

Safety requirements for bonded abrasive products

The European Standard EN 12413:1999 has the status of a
British Standard

ICS 25.100.70

NO COPYING WITHOUT BSI PERMISSION EXCEPT AS PERMITTED BY COPYRIGHT LAW



Document Sharing Hub

National foreword

This British Standard is the English language version of EN 12413:1999.

The UK participation in its preparation was entrusted to Technical Committee MTE/13, Grinders, wheels, abrasive tools, paper and cloths, powders, which has the responsibility to:

- aid enquirers to understand the text;
- present to the responsible European committee any enquiries on the interpretation, or proposals for change, and keep the UK interests informed;
- monitor related international and European developments and promulgate them in the UK.

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

Cross-references

The British Standards which implement international or European publications referred to in this document may be found in the BSI Standards Catalogue under the section entitled “International Standards Correspondence Index”, or by using the “Find” facility of the BSI Standards Electronic Catalogue.

A British Standard does not purport to include all the necessary provisions of a contract. Users of British Standards are responsible for their correct application.

Compliance with a British Standard does not of itself confer immunity from legal obligations.

Summary of pages

This document comprises a front cover, an inside front cover, the EN title page, pages 2 to 45 and a back cover

The BSI copyright notice displayed in this document indicates when the document was last issued.

This British Standard, having been prepared under the direction of the Engineering Sector Committee, was published under the authority of the Standards Committee and comes into effect on 15 November 1999

© BSI 11-1999

Amendments issued since publication

Amd. No.	Date	Comments

ISBN 0 580 32830 9

English version

Safety requirements for bonded abrasive products

Exigences de sécurité pour les produits abrasifs agglomérés

Sicherheitsanforderungen für Schleifkörper aus gebundenem Schleifmittel

This European Standard was approved by CEN on 17 March 1999.

CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration. Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CEN member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the Central Secretariat has the same status as the official versions.

CEN members are the national standards bodies of Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and United Kingdom.

CEN

European Committee for Standardization
Comité Européen de Normalisation
Europäisches Komitee für Normung

Central Secretariat: rue de Stassart 36, B-1050 Brussels

© 1999 CEN All rights of exploitation in any form and by any means reserved worldwide for CEN national Members.

Foreword

This European Standard has been prepared by Technical Committee CEN/TC 143, Machine tools — Safety, the Secretariat of which is held by UNI.

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 October 1999, and conflicting national standards shall be withdrawn at the latest by October 1999.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and the United Kingdom.

Contents

Foreword	2
0 Introduction	3
1 Scope	3
2 Normative references	3
3 Definitions and symbols	3
3.1 bonded abrasive products	3
3.2 abbreviations for materials	3
3.3 grinding machine	4
3.4 type of application	4
3.5 method of operation	4
3.6 abbreviations for bonded abrasive products	5
3.7 symbols for speed of rotation, speeds and safety factors	6
3.8 other symbols	6
3.9 other definitions	6
4 List of hazards	6
5 Requirements	6
5.1 General requirements	6
5.2 Dimensional limitations for standard grinding wheel shapes depending on type of machine, type of application and maximum operating speed	6

5.3 Limits deviations and run-out tolerances	6
5.4 Admissible unbalance	8
5.5 Marking	8
5.6 Blotters	8
5.7 Mounted points	8
6 Inspection and testing by the manufacturer	8
6.1 Test methods	8
6.2 Scope of the inspection	25
7 Information for use	26
Annex A (normative) Marking	27
A.1 Purpose	27
A.2 Content of marking	27
A.3 Execution of marking	27
A.4 Design of the marking	30
Annex B (normative) Blotters	31
B.1 Purpose	31
B.2 Scope	31
B.3 Requirements	32
B.4 Supply of blotters with abrasive products	32
Annex C (normative) Mounted points	33
C.1 Scope	33
C.2 Shapes, dimensions and limit deviations	33
C.3 Maximum permissible speed	33
C.4 Calculation of maximum permissible speeds of rotation	41
Annex D (informative) Procedures of test methods for side load capacity	43
D.1 Single point side load	43
D.2 Three point side load	43
D.3 Impact test	43
Annex E (informative) Conversion table for speed of rotation and peripheral surface speed	44
Annex F (informative) Bibliography	45

0 Introduction

This standard has been prepared to be a European Standard to provide one means of conforming with the Essential safety requirements of the Machinery Directive and associated EFTA regulations.

