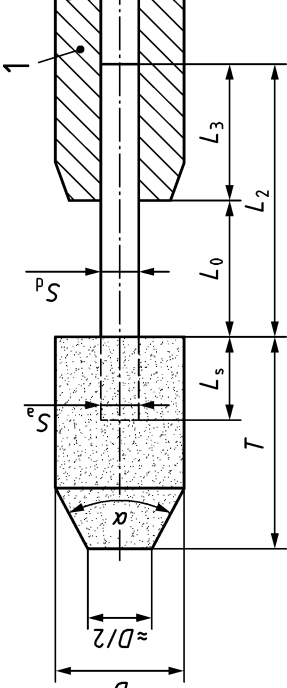
$$l = \frac{\pi}{64} \cdot S^4 \text{ and } W = \frac{\pi}{32} S^3 \quad (B.3)$$

The approximate centre of gravity distance L_M and the reduced mass M shall be determined as a function of the shape of the mounted point, see Table B.1.

Table B.1 — Approximate centre of gravity distance L_M and reduced mass M

Mounted points	Gravity distance L_M and reduced mass M
<p>Cylindrical shape</p>  <p>Key 1 Collet</p>	$L_M = L_0 + \frac{D^2 \cdot T^2 - L_s^2 \cdot S_a^2}{2 \cdot D^2 \cdot T - 2 \cdot L_s \cdot S_a^2}$ $M = m_{sr} + \frac{\pi \cdot \rho_k}{4} \cdot (D^2 \cdot T - L_s \cdot S_a^2) \cdot 10^{-3}$
<p>Conical shape</p>  <p>Key 1 Collet</p>	$L_M = L_0 + \frac{\frac{77}{168} \cdot D^2 \cdot T^2 - L_s^2 \cdot S_a^2}{2 \cdot \left(\frac{7}{12} \cdot D^2 \cdot T - L_s \cdot S_a^2 \right)}$ $M = m_{sr} + \frac{\pi \cdot \rho_k}{4} \cdot \left(\frac{7}{12} \cdot D^2 \cdot T - L_s \cdot S_a^2 \right) \cdot 10^{-3}$

Mounted points	Gravity distance L_M and reduced mass M
<p>Spherical shape</p>  <p>Key 1 Collet</p>	$L_M = L_0 + \frac{1}{3} \cdot D^4 - \frac{1}{2} \cdot L_s^2 \cdot S_a^2$ $M = m_{sr} + \frac{\pi \cdot \rho_k}{4} \cdot \left(\frac{2}{3} \cdot D^3 - L_s \cdot S_a^2 \right) \cdot 10^{-3}$
<p>Cylindrical shape with round end</p>  <p>Key 1 Collet</p>	$L_M = L_0 + \frac{1}{2} \cdot \left[\frac{D^2 \cdot \left(T^2 - \frac{1}{3} \cdot D \cdot T + \frac{1}{24} \cdot D^2 \right) - L_s^2 \cdot S_a^2}{D^2 \cdot \left(T - \frac{1}{6} \cdot D \right) - L_s \cdot S_a^2} \right]$ $M = m_{sr} + \frac{\pi \cdot \rho_k}{4} \cdot \left[D^2 \cdot \left(T - \frac{D}{6} \right) - L_s \cdot S_a^2 \right] \cdot 10^{-3}$

Mounted points	Gravity distance L_M and reduced mass M
<p>Cylindrical shape with conical end (full point)</p>  <p>Key 1 Collet</p>	$L_M = L_0 + \frac{D^2 \cdot \left(T^2 - \frac{2 \cdot \sqrt{3}}{3} \cdot D \cdot T + \frac{3}{8} \cdot D^2 \right) - L_s^2 \cdot S_a^2}{2 \cdot D^2 \cdot \left(T - \frac{\sqrt{3}}{3} \cdot D \right) - L_s \cdot S_a^2}$ $M = m_{sr} + \frac{\pi \cdot \rho_k}{4} \cdot D^2 \cdot \left[T - \frac{\sqrt{3}}{3} \cdot D \right] - L_s \cdot S_a^2 \cdot 10^{-3}$
<p>Cylindrical shape with conical end (truncated end)</p>  <p>Key 1 Collet</p>	$L_M = L_0 + \frac{D^2 \cdot \left(T^2 - \frac{5\sqrt{3}}{24} \cdot D \cdot T + \frac{7}{128} \cdot D^2 \right) - L_s^2 \cdot S_a^2}{2 \cdot D^2 \cdot \left(T - \frac{5\sqrt{3}}{48} \cdot D \right) - L_s \cdot S_a^2}$ $M = m_{sr} + \frac{\pi \cdot \rho_k}{4} \cdot D^2 \cdot \left[T - \frac{5\sqrt{3}}{48} \cdot D \right] - L_s \cdot S_a^2 \cdot 10^{-3}$

