

# **ABRASIVE GRINDING WHEELS**

## **Catalogue**

## Diprotex meets all your grinding and polishing requirements, by providing technical products with technical support.

At Diprotex we are continually offering new abrasive products and technologies, in a broad range of applications through our intensive research and development to face the demands higher efficiencies, precision, and cost savings.

To better service our customers; a global sales and engineering network is in place to service and support your needs of manufacturing in today's global climate and market place.

The Diprotex Company, Abrasives, is a global, full fine abrasive industry leader, committed to our customers need for technology engineering and service.

## The history of Diprotex

DIPROTEX has become an international benchmark for success because of our ability to quickly adapt to the changing market and diverse needs of customers, and by leading the way in applying the most advanced technology for industrial CBN and Diamond products.

Since 1968, DIPROTEX has been able to greatly expand its market share throughout the world, because we have established a world reputation of high quality products, service, knowledge and expertise in the industry.

DIPROTEX is deeply committed to keep customers up-to-date and equipped with the most competitive products and technical information. Our success can only be measured by the success of our customers.

The key of flexibility and strength in the global market are our many alliances with reliable overseas partners and customers throughout the world. DIPROTEX has successfully teamed up with high-tech manufacturers in Europe, Japan, and USA for the research and development of high precision diamond and CBN wheels, rotary dressers.

The success of a company in today's world depends on their ability to adapt and compete in the global marketplace. DIPROTEX is able to thrive in the age of globalization because we are already globalized. DIPROTEX is your partner for success.

## ISO qualification

### Acquisition of ISO 9001 Series

Diprotex has as its basic doctrine the goal of providing quality products and service to customers worldwide as a comprehensive manufacturer of grinding and polishing equipment, responding to customer's vast needs, and maintaining reliability and satisfaction.





## CONTENTS

### BASIC INFORMATION ON GRINDING WHEELS

	Page
<b>PRODUCTION PROGRAMME REVIEW</b>	<b>5</b>
- Grinding wheels made of aluminas and silicon carbides	5
- Grinding tools made of super hard abrasives – diamond and cubic boron nitride	5
<b>MARKING SISTEM</b>	<b>6</b>
- Specification of the wheel material	7
- Field of application for individual types of aluminas	7
- Grain size	8
- Hardness of the grinding tools	8
- Structure of the grinding tools	8
- Bond	9
<b>DESIGNATION OF GRINDING TOOL TYPES</b>	<b>10</b>
Standard dimensions of grinding tools	15
- Standard diameters – D	15
- Standard thicknesses – T	16
- Standard holes	16
Ordering of grinding tools	17
Grinding process	17

### CLASSES OF GRINDING

<b>ROUGH GRINDING AND CUTTING</b>	<b>19</b>
<b>ROUGH GRINDING – SNAGGING ON SWING FRAMES AND STATIONARY GRINDING MACHINES</b>	<b>19</b>
- Snagging grinding wheels	19
<b>HIGH PRESSURE GRINDING (FETTLING)</b>	<b>20</b>
- Hot pressed snagging wheels	20
<b>GRINDING ON PORTABLE STRAIGHT GRINDING MACHINES</b>	<b>21</b>
- Reinforced straight grinding wheels	22
- Grinding cones with nuts	23
- Mounted wheels	24
- Thin non-reinforced cut-off wheels	25
<b>PRECISE GRINDING</b>	<b>27</b>
<b>CYLINDRICAL GRINDING</b>	<b>27</b>
- Crankshaft grinding	29
- Camshaft grinding	29
- Roll grinding	31
<b>CYLINDRICAL GRINDING – CENTRELESS</b>	<b>32</b>
<b>SURFACE GRINDING</b>	<b>34</b>
- With straight grinding wheels	34
- With cup wheels, cylinders and segments	35
- Double wheel surface grinding	36
- Grinding wheels for spring grinding	37