This standard is addressed to designers, manufacturers and suppliers of the grinding tools described in the Scope. In addition, it helps designers, manufacturers and suppliers of grinding machines in the selection of grinding tools, in order to reduce the risks and achieve conformity of the respective machinery with the Essential safety requirements of the Machinery Directive.

The extent to which hazards are covered is indicated in the Scope of this standard.

1 Scope

This standard 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 grinding tools.

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

The hazards taken into consideration are listed in clause 4 of this standard.

This standard applies to bonded abrasive products with aluminium oxide, silicon carbide or zirconia alumina as abrasive. It does not apply to rotating superabrasives with diamond or cubic boron nitride as abrasive and also not to coated abrasive products.

2 Normative references

This European Standard incorporates by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated reference subsequent amendments to, or revisions of, any of these publications apply to this European Standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies.

ISO 525, *Bonded abrasive products — General — Designation, marking, range of outside diameters and tolerances.*

ISO 6103, *Bonded abrasive products — Static balancing of grinding wheels — Testing.*

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

3 Definitions and symbols

3.1

bonded abrasive products

bonded abrasive products are production tools that perform their task by cutting a chip or piece from the material being ground. They consist of abrasives and bond

Bonded abrasive products within the meaning of this standard are all grinding wheels, cup wheels, cylinder wheels, segments and mounted wheels.

3.2 abbreviations for materials

For the purposes of this standard the following definitions and symbols apply.

Table 1 — Abrasives

A	Aluminium oxide
B	Silicon carbide
Z	Zirconia alumina

Table 2 — Grit

Macro grits			Micro grits
coarse	medium	fine	very fine
4	30	70	230
5	36	80	240
6	40	90	280
7	46	100	320
8	54	120	360
10	60	150	400
12	—	180	500
14		220	600
16		—	800
20			1 000
22			1 200
24			—

Table 3 — Hardness grade

Hardness grade is designated by a letter of the alphabet. "A" being the softest and "Z" the hardest.				
A	B	C	D	extremely soft
E	F	G	—	very soft
H	I	J	K	soft
L	M	N	O	medium
P	Q	R	S	hard
T	U	V	W	very hard
X	Y	Z	—	extremely hard

Table 4 — Structure

Wheel structure may be designated by numbers, usually 0 to 14, with higher numbers indicating more open structure.
--

Table 5 — Type of bond

V	Vitrified bond
R	Rubber bond
RF	Reinforced rubber bond
B	Resinoid and other thermosetting organic bonds
BF	Resinoid bond fibre-reinforced
E	Shellac bond
MG	Magnesite bond
PL	Plastic bond



Documents

Document Sharing Hub

3.3 grinding machine

3.3.1

stationary grinding machines

machines are fixed to their position during operation due to their nature or their mechanical attachment. They also include for example fixed swing-frame grinding machines and mobile machines clamped firmly in position during use, e.g. track grinding machine

3.3.2

mobile grinding machines

machines which are manually guided (but not supported) by hand during use, e.g. floor grinding machines, flexibly suspended swing-frame grinding machines

3.3.3

hand-held grinding machines

machines, including those with flexible drives, are held in the hand during the grinding process

3.3.4

stationary cutting-off machines

machines are specifically designed for cutting-off or slotting applications. They also include transportable cutting-off machines, which are clamped firmly in position during use

3.3.5

mobile cutting-off machines

machines which are guided (but not supported) by hand during the cutting process, e.g. floor saws, flexibly suspended swing-frame cutting-off machines

3.3.6

hand-held cutting-off machines

machines which are held in the hand during cutting off applications

3.3.7

grinding- and cutting-off machines with totally enclosed working area

stationary machines for mechanically guided grinding or cutting-off with operating areas, which are protected by separating guards in such a way that machining processes, including loading and unloading of workpieces, can be carried out inside them and persons are protected against hazards generated by bursting of an abrasive product