Mounted points		Gravity distance L_M and reduced mass M
<p>Ogival shape</p>	$L_M = L_0 + \frac{D^2 \cdot T^2 - \frac{\sqrt{3}}{2} \cdot D \cdot T + \frac{1}{4} \cdot D^2}{2 \cdot D^2 \cdot T - \frac{\sqrt{3}}{4} \cdot D - L_s \cdot S_a^2} - L_s^2 \cdot S_a^2$ $M = m_{sr} + \frac{\pi \cdot \rho_k}{4} \cdot D^2 \cdot \left[T - \frac{\sqrt{3}}{4} \cdot D - L_s \cdot S_a^2 \right] \cdot 10^{-3}$	
<p>Taper cup shape</p>	$L_M = L_0 + \frac{0,0852 \cdot D^2 \cdot T^2 - \frac{1}{8} \cdot L_s^2 \cdot S_a^2}{0,1628 \cdot D^2 \cdot T - \frac{1}{4} \cdot L_s \cdot S_a^2}$ $M = m_{sr} + \pi \cdot \rho_k \cdot \left(0,1628 \cdot D^2 \cdot T - L_s \cdot \frac{S_a^2}{4} \right) \cdot 10^{-3}$	

Key

1 Collet

Key

1 Collet

Table B.2 — Designation of the calculation quantities

Symbols	Designation	Unit
D	Outside diameter of mounted point	mm
L_0	Unsupported overhang	mm
S_d	Spindle diameter	mm
L_2	Length of spindle	mm
L_3	Clamping length of mounted point	mm
T	Overall thickness of mounted point	mm
E	Modulus of elasticity of the spindle material	N/mm ²
R_e	Yield point of the spindle material	N/mm ²
e	Mass eccentricity	mm
ρ_s	Specific density of spindle material	g/cm ³
ρ_k	Specific density of the abrasive product	g/cm ³
K_m	Reducing factor of mass ^a	—
m_{sr}	Reduced mass of spindle ^b	g
m_k	Mass of mounted point without spindle	g
m_s	Mass of spindle	g
L_s	Spindle length inside abrasive product — for cylindrical shape ($L_s = 0,5 T$) — for all other shapes ($L_s = 0,4 T$)	mm
S_a	Diameter of spindle inside the abrasive product ($S_a = S_d$) for plain spindle	mm

a K_m is calculated with following formulae:

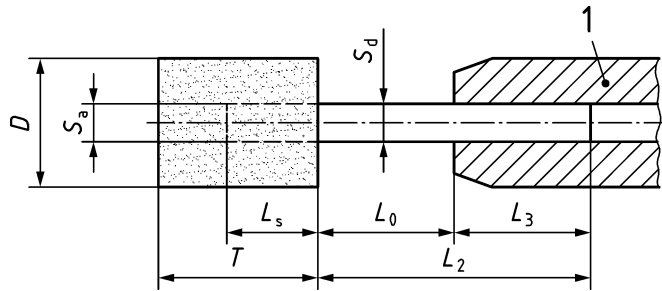
$$K_m = \frac{\frac{33}{140} + \frac{1239}{6720} \cdot \frac{m_s}{m_k}}{1 + \frac{3}{4} \cdot \frac{m_s}{m_k}}$$

b m_{sr} is calculated as follows:

$$m_{sr} = K_m \cdot \pi \cdot \frac{S_d^2}{4} \cdot \rho_s \cdot (L_0 + L_s) \cdot 10^{-3}$$