	Page
<b>INTERNAL GRINDING</b>	38
- Table of wheel types and dimensions	39
<b>TOOL GRINDING</b>	40
Tool grinding with straight grinding wheels type 1, 5, 7	40
- On stationary grinding machines	40
- On universal grinders	41
Tool grinding with grinding wheels type 2, 3, 4, 6, 11, 12 on universal grinding machines	42
Table of dimensions for standard wheel shapes	43
Saw sharpening	47
<b>GEAR GRINDING</b>	48
- On "Niles" system machines	48
- On "Maag" system machines	49
- "Klingelnberg" wheel tapered one side	50
- Gear grinding on "Reishauer" system machines	51
<b>THREAD GRINDING</b>	52
<b>GRINDING WHEELS FOR GRINDING GROOVES</b>	53
<b>PROFILE GRINDING ON CYLINDRICAL WORKPIECE; SAW TEETH SHARPENING</b>	53
<b>HONING</b>	54
<b>HAND GRINDING</b>	55
- Grinding sticks	55
- Rubbing bricks	57
- Dressing tools for grinding wheels	58
- Recommended specifications for grinding sticks, rubbing bricks and dressing tools	59

## SAFETY IN GRINDING

General rules	60
Grinding on portable grinding machines	61
Safety guards	61
Storage of the grinding tools	62
Recommendations	63
Truing and dressing of grinding tools	63
Mounting	64
Peripheral speeds	66
Higher operating speeds	67
Peripheral speeds table	67
<b>QUESTIONNAIRE</b>	69
<b>TYPES OF GRINDING AND APPROPRIATE TYPES OF GRINDING TOOLS</b>	70

## PRODUCTION PROGRAMME REVIEW

Due to many years of experience and research in the field of quality and effective grinding we are able to offer our customers high quality grinding tools for usage in all fields of industry which includes ironworks and foundries, machine building, tool making, shipbuilding, car industry, metal construction industry, processing equipment, maintenance of railway tracks, glass industry, building industry, stonecutting, agriculture, leather industry, food industry, craft shops, hobby usage, and many other applications.

Production programme includes:

### Grinding wheels made of aluminas and silicon carbides

for standard and increased peripheral speeds in types and dimensions standardised per ISO and DIN Standards as well as for non-standard types and dimensions if so required;

- grinding wheels in diameters from 3 mm to 1250 mm, in thickness from 1,5 mm to 300\* mm for vitrified bonded and from 0,8 mm to 300\* mm for resinoid bonded wheels
- grinding segments of various shapes and dimensions
- hone stones
- grinding tools for hand grinding – sticks, bricks
- special products

\* Grinding wheels in bigger thicknesses are offered combined or glued of two or more pieces.

# Marking System

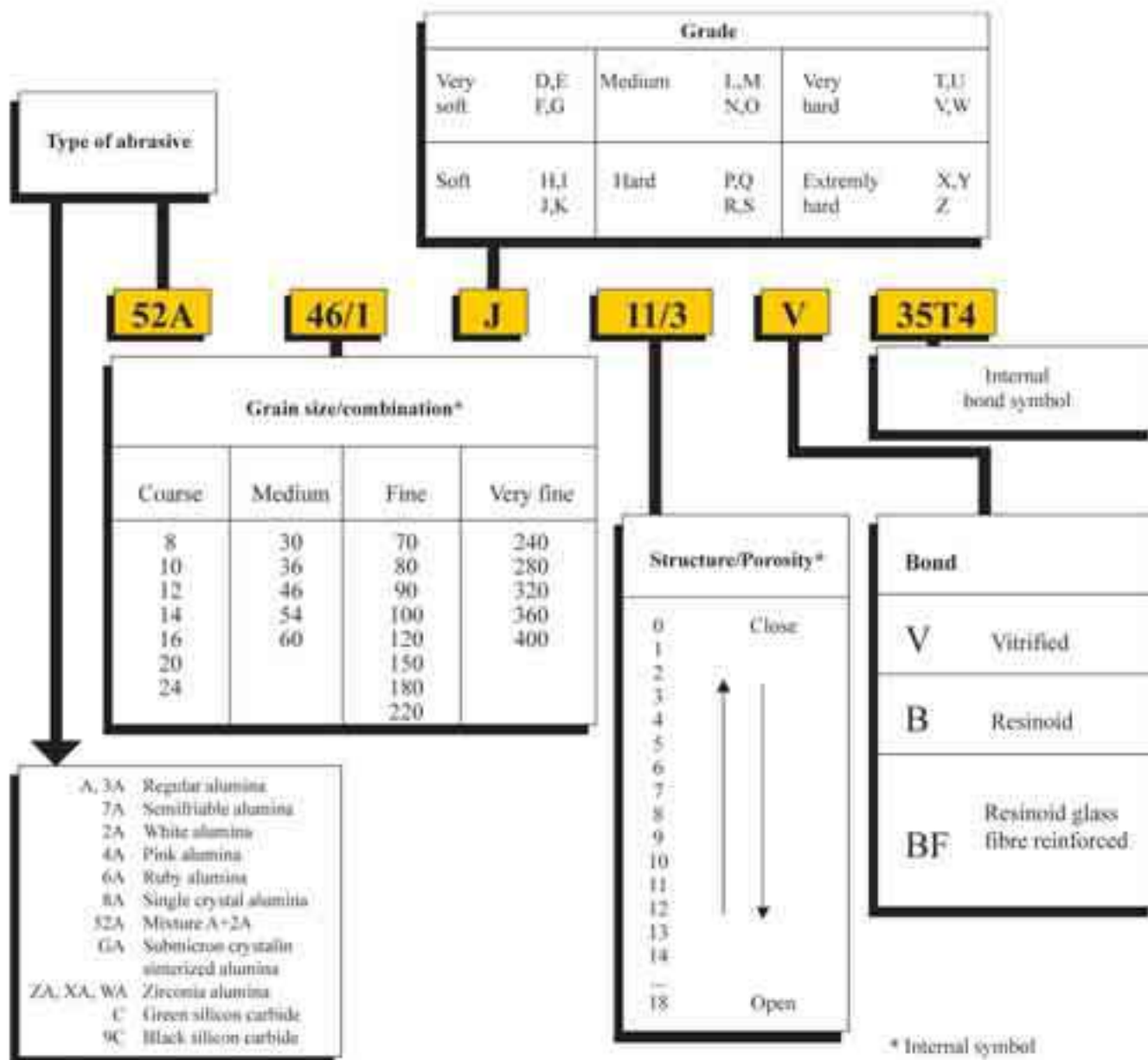
To allow us to fully identify the abrasive product out of our production programme please specify the following data:

- The grinding wheel type
- Dimensions in mm
- Specification
- Wheel operating speed or spindle rotational speed
- Any special requirements regarding making of the grinding wheel (balance tolerance...)

The specification of a grinding tool is determined by the following elements:

- Class and type of the abrasive grain
- Grain size (and its combination)
- Hardness grade
- Structure
- Bond

System for marking the specification of grinding tools made of aluminas and silicon carbides:



## Specification of the wheel material

The grinding tool consists of the abrasive grains, the binding components and pores.

The abrasive grains function as cutting blades, while the bond holds the cutting particles together and forms together with them a compact unity.

### ABRASIVE GRAIN

For manufacturing of our basic programme of grinding tools we use several types of fused aluminas and silicon carbides.

#### Fused aluminas

We use several types of aluminas:

- Regular aluminium oxide (3A, A)
- Semi-friable aluminium oxide (7A, 52A)
- White aluminium oxide (2A)
- Pink aluminium oxide (4A)
- Dark red (ruby) aluminium oxide (6A)
- Single crystal aluminium oxide (8A)
- Submicron cristalyn sinterized alumina (GA)
- Zirconia alumina (ZA, XA, WA)

#### Field of application for individual types of aluminas

Type of abrasive	Material to be ground	Mechanical characteristics of the material
Regular aluminium oxide	Low-alloyed, unhardened steels	Tensile strength between 300-500 N/mm <sup>2</sup>
Semi-friable aluminium oxide	General application	Grade up to 60 HRC
Processed aluminium oxide	High-alloyed steels, for precision grinding	Tensile strength higher than 500 N/mm <sup>2</sup> Hardness over 62 HRC
Special zirconia alumina abrasive stands out for its resistance against chemical, thermal and mechanical influence. It is used for producing hot and cold pressed grinding tools, which are applied under the hardest conditions.		
GA has an excellent capacity of cutting and very long life.		

#### Silicon carbide

Two types are used:

Green silicon carbide (C) is an extremely hard material (hardness 9,5 on Mohs' scale). Because of its high cutting ability, it is suitable for processing carbide metals, gray iron and chilled iron, plastics, rubber, non-ferrous metals, ceramics, glass, nitralloy steels and acid-resistant steels.