3.4 type of application

see Table 6

3.4.1

mechanically guided grinding

the feed movements of the grinding tool and/or the workpiece are guided by mechanical means

3.4.2

manually guided grinding

the feed movements of the grinding tool and/or the workpiece are manually guided by the operator

3.4.3

hand-held grinding

the grinding machine is entirely guided by the operator's hands

3.5 method of operation

3.5.1

peripheral grinding

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

3.5.2

face grinding

grinding with the face of the wheel

3.5.3

cutting-off

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

3.5.4

high pressure grinding

grinding with high contact pressure

Table 6 — Type of application

Grinding method	Type of machine	Type of application	Abrasive product	Workpiece
Grinding	Stationary grinding machines	Mechanically guided grinding	Fixed	Guided mechanically
			Guided mechanically	Fixed
			Guided mechanically	Guided mechanically
	Stationary and mobile grinding machines	Manually guided grinding	Guided by hand	Fixed
			Fixed	Guided by hand
	Hand-held grinding machines	Hand-held grinding	Guided by hand	Fixed
Cutting-off	Stationary cutting-off machines	Mechanically guided cutting-off	Fixed	Guided mechanically
			Guided mechanically	Fixed
			Guided mechanically	Guided mechanically
	Stationary and mobile cutting-off machines	Manually guided cutting-off	Guided by hand	Fixed
			Fixed	Guided by hand
	Hand-held cutting-off	Hand-held cutting-off	Guided by hand	Fixed

3.6 abbreviations for bonded abrasive products

Table 7 — Abbreviations for bonded abrasive products

Symbol	Designation
<i>A</i>	Smallest width of a trapezoidal segment
<i>B</i>	Width of a segment
<i>C</i>	Thickness of a segment
<i>D</i>	Outside diameter of abrasive products
<i>E</i>	Thickness at bore of cup, dish, recessed and relieved wheels
<i>F</i>	Depth of the 1st recess
<i>G</i>	Depth of the 2nd recess
<i>H</i>	Abrasive product bore diameter, thread diameter of wheels with threaded insert
<i>J</i>	Smallest diameter of tapered cup, dish, tapered and hubbed grinding wheels
<i>K</i>	Internal diameter of recess of tapered cup and dish wheels
<i>L</i>	Length of a segment, length of thread bore of wheels with threaded insert

Table 7 — Abbreviations for bonded abrasive products (continued)

Symbol	Designation
<i>L</i> ₀	Overhang length of mounted wheels and points
<i>L</i> ₂	Length of the spindle of mounted wheels and points
<i>L</i> ₃	Clamping length of the spindle of mounted wheels and points
<i>L</i> _f	Unsupported length of the segments
<i>N</i>	Depth of the relief
<i>P</i>	Recess diameter
<i>S</i> _d	Diameter of spindle of mounted wheels and points
<i>T</i>	Overall thickness
<i>T</i> _D	Limits of deviation of outside diameter
<i>T</i> _H	Limits of deviation of bores diameter
<i>T</i> _T	Limits of deviation of the thickness
<i>U</i>	Smallest thickness of tapered, hubbed and depressed centre wheels, e.g. in Type 4 or Type 38
<i>W</i>	Rim width of cups, cylinders and dishes

NOTE All dimensions are in millimetres.