B.2 Example for application of the calculation method

B.2.1 Mounted point cylindrical shape



Key
 1 Collet

Figure B.1

B.2.2 Assumptions for the calculation

Table B.3 — Characteristics for the calculation of maximum permissible speed of rotation

Unsupported overhangs	$L_0 = 5, 10, 15, 20, 25$ and 30 mm
Limit deviation of spindle diameter S_d	h9
Limit deviation of length of spindle L_2	± 3 mm
Modulus of elasticity of the spindle material	$E = 210\ 000$ N/mm ²
Yield point of the spindle material	$R_e = 300$ N/mm ²
Mass eccentricity	$e = 0,2$ mm
Specific density of spindle material	$\rho_s = 7,85$ g/cm ³
Specific density of the abrasive product	$\rho_k = 2,5$ g/cm ³

B.2.3 Maximum permissible speeds of rotation

Table B.4 — Mounted points cylindrical shape with $S_d = 8$ mm spindle diameter

D mm	T mm	S_d mm	L_2 mm	Maximum permissible speeds of rotation n_{\max} in 1/min for overhang length L_0 in mm					
				5	10	15	20	25	30
25	32	8	40	38 100	38 100	38 100	38 100	34 700	30 600
	40			38 100	38 100	36 600	32 100	28 300	25 200
	50			38 000	33 000	28 900	25 600	22 700	20 300
32	32	8	40	29 800	29 800	29 800	29 800	27 300	24 200
	40			29 800	29 800	28 700	25 200	22 300	19 800
40	20	8	40	23 800	23 800	23 800	23 800	23 800	23 800
	32			23 800	23 800	23 800	23 800	22 000	19 500
	40			23 800	23 800	23 000	20 200	17 900	15 900
50	8	8	40	19 000	19 000	19 000	19 000	19 000	19 000
	13			19 000	19 000	19 000	19 000	19 000	19 000
	25			19 000	19 000	19 000	19 000	19 000	19 000
	40			19 000	19 000	18 400	16 200	14 300	12 800
63	10	8	40	15 100	15 100	15 100	15 100	15 100	15 100
	16			15 100	15 100	15 100	15 100	15 100	15 100
	25			15 100	15 100	15 100	15 100	15 100	15 100

Annex C
 (normative)

Verification methods for side load capacity

C.1 General

Verification of compliance with the requirements for side load capacity according to 5.2.3 is effected with the following methods. For all methods, the abrasive product under test is mounted to a rotating spindle by means of flanges. The flanges have the dimensions given in Table C.1.

Table C.1 — Outside diameters of flanges for mounting abrasive products for the determination of the side load capacity

Type of abrasive product	Outside diameter <i>D</i> mm	Type of machine	Outside diameter of flanges <i>D_F</i> mm
Depressed-centre grinding wheels, straight and depressed-centre cutting-off wheels	$115 \leq D \leq 230$	Hand-held machines	41
	300		100
	350/356		117
	400/406		133

C.2 Single point side load

The rotating abrasive product is laterally loaded by means of a live pressure roll steadily fed in the direction of the axis until rupture (Figure C.1). The pressure roll has an outside diameter between 70 mm and 80 mm, a width of 25 mm and a convexity of 25 mm. It is engaged to one of the lateral faces of cutting-off wheels and to the working face of depressed-centre grinding wheels. The distance *R* between the point of application of the force of the pressure roll and the axis of rotation of the abrasive product is given in Formula (C.1):

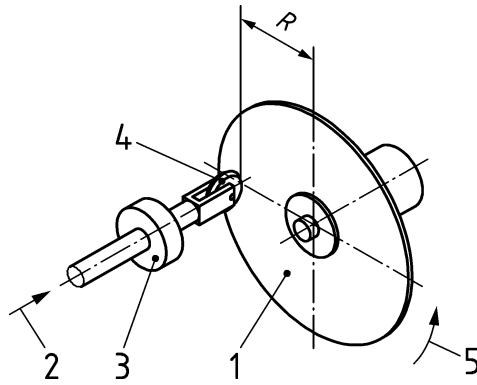
$$R = \frac{D}{2} - 18 \tag{C.1}$$

Where

R is the distance, expressed in mm

D is the outside diameter, expressed in mm

The abrasive product shall rotate with the specified maximum operating speed. The pressure roll is applied with a feeding rate of 3 mm/s until rupture of the abrasive product. The force acting on the pressure roll in the feed direction, the single point side load *F_{S1}*, is measured.