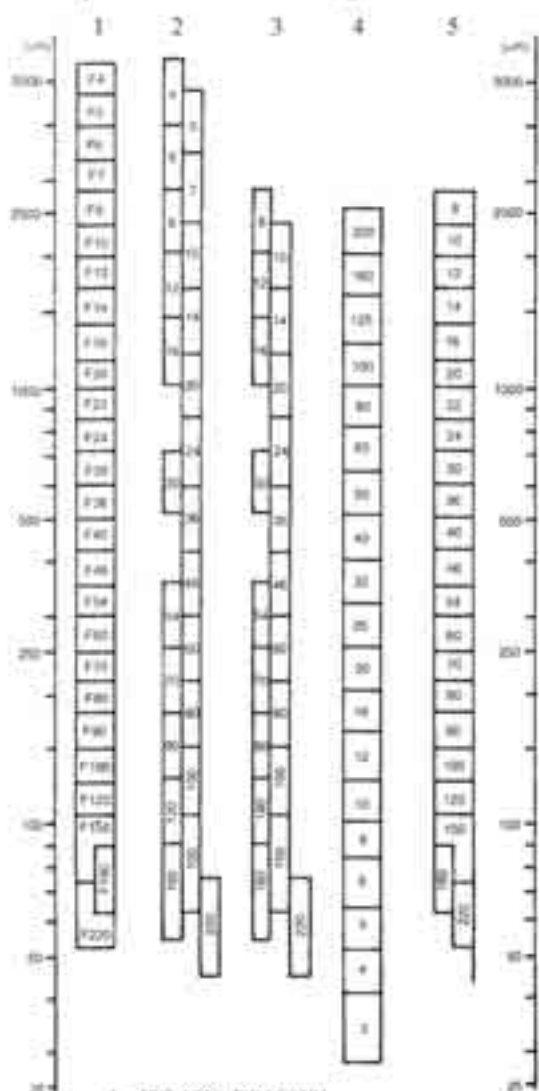
Black silicon carbide (9C) is a little less brittle than silicon carbide and is used for grinding of all the above listed materials except carbide metals.



## GRAIN SIZE

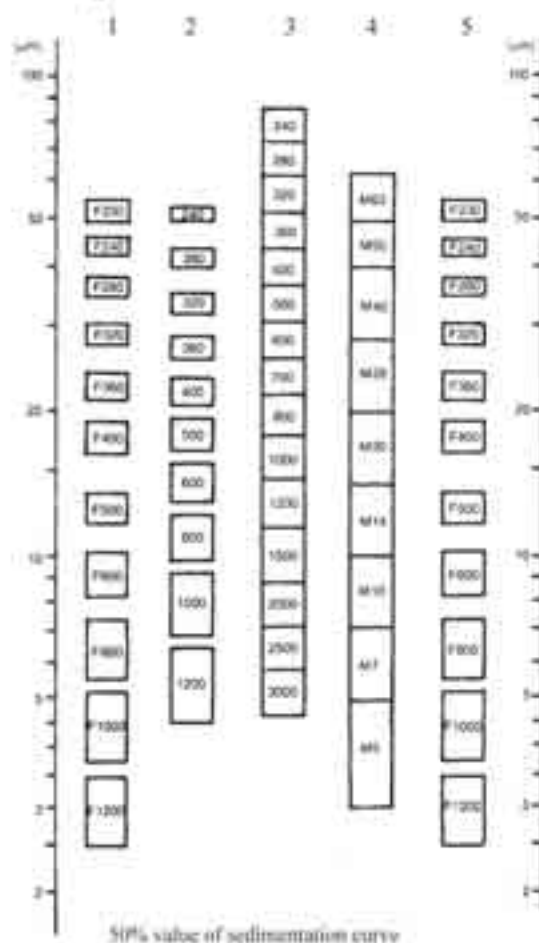
The grain size is designated by means of numbers according to the ISO Standard 8486.

### A comparison of the national grain-size standards



- 1 - ISO 8486, DIN 69101
- 2 - ANSI B 74.12-1976 (USA)
- 3 - JIS R 6001-1973 (Japan)
- 4 - GOST 3647-71
- 5 - PN-76 M-59115 (Poland)

### Micro-granulation



50% value of sedimentation curve

## HARDNESS OF THE GRINDING TOOLS

The hardness of the grinding tools is proportional to the bond strength with which a single grain is tied in the bond-matrix. It depends on the following:

- The quantity and type of bond
- The structure
- The type of the abrasive grain
- Grinding tool making procedure

The grade of hardness is expressed by classes of hardness, designated with English alphabet letter symbols (capitals-D-Z).