3.7 symbols for speed of rotation, speeds and safety factors

Table 8 — Speed and test

Abbreviations	Designation	Definition	Unit
<i>n</i>	Speed of rotation	Revolutions per minute (rpm)	min ⁻¹ or $\frac{1}{\text{min}}$
<i>n</i> _{ab}	Deflection speed of mounted points	Speed in r/min at which the spindle of mounted points is deflecting under centrifugal force	min ⁻¹ or $\frac{1}{\text{min}}$
<i>n</i> _{max}	Maximum permissible speed of rotation	Revolutions per minute (r/min) of the new abrasive product at maximum peripheral operating speed	min ⁻¹ or $\frac{1}{\text{min}}$
<i>v</i>	Peripheral surface speed	Speed at the periphery of the abrasive product	m/s
<i>v</i> _s	Maximum operating speed	The maximum permissible peripheral surface speed of a rotating abrasive product	m/s
<i>v</i> _{pr}	Safety test speed	Peripheral speed at which abrasive products are tested by the manufacturer	m/s
<i>f</i> _{pr}	Test speed factor	The ratio of the safety test speed, divided by the maximum operating speed	—
<i>v</i> _{br}	Bursting speed	The peripheral surface speed at which the abrasive product breaks under stress	m/s
<i>v</i> _{br min}	Minimum bursting speed	Peripheral surface speed, which the abrasive product shall at least reach without bursting due to centrifugal force	m/s
<i>S</i>	Safety factor	The bursting speed, divided by the maximum operating speed, all squared. The formula for <i>S</i> is: $S = \left(\frac{v_{br}}{v_s} \right)^2$	—
<i>S</i> _{ab}	Safety factor of spindle deflection for mounted points	The ratio of the deflection speed, divided by the maximum permissible speed of rotation. The formula is: $S_{ab} = \frac{n_{ab}}{n_{max}}$	—

3.8 other symbols

Table 9 — Symbols

Symbol	Designation	Unit
A	Working capacity	Nm
F_{S1}	Single point side load	N
F_{S3}	Three point side load	N
R_e	yield point	N/mm ²
ϱ	density	kg/dm ³
▼	The grinding face of the abrasive product, see Table 10.	—

3.9 Other definitions

3.9.1

label

labels contain essential information on the abrasive products to which they belong

3.9.2

blotter

blotters are placed between abrasive products and flanges

4 List of hazards

Table 10 — List of hazards

Hazard designation	Hazardous situation (examples)	Relevant clauses in this standard
Ejection of parts	1) Wheel breakage	
	— improper design, manufacturing defects	5.1, 5.2, 5.3, 5.7 and annex C
	— manufacturing defects	6
	— wrong selection	5.5, 7 and annex A
	— improper handling and storage	7
	— improper use (mounting and grinding process)	7, annex A and annex B
	2) Loosening of grinding particles	7
Vibration	Unbalanced caused by inadmissible out of balance	—
	— manufacturing defect	5.4 and 6
	— improper use, mounting	7

5 Requirements

5.1 General requirements

Abrasive products are subject to high stresses during grinding. Therefore they shall have specified safety factors and bursting speeds as a function of type of machine, type of application and maximum operating speed.

5.1.1 Maximum operating speeds

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

< 16 – 16 – 20 – 25 – 32 – 35 – 40 – 50 – 63 – 80 – 100 – 125 – 140 – 160 in m/s.

Conversion table for speeds of rotation and maximum operating speeds as a function of the outside diameter D of the abrasive products, see annex E.

5.1.2 Safety factors

The safety factor against breaks under stress shall correspond to the values given in Table 11.

5.1.3 Side load capacity

Depressed-centre wheels (type 27, type 28), straight cutting-off wheels (type 41), and depressed-centre cutting-off wheels (type 42) for hand-held applications shall have an adequate side load capacity.

5.2 Dimensional limitations for standard grinding wheel shapes depending on type of machine, type of application and maximum operating speed

Bonded abrasive products shall comply with the dimensional limits as specified in Table 12, as a function of the shape, type of machine, type of application and maximum operating speed. Where no operating speed has been specified by the user, the manufacturer shall design, test and mark the wheel according to Table 12 below.

On specific request by the user, grinding wheels may be designed, tested and marked with a maximum operating speed not higher than the special maximum operating speeds as specified in Table 12.

For totally-enclosed machines only, the speeds given in Table 12 may be exceeded provided that the required safety factor has been met in Table 11.

5.3 Limit deviations and run-out tolerances

The admissible limit deviations and run-out tolerances shall not exceed the values given in ISO/DIS 13942, *Bonded abrasive products — Limit deviations and run-out tolerances*.

In the case of high temperature applications, nominal bore diameter and limit deviations for abrasive products with vitrified bond may be adapted by the manufacturer.