Key

- 1 Abrasive product
- 2 Feed
- 3 Load cell
- 4 Pressure roll
- 5 Direction of rotation

Figure C.1 — Single point side load test

The pressure roll (4) in Figure C.1 shall be manufactured according to the drawing in Figure C.2. Before commencing a single point side load test, the pressure roll should be checked for wear. For wheels with $D \leq 150$ mm, wear should be ≤ 1 mm of roll diameter, for wheels with $D > 150$ mm, wear should be ≤ 3 mm of roll diameter.

Dimensions in millimetres

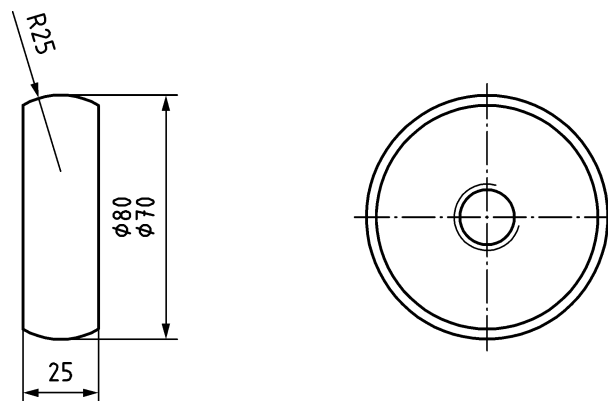


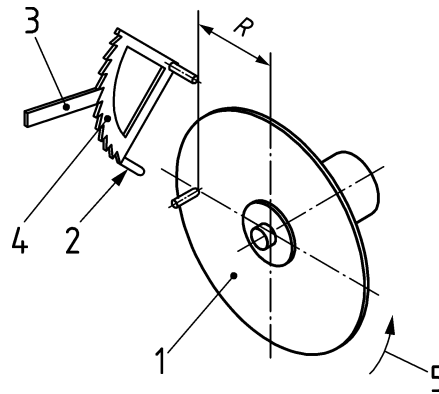
Figure C.2 — Pressure roll

C.3 Impact test

The rotating abrasive product is laterally loaded with one or several impacts supplied successively by means of a pendulum testing machine until rupture (Figure C.3). The pendulum testing machine consists of a frame, inside which a pendulum with striker and, if necessary, additional mass, is mounted. Its potential working capacity is adjustable in 50 steps up to 20 Nm (without additional mass) or 42 Nm (with additional mass). The force is applied by means of a striker with a diameter of 30 mm, an unsupported length of 115 mm and a maximum radius of 40 mm. The striker is engaged to one of the lateral faces of cutting-off wheels and to the lateral face used for grinding of depressed centre grinding

wheels. The distance R between the point of application of the striker of the pendulum testing machine and the axis of rotation of the abrasive product shall be as given in the aforementioned Formula (C.1).

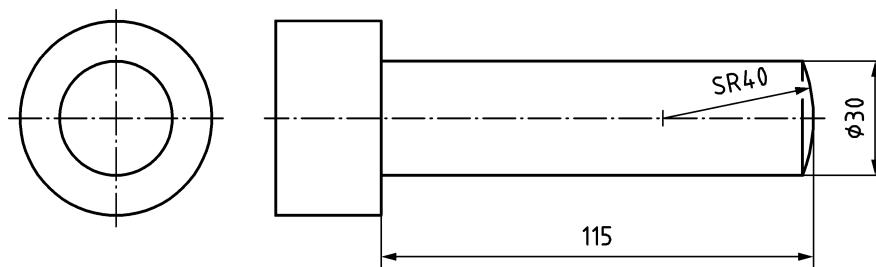
The abrasive product rotates with the specified maximum operating speed and is at first loaded with the required minimum working capacity values required in Table 5 and inspected for visible damages. If no damage is visible to the naked eye, the test is repeated with higher working capacities to be set on the pendulum testing machine. Both the highest working capacity at which still no visible damages have occurred and the working capacity of the next higher grade and the resulting damages are being determined.