## STRUCTURE OF THE GRINDING TOOLS

The structure of the grinding tools is designated with number symbols from 0-18. It depends upon the relative distance between the individual abrasive grains.



## BOND

### Vitrified bond

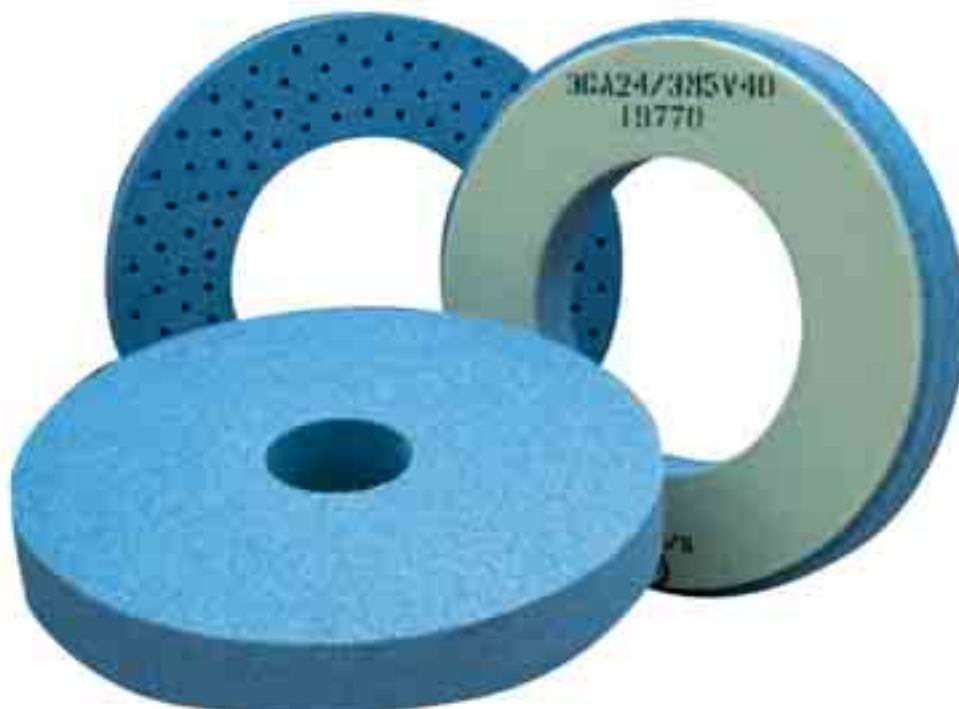
The main components of vitrified bonds are clays, kaolin, feldspar, frits and other ingredients. During the burning in ceramic kilns the components are partly fused and sintered. They also interact and during cooling they change into a state similar to glass or porcelain. Vitrified bond is brittle, it has no elasticity and is quite resistant to deformation. It is sensitive to impact, percussion, high load and changes in temperature. It is unaffected by moisture and dampness at temperatures higher than 0° C.

### Resinoid bond

The main components of resinoid bonds are phenolic formaldehyde resins condensed to an infusible and insoluble state. The fillers regulate some technological and cutting characteristics of the bond. They also regulate hardness. The resinoid bond is less brittle, a little more elastic and is less resistant to deformation than the vitrified bonds. It also is a little less impact and percussion sensitive and less affected by changes in temperature than vitrified bonds, but it is not so stable as regards dampness and the influence of alkalic coolants.

### Reinforced resinoid bond

It is a variety of resinoid bond with fibreform material added (usually fibreglass-fabric). The bond thus reinforced exhibits a much greater range of strength and gives the products greater hardness as well as enables usage by increased operating speeds and side loads.



Vitrified grinding wheels made with GA Submicron crystalline-sintered alumina.

# Designation of Grinding Tool Types (ISO 525)

Basic types and their limitations (working face is marked on the sketch)