Table 11 — Maximum operating speeds, safety factors and minimum bursting speeds for different types of machine and types of application

Type of machine	Type of application	Maximum operating speed v_s in m/s	Coefficient of safety S	Minimum bursting speed $v_{br \text{ min}}$ in m/s
Stationary grinding machines	Mechanically guided grinding	< 16	3	—
		16	3	28
		20	3	35
		25	3	43
		32	3	55
		35	3	61
		40	3	69
		50	3	87
		63	3	109
		80	3	139
	Mechanically guided grinding, totally enclosed	40	1,75	53
		50	1,75	66
		63	1,75	83
		80	1,75	106
		100	1,75	132
		125	1,75	165
		140	1,75	185
		160	1,75	212
	Mechanically guided high-pressure grinding	63	3,5	118
		80	3,5	150
	Mechanically guided high-pressure grinding, totally enclosed	63	3	109
		80	3	139
		100	3	173
Stationary and mobile grinding machines	Manually guided grinding	< 16	3	—
		16	3	28
		20	3	35
		25	3	43
		32	3	55
		35	3	61
		40	3	69
		50	3	87
		63	3	109
		80	3,5	150
Hand-held grinding machines	Hand-held grinding	16	3	28
		20	3	35
		25	3	43
		32	3	55
		35	3	61
		40	3	69
		50	3	87
		63	3,5	118
		80	3,5	150

Table 11 — Maximum operating speeds, safety factors and minimum bursting speeds for different types of machine and types of application (*continued*)

Type of machine	Type of application	Maximum operating speed v_s in m/s	Coefficient of safety S	Minimum bursting speed $v_{br \text{ min}}$ in m/s
Stationary cutting-off machines	Mechanically guided cutting-off	35	2	50
		40	2	57
		50	2	71
		63	2	89
		80	2	113
		100	2	141
	Mechanically guided cutting-off, totally enclosed	40	1,75	53
		50	1,75	66
		63	1,75	83
		80	1,75	106
		100	1,75	132
		125	1,75	165
Stationary and mobile cutting-off machines	Manually guided grinding	63	3,5	118
		80	3,5	150
Hand-held cutting-off machines	Hand-held cutting-off	50	3,5	94
		63	3,5	118
		80	3,5	150
		100	3,5	188

5.4 Admissible unbalance

The admissible unbalance shall not exceed the values given in ISO 6103, *Bonded abrasive products — Static balancing of grinding wheels — Testing*.

5.5 Marking

The marking of bonded abrasive products shall be indelible and legible. Whenever possible it shall appear on the bonded abrasive product.

Bonded abrasive products shall be marked according to annex A.

5.6 Blotters

Blotters shall be supplied by the manufacturer, supplier or importer when there is a need for this for a safe mounting and use of the bonded abrasive product. Requirements for blotters, see annex B.

5.7 Mounted points

Mounted points in accordance with this standard shall have a safety factor against breakage caused by centrifugal force of $S = 3$. The safety factor of spindle deflection shall be $S_{ab} = 1,3$. Further requirements, see annex C.

6 Inspection and testing by the manufacturer

Abrasive products shall only be delivered after they have been tested successfully and inspected according to this standard.

The inspection of abrasive products has the purpose of showing manufacturing defects affecting safety. It shall be carried out as part of the manufacturing process before delivery of the bonded abrasive products.

6.1 Test methods

For testing of conformity with the requirements according to clause 5, the following test methods are applied:

- safety speed test, according to 6.1.1;
- bursting test according to 6.1.2;
- visual inspection according to 6.1.3;
- ring test according to 6.1.4;
- testing of the bore diameter according to 6.1.5;
- unbalance test, according to 6.1.6;
- testing of side load capacity, according to 6.1.7.

Table 12 — Standard grinding wheel spaces depending on type of machine, type of application and maximum operating speed