- Key**
- 1 abrasive product
 - 2 striker
 - 3 detent pawl
 - 4 pendulum
 - 5 direction of rotation

Figure C.3 — Impact test

The striker (2) in Figure C.3 shall be manufactured according to the drawing in Figure C.4.



- Key**
- SR spherical radius

Figure C.4 — Striker

Annex D (informative)

Colour codes

Colour codes can be used as additional marking of the maximum operating speed, see Table A.1. If they are used, the requirements of Table D.1 shall be met. Colour codes shall only be applied for the discrete speed values given in Table D.1. Intermediate speeds shall not have a colour stripe.

Table D.1 — Colour codes and design of colour codes

Maximum operating speed v_s m/s	Colour code		
	Number and colour	Width of colour stripe	Width of gap
50	1 × blue	5 mm to 20 mm	—
63	1 × yellow		
80	1 × red		
100	1 × green		
125	1 × blue 1 × yellow	5 mm to 20 mm each	at least 2 mm, not greater than width of a colour stripe

Colour code stripes shall extend through the centre and across the whole diameter of the abrasive product or the label. They shall be straight and of even width. Any of the coloured markings on the products shall not be confused with the colour code according to Table D.1.

Abrasive products in magnesite bond shall be marked with a white colour code independently from their maximum operating speeds.

Annex E
(informative)

Speed conversion table

The values given in Table E.1 are not the exact calculated values but recommended values to be used for marking the abrasive products.

Table E.1 — Speed conversion ($16 \leq v \leq 125$)

Outside diameter <i>D</i> of the abrasive product mm	Peripheral speed <i>v</i> m/s											
	16	20	25	32	35	40	45	50	63	80	100	125
	Speed of rotation <i>n</i> 1/min or rpm											
6	51 000	64 000	80 000	102 000	112 000	128 000	143 240	160 000	201 000	—	—	—
8	38 200	48 000	60 000	76 500	84 000	95 500	107 430	120 000	150 500	191 000	—	—
10	30 600	38 200	48 000	61 200	67 000	76 500	86 000	95 500	120 500	153 000	191 000	—
13	23 550	29 500	35 600	47 100	51 500	58 800	66 500	73 500	92 600	118 000	147 000	184 000
16	19 100	23 900	29 850	38 200	41 800	47 800	54 000	59 700	75 200	95 500	120 000	150 000
20	15 300	19 100	23 900	30 600	33 500	38 200	43 000	47 800	60 200	76 500	95 500	120 000
25	12 300	15 300	19 100	24 500	26 800	30 600	34 400	38 200	48 200	61 200	76 500	95 500
32	9 550	11 950	14 950	29 100	20 900	23 900	26 900	30 000	37 600	48 000	60 000	75 000
40	7 650	9 550	11 950	15 300	16 750	19 100	21 500	23 900	30 100	38 200	47 200	59 700
50	6 150	7 650	9 550	12 250	13 400	15 300	17 200	19 100	24 100	30 600	38 200	47 750
63	4 850	6 100	7 600	9 750	10 650	12 150	13 650	15 200	19 100	24 300	30 250	37 900
80	3 850	4 800	6 000	7 650	8 400	9 550	10 750	12 000	15 100	19 100	23 900	29 850
100	3 100	3 850	4 800	6 150	6 700	7 650	8 600	9 550	12 100	15 300	19 100	23 900
115	2 700	3 350	4 200	5 350	5 850	6 650	7 500	8 350	10 500	13 300	16 650	20 800
125	2 450	3 100	3 850	4 900	5 350	6 150	6 900	7 650	9 650	12 250	15 300	19 100
150	2 050	2 550	3 200	4 100	4 500	5 100	5 750	6 400	8 050	10 200	12 700	16 000
180	1 700	2 150	2 700	3 400	3 750	4 250	4 800	5 350	6 700	8 500	10 650	13 300
200	1 550	1 950	2 400	3 100	3 350	3 850	4 300	4 800	6 050	7 650	9 550	11 950
230	1 350	1 700	2 100	2 700	2 950	3 350	3 750	4 200	5 250	6 650	8 350	10 400
250	1 250	1 550	1 950	2 450	2 700	3 100	3 450	3 850	4 850	6 150	7 650	9 550
300	1 050	1 300	1 600	2 050	2 250	2 550	2 870	3 200	4 050	5 100	6 400	8 000
350/356	875	1 100	1 400	1 750	1 950	2 200	2 450	2 750	3 450	4 400	5 500	6 850
400/406	765	960	1 200	1 550	1 700	1 950	2 150	2 400	3 050	3 850	4 800	6 000