BASIC TYPE	SKETCH	DESIGNATION OF DIMENSIONS	LIMITS			
			BOND	PERIPHERAL SPEED <sup>*)</sup> NORMAL      EXCIP.	DIMENSIONS	
1..		Straight grinding wheel $D \times T \times H$	V B BF	40 m/s 50 m/s 80 m/s	H $\leq$ 0,67 D T $\geq$ 0,02 D <sup>*)2</sup> T $\geq$ 0,02 D T = 4 mm	
2..		Grinding ring wheel $D \times T \times W$	V B	32 m/s 40 m/s	W $\leq$ 0,17 D	
3..		Grinding wheel tapered one side $D \times T \times U \times H \times V$	V B	40 m/s 50 m/s	H $\leq$ 0,67 D	
4..		Grinding wheel tapered both sides $D \times T \times U \times H \times V$	V B BF	40 m/s 50 m/s 80 m/s	- - 4A	H $\leq$ 0,67 D
5..		Grinding wheel one side recessed $D \times T \times H \times P \times F$	V B BF	40 m/s 50 m/s 80 m/s	- - 5A	H $\leq$ 0,67 D E $\geq$ 0,5T 0,5T > E $\geq$ 0,2T
6..		Cylinder cup wheel $D \times T \times H \times W$	V B	32 m/s 40 m/s	0,3T > E $\geq$ 0,2T	
7..		Grinding wheel recessed two sides $D \times T \times H \times P \times F \times G$	V B	40 m/s 50 m/s	H $\leq$ 0,67 D E $\geq$ 0,5D	

\*1 By ordering the increased operating peripheral speeds must obligatory be stated.

Normal operating peripheral speeds can be lower for softer and/or open structure grinding wheels.

\*2 D = 250 mm H = 0,67 D T > 0,01 D

\*\* All under groups derived from basic type.

BASIC TYPE	SKETCH	DESIGNATION OF DIMENSIONS	LIMITS		
			BOND	PERIPHERAL SPEED % NORMAL      EXCP.	DIMENSIONS
9..		Both sides cylinder cup wheel $D \times T \times H - W, E, G,$	V: B:	32 m/s 40 m/s	$H \geq 0,67D$ $0,4T > E \geq 0,2T$
11..		Flaring cup wheel $D1 \times T \times H - W, E, K,$	V: B:	32 m/s 40 m/s	$0,3T > E \geq 0,2T$
12..		Dish wheel $D1 \times T \times D2 \times H - W, E, K, V,$	V: B:	32 m/s 40 m/s	$E \geq 0,5T$
13..		Face shaped dish wheel $D1 \times T \times D2 \times H - E, V, (K, L)$	V: B:	32 m/s 40 m/s	$E \geq 0,5T$
15..		Grinding cone with nut $D \times T/T1 \times$ nut - R,	V: B:	32 m/s 40 m/s	
16..		Grinding cone with nut $D \times T \times$ nut - R, (R)	V: B:	32 m/s 40 m/s	
17..		Grinding cone with nut $D1 \times T \times$ nut for type 17R radius R, to be specified	V: B:	32 m/s 40 m/s	
18..		Grinding cone with nut $D \times T \times$ nut for type 18R radius R, to be specified	V: B:	32 m/s 40 m/s	

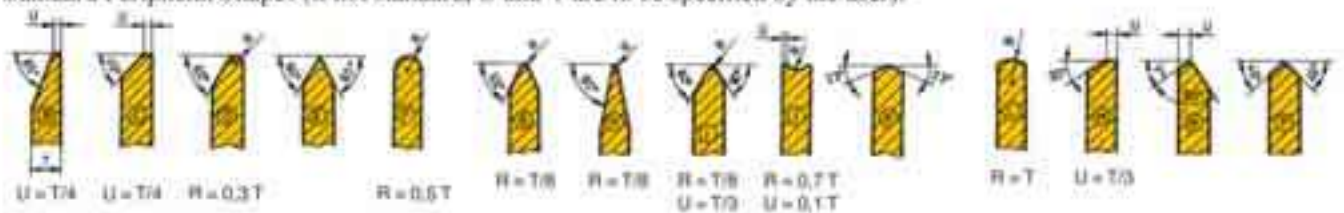
BASIC TYPE	SKETCH	DESIGNATION OF DIMENSIONS	LIMITS		
			BOND	PERIPHERAL SPEED (1) NORMAL      EXCE.	DIMENSIONS
19..		Grinding cone with nut $D \times T \times \text{nut}$ for type 19R radius R.. to be specified	V B	32 m/s 40 m/s	
20..		Grinding wheel relieved one side $D \times K \times T \times N \times H$	V B	40 m/s 50 m/s	$H \geq 0,67D$ $E \geq 0,5T$
21..		Grinding wheel relieved both sides $D \times K \times T \times N \times H$	V B	40 m/s 50 m/s	$H \geq 0,67D$ $E \geq 0,5T$
22..		Wheel relieved one side and recessed other side $D \times K \times T \times N \times H - P \times F$	V B	40 m/s 50 m/s	$H \geq 0,67D$ $E \geq 0,5T$
23..		Wheel recessed and relieved same side $D \times T \times N \times H - P \times F$	V B	40 m/s 50 m/s	$H \geq 0,67D$ $E \geq 0,5T$
24..		Wheel relieved and recessed on one side, recessed on the other side $D \times T \times N \times H - P \times F \times G$	V B	40 m/s 50 m/s	$H \geq 0,67D$ $E \geq 0,5T$
25..		Wheel relieved and recessed on one side, relieved on the other side $D \times K \times T \times N \times H - P \times F$	V B	40 m/s 50 m/s	$H \geq 0,67D$ $E \geq 0,5T$
26..		Wheel relieved and recessed both sides $D \times T \times N \times H - P \times F \times G$	V B	40 m/s 50 m/s	$H \geq 0,67D$ $E \geq 0,5T$