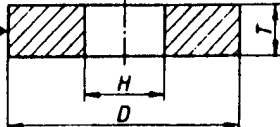
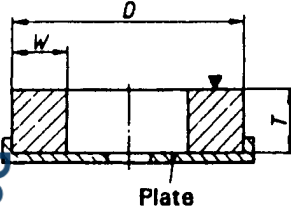
Shape, Designation, Dimensional	Type of machine ¹⁾	Type of application ¹⁾	Maximum operating speeds and dimensional limitations																
			Standard operating speeds in m/s									Special operating speeds in m/s							
			Dimensional limitations	V	B	BF	R	RF	E	MG	PL	Dimensional limitations	V	B	BF	R	RF	PL	
Type 1 Straight grinding wheel  $D \times T \times H^{(2)}$	Stationary grinding machines	Mechanically guided grinding	$H \leq 0,67D$	40	50	63	50	—	40	25 ^{*)}	50	$H \leq 0,67D$	63	63	—	63	63	63	
		Mechanically guided grinding totally enclosed		—	—	—	—	—	—	—	—	—	$H \leq 0,50D$	80	80	80	80	80	—
		Mechanically guided high pressure grinding	$H \leq 0,50D$	—	80	—	—	—	—	—	—	—	—	—	—	—	—	—	—
		Mechanically guided high pressure grinding totally enclosed		—	—	—	—	—	—	—	—	$H \leq 0,33D$	—	100	—	—	—	—	
	Stationary and mobile grinding machines	Manually guided grinding	$H \leq 0,67D$	35	50	63	50	50	40	25 ^{*)}	50	$H \leq 0,50D$	—	63	—	63	63	—	
										16 ^{**))}	—	$H \leq 0,33D$	—	—	80	—	80	—	
	Hand-held grinding machines	Hand-held grinding	$H \leq 0,25D$	—	50	80	50	80	—	—	50	$H \leq 0,25D$	—	63	—	63	—	—	
^{*)} $D \leq 1\,000$ mm. ^{**))} $D > 1\,000$ mm.																			
Type 2 Cemented or clamped cylinder wheel  $\times T \times W^{(2)}$	Stationary grinding machines	Mechanically guided grinding	$W < 0,17D$	32	40	—	—	—	—	25	40	$W < 0,17D$	63	63	—	—	—	50	
		Manually guided grinding		32	40	—	—	—	—	—	40		—	50	—	—	—	50	
	Definitions see 3.3 and 3.4. Designation of characteristics, see ISO 525.																		

Table 12 — Standard grinding wheel spaces depending on type of machine, type of application and maximum operating speed
(continued)

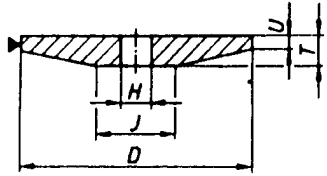
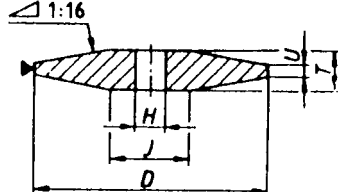
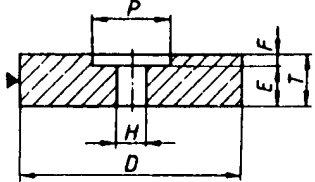
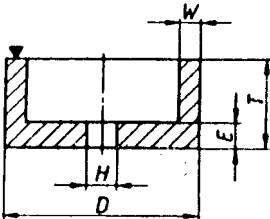
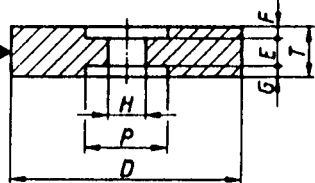
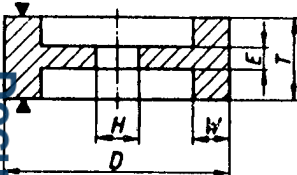
Shape, Designation, Dimensional	Type of machine ¹⁾	Type of application ¹⁾	Maximum operating speeds and dimensional limitations															
			Standard operating speeds in m/s									Special operating speeds in m/s						
			Dimensional limitations	V	B	BF	R	RF	E	MG	PL	Dimensional limitations	V	B	BF	R	RF	PL
Type 3 Wheel tapered on one side  $D/J \times T \times H^{(2)}$	Stationary grinding machines	Mechanically guided grinding	$H \leq 0,67 D$	40	50	—	50	—	—	—	50	$H \leq 0,67D$	63	63	—	63	—	63
Mechanically guided grinding totally enclosed		—		—	—	—	—	—	—	—	—	$H \leq 0,50D$ $H \leq 0,50D$	80	80	—	80	—	—
Type 4 Wheel tapered on both sides  $D \times T \times H^{(2)}$	Hand-held grinding machines	Hand-held grinding	$D \leq 200$	—	50	80	—	—	—	—	—	—	—	—	—	—	—	
Type 5 Wheel recessed on one side 	Stationary grinding machines	Mechanically guided grinding	$H \leq 0,67D$ $E \geq 0,50T$	40	50	—	50	—	—	—	50	$H \leq 0,67D$ $E \geq 0,50T$	63	63	63	63	63	63
Mechanically guided grinding totally enclosed		—		—	—	—	—	—	—	—	—	$H \leq 0,50D$ $E \geq 0,50T$	80	80	80	80	80	—
Stationary and mobile grinding machines	Manually guided grinding	35		50	—	50	—	—	—	50	$H \leq 0,50D$ $E \geq 0,50T$	—	—	63	—	63	—	
		—		—	—	—	—	—	—	—	$H \leq 0,33D$ $E \geq 0,50T$	—	—	80	—	80	—	
Hand-held grinding machines	Hand-held grinding	$H \leq 0,25D$ $E \geq 0,75T$	—	50	80	50	80	—	—	50	$H \leq 0,25D$ $E \geq 0,75T$	—	63	—	63	—	—	
1) Definitions see 3.3 and 3.4. 2) Designation of characteristics, see ISO 525.																		