Outside diameter <i>D</i> of the abrasive product mm	Peripheral speed <i>v</i> m/s											
	16	20	25	32	35	40	45	50	63	80	100	125
	Speed of rotation <i>n</i> 1/min or rpm											
450/457	680	850	1 100	1 400	1 500	1 700	1 950	2 150	2 700	3 400	4 250	5 350
500/508	615	765	960	1 250	1 350	1 550	1 750	1 950	2 450	3 100	3 850	4 800
600/610	510	640	800	1 050	1 150	1 300	1 450	1 600	2 050	2 550	3 200	4 000
650/660	460	580	720	930	1 010	1 160	1 300	1 450	1 820	2 320	2 900	3 620
750/762	410	510	640	820	895	1 050	1 150	1 300	1 650	2 050	2 550	3 200
800/813	385	480	600	765	840	960	1 075	1 200	1 550	1 950	2 400	3 000
900/914	340	425	535	680	750	850	955	1 100	1 350	1 700	2 150	2 700
1 000/ 1 015	310	385	480	615	670	765	860	960	1 250	1 550	1 950	2 400
1 060/ 1 067	295	365	455	585	640	730	820	910	1 150	1 500	1 850	2 300
1 120	280	350	435	560	610	695	780	870	1 100	1 400	1 750	2 200
1 220	255	320	400	510	560	640	720	800	1 050	1 300	1 600	2 000
1 250	245	305	380	490	535	610	690	760	960	1 220	1 530	1 910
1 500	205	255	320	410	450	510	570	640	805	1 020	1 270	1 600
1 800	170	220	265	340	375	425	475	535	670	850	1 100	1 350

Annex F
(informative)

Recommended scope of the in-process inspection

It is the responsibility of the manufacturer to ensure that all of his products meet the requirements of this standard where relevant.

Tests shall also be conducted to ensure that the process is under control. The sampling levels shall be determined by the manufacturer at a level suitable to confirm conformance. Tables F.1 to F.3 specify the recommended scope of the in-process inspection. Their application presumes that the bursting speed test and – if necessary – the side load test and impact test were successfully affected as type test and that the production of the abrasive products is carried out under controlled conditions.

Table F.1 — Products requiring only visual inspection

Abrasive product	Type
Segments	31
Mounted points and wheels	52
Plugs and cones	16 to 19
Wheels in magnesite bond (Mg)	all

Table F.2 — All other products for use on stationary and mobile machines

Abrasive product	Type	Bond	Dimensions mm	Maximum operating speed m/s	Recommended minimum percentage of manufacturing batch to be tested		
					Safety speed test	Visual inspection	
Straight cutting-off wheels, unreinforced	41	B, R, E	$D < 150$	all	—	100 %	
			$D \geq 150$	all	5 %	100 %	
Straight and depressed-centre cutting-off wheels, reinforced	41, 42	BF, RF	$D < 150$	all	—	100 %	
			$D \geq 150$	all	5 % ^a	100 %	
Straight grinding wheels, reinforced	1, 4, 5	BF, RF	$D < 150$	all	—	100 %	
			$D \geq 150$	all	5 %	100 %	
Straight grinding wheels, highly compressed, for high-pressure grinding	1	B, BF	$D \geq 400$	all	100 %	100 %	
Disc wheels and cylinder wheels, bolted, cemented or clamped to a support plate	2, 35, 36, 37	V, B, R, PL	all	≤ 50	—	100 %	
				> 50	10 %	100 %	
Cup wheels	6, 11	V, B, R, PL	$D > 80$	< 50	—	100 %	
				≥ 50	10 %	100 %	
All other abrasive products	all	V, B, R, E, PL	$D < 150$	all	—	100 %	
			$150 \leq D \leq 406$	≤ 80	10 %	100 %	
				> 80	100 %	100 %	
			$406 < D \leq 762$	$T \leq 100$	≤ 50	10 %	100 %
				$T > 100$	> 50	100 %	100 %
$D > 762$	all	100 %	100 %				

^a The manufacturer may alternatively test 0,1 % of the batch to the minimum bursting speed.