Table 12 — Standard grinding wheel spaces depending on type of machine, type of application and maximum operating speed
(continued)

Shape, Designation, Dimensional	Type of machine ¹⁾	Type of application ¹⁾	Maximum operating speeds and dimensional limitations															
			Standard operating speeds in m/s									Special operating speeds in m/s						
			Dimensional limitations	V	B	BF	R	RF	E	MG	PL	Dimensional limitations	V	B	BF	R	RF	PL
Type 6 Straight cup wheel  $D \times T \times H - W \times E^{(2)}$	Stationary grinding machines	Mechanically guided grinding	$E \geq 0,20T$	32	40	—	40	—	—	—	40	$E \geq 0,20T$	63	63	—	63	—	—
		Manually guided grinding		32	40	—	40	—	—	—	40		—	50	—	—	—	—
	Hand-held grinding machines	Hand-held grinding	$D \leq 180$ $T \leq 70$ $E \geq 0,25T$	—	50	—	—	—	—	—	—	—	—	—	—	—	—	—
Type 7 Wheel recessed on both sides  $D \times T \times H - P \times F/G^{(2)}$	Stationary grinding machines	Mechanically guided grinding	$H \leq 0,67D$ $E \geq 0,50T$	40	50	—	50	—	—	—	50	$H \leq 0,67D$ $E \geq 0,50T$	63	63	—	63	—	63
		Mechanically guided grinding totally enclosed		—	—	—	—	—	—	—	—	—	$H \leq 0,50D$ $E \geq 0,50T$	80	80	—	80	—
													100	100	—	100	—	—
Type 9 Double cup wheel  $\times T \times H - W \times E^{(2)}$	Stationary grinding machines	Mechanically guided grinding	$E \geq 0,2T$	32	40	—	40	—	—	—	40	$E \geq 0,2T$	50	50	—	50	—	—

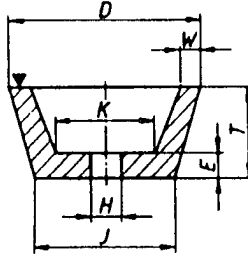
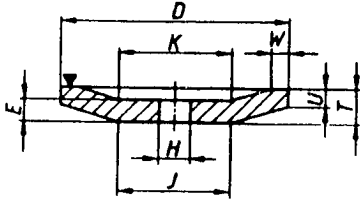
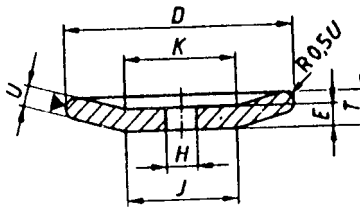
Definitions see 3.3 and 3.4.

Designation of characteristics, see ISO 525.

Definitions see 3.3 and 3.4.

Designation of characteristics, see ISO 525.

Table 12 — Standard grinding wheel spaces depending on type of machine, type of application and maximum operating speed
(continued)

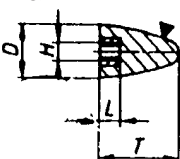
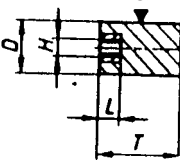
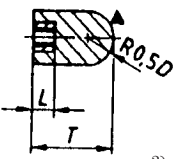
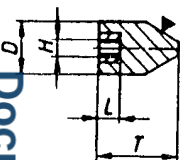
Shape, Designation, Dimensional	Type of machine ¹⁾	Type of application ¹⁾	Maximum operating speeds and dimensional limitations															
			Standard operating speeds in m/s									Special operating speeds in m/s						
			Dimensional limitations	V	B	BF	R	RF	E	MG	PL	Dimensional limitations	V	B	BF	R	RF	PL
Type 11 Taper cup wheel  $D/J \times T \times H - W \times E^{(2)}$	Stationary grinding machines	Mechanically guided grinding	$E \geq 0,2T$	32	40	—	40	—	—	—	40	$E \geq 0,2T$	50	50	—	50	—	—
		Mechanically guided grinding totally enclosed	—	—	—	—	—	—	—	—	—	$E \geq 0,2T$	63	80	—	63	—	50
		Manually guided grinding	$E \geq 0,2T$	32	40	—	40	—	—	—	40	—	—	—	—	—	—	—
	Hand-held grinding machines	Hand-held grinding	$E \geq 0,25T$	—	50	—	—	—	—	—	40	—	—	—	—	—	—	—
Type 12 Dish wheel  $D/J \times T \times H^{(2)}$	Stationary grinding machines	Mechanically guided grinding	$E \geq 0,5T$	32	40	—	40	—	—	—	40	$E \geq 0,5T$	50	50	—	50	—	—
		Mechanically guided grinding totally enclosed	—	—	—	—	—	—	—	—	—	$E \geq 0,5T$	63	80	—	63	—	50
		Manually guided grinding (tool sharpening)	$E \geq 0,5T$	32	40	—	40	—	—	—	—	—	—	—	—	—	—	—
Type 13 Saucer wheel  $D/J \times T/U \times H - K^{(2)}$		Mechanically guided grinding	$E \geq 0,5T$	32	40	—	40	—	—	—	40	$E \geq 0,5T$	50	50	—	50	—	—
		Mechanically guided grinding totally enclosed	—	—	—	—	—	—	—	—	—	$E \geq 0,5T$	63	80	—	63	—	50
		Manually guided grinding (tool sharpening)	$E \geq 0,5T$	32	40	—	40	—	—	—	—	—	—	—	—	—	—	—

¹⁾ Definitions see 3.3 and 3.4.

²⁾ Designation of characteristics, see ISO 525.

Definitions see 3.3 and 3.4.
Designation of characteristics, see ISO 525.

Table 12 — Standard grinding wheel spaces depending on type of machine, type of application and maximum operating speed
(continued)

Shape, Designation, Dimensional	Type of machine ¹⁾	Type of application ¹⁾	Maximum operating speeds and dimensional limitations															
			Standard operating speeds in m/s									Special operating speeds in m/s						
			Dimensional limitations	V	B	BF	R	RF	E	MG	PL	Dimensional limitations	V	B	BF	R	RF	PL
Type 16 Plug, tapered cone  $D \times T - H \times L^2)$	Hand-held grinding machines	Hand-held grinding	$D \leq 80$ $T \leq 100$	40	50	—	—	—	—	—	—	$D \leq 80$ $T \leq 100$	50	—	—	—	—	—
Type 18 Cylindrical plug, flat end  $D \times T - H \times L^2)$																		
Type 18R Cylindrical plug, round end  $D \times T - H \times L^2)$	Hand-held grinding machines	Hand-held grinding	$D \leq 80$ $T \leq 100$	40	50	—	—	—	—	—	—	$D \leq 80$ $T \leq 100$	50	—	—	—	—	—
Type 19 Cylindrical plug, taper-roll shaped  $\times T - H \times L^2)$																		
Definitions see 3.3 and 3.4. Designation of characteristics, see ISO 525.																		