Table F.3 — All other products for use on hand-held machines

Abrasive product	Type	Bond	Diameter mm	Thickness mm	Maximum operating speed m/s	Recommended minimum percentage of manufacturing batch to be tested				
						Destructive bursting speed test	Destructive side load test	Destructive impact test	Balance test	Visual inspection
Grinding wheels	1, 4, 5	B, BF	$150 \leq D \leq 250$	all	≤ 80	0,1 %	—	—	•	100 %
Cup wheels	6, 11	B	$D > 80$	all	≤ 80	0,1 %	—	—	—	100 %
Straight and depressed- centre cutting-off wheels, reinforced	41, 42	BF, RF	$D < 115$	all	all	—	—	—	—	100 %
			$115 \leq D < 150$	all	all	0,01 %	0,01 %	—	—	100 %
			$150 \leq D \leq 406$	< 2	all	0,01 %	0,01 %	0,01 %	•	100 %
			$150 \leq D \leq 406$	≥ 2	all	0,1 %	0,01 %	0,01 %	•	100 %
Depressed-centre grinding wheels, reinforced	27, 28, 29*	BF, RF	$D < 115$	all	all	—	—	—	—	100 %
			$115 \leq D < 150$	all	all	0,01 %	0,01 %	—	—	100 %
			$150 \leq D \leq 230$	< 2	all	0,01 %	0,01 %	0,01 %	•	100 %
			$150 \leq D \leq 230$	$2 - 6$	all	0,1 %	0,01 %	0,01 %	•	100 %
			$150 \leq D \leq 230$	> 6	all	0,1 %	—	—	•	100 %
<ul style="list-style-type: none"> • Balance shall be tested at a level sufficient to confirm conformance to the standard ISO 6103 * Only destructive bursting speed test, balance test and visual inspection. 										
<p>NOTE Products requiring destructive testing can be either:</p> <ul style="list-style-type: none"> — tested to the minimum requirement only (confirmation of destructive design test capability will need to be confirmed by the manufacturer at a frequency he considers appropriate); — tested to failure (reconfirmation of destructive design test capability is not necessary). 										

Bibliography

- [1] EN ISO 11148-7, *Hand-held non-electric power tools - Safety requirements - Part 7: Grinders (ISO 11148-7)*
- [2] EN ISO 11148-9, *Hand-held non-electric power tools - Safety requirements - Part 9: Die grinders (ISO 11148-9)*
- [3] EN ISO 16089, *Machine tools - Safety - Stationary grinding machines (ISO 16089)*
- [4] EN 60745-2-3, *Hand-held motor-operated electric tools — Safety — Part 2-3: Particular requirements for grinders, polishers and disc-type sanders*
- [5] EN 60745-2-22, *Hand-held motor-operated electric tools - Safety - Part 2-22: Particular requirements for cut-off machines*
- [6] EN 60745-2-23, *Hand-held motor-operated electric tools - Safety - Part 2-23: Particular requirements for die grinders and small rotary tools*
- [7] EN 61029-2-4, *Safety of transportable motor-operated electric tools - Part 2-4: Particular requirements for bench grinders*
- [8] EN 61029-2-10, *Safety of transportable motor-operated electric tools - Part 2-10: Particular requirements for cutting-off grinders*
- [9] EN 62841-3-4, *Electric motor-operated hand-held tools, transportable tools and lawn and garden machinery - Safety - Part 3-4: Particular requirements for transportable bench grinders*
- [10] EN ISO 7010, *Graphical symbols - Safety colours and safety signs - Registered safety signs (ISO 7010)*
- [11] EN ISO 19432, *Building construction machinery and equipment - Portable, hand-held, internal combustion engine driven cut-off machines - Safety requirements (ISO 19432)*
- [12] ISO 3864-2, *Graphical symbols — Safety colours and safety signs — Part 2: Design principles for product safety labels*

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