BASIC TYPE	SKETCH	DESIGNATION OF DIMENSIONS	LIMITS		
			BOND	PERIPHERAL SPEED* NORMAL      EXCP.	DIMENSIONS
27..		Depressed center wheel $D \times U \times H$	BF	80 m/s	$D \leq 250 \text{ mm}$ $4 \text{ mm} < U \leq 10 \text{ mm}$
28..		Koolie hat type grinding wheel $D \times U \times H$	BF	80 m/s	$D \leq 250 \text{ mm}$ $4 \text{ mm} < U \leq 10 \text{ mm}$
29..		Depressed semi-flexible grinding wheel Rondex $D \times U \times H$	BF	80 m/s	$D \leq 250 \text{ mm}$ $U \geq 0,02D$
30..		Fibre disc $D \times H$	B	80 m/s	$D \leq 250 \text{ mm}$
31..		Grinding segment $B \times C \times L$ $B \times A \times C \times L$ $B \times C \times L - R$ $B \times A \times C \times L - R$			
35..		Straight wheel for side grinding $D \times T \times H$	V B	32 m/s 40 m/s	$H \leq 0,67D$
36..		Grinding wheel for side grinding with inserted nuts $D \times T \times H - n/nut$ (n = number of nuts)	V B	32 m/s 40 m/s	$H \leq 0,67D$
37..		Grinding ring with inserted nuts $D \times T - W - n/nut$ (n = number of nuts)	V B	32 m/s 40 m/s	$W < 0,17D$

BASIC TYPE	SKETCH	DESIGNATION OF DIMENSIONS	LIMITS		
			BOND	PERIPHERAL SPEED*1 NORMAL      EXCIP	DIMENSION
38..		Grinding wheel stepped one side $D \times T / U \times H$	V B	40 m/s 50 m/s	$H \leq 0,67D$
39..		Grinding wheel stepped both sides $D \times T / U \times H$	V B	40 m/s 50 m/s	$H \leq 0,67D$
41..		Straight cutting wheel $D \times T \times H$	B BF	50 m/s 80 m/s	$D > 230\text{mm}$ $H \leq 0,33D$ $T \leq 0,02D$ oder $D \leq 230\text{mm}$ $H \leq 0,33D$ $T < 4\text{mm}$
42..		Depressed center cutting wheel $D \times U \times H$	BF	80 m/s	$D > 230\text{mm}$ $H \leq 0,33D$ $U \leq 0,02D$ oder $D \leq 230\text{mm}$ $H \leq 0,33D$ $T < 4\text{mm}$
52..		Mounted wheel $D \times T \times \text{shaft}$	V B	40 m/s 50 m/s	$3\text{mm} < D < 80\text{mm}$
54..		Honing stone $B \times C \times L$			
90..		Grinding stick $B \times C \times L$			

Standard Peripheral Shapes (if not standard, U and V are to be specified by the user).



\*1 By ordering the increased operating peripheral speeds must obligatory be stated.  
Normal operating peripheral speeds can be lower for softer and/or open structure grinding wheels.

## Standard dimensions of grinding tools in mm and inches

### 1. Standard diameters - D

mm	Inches	mm	Inches
* 3	1/8	* 230	
* 4	5/32	* 250	
* 5	3/16	254	10
* 6	1/4	* 300	
* 8	5/16	305	12
* 10	3/8	* 350	
* 13	1/2	356	14
* 16	5/8	* 400	
* 20	3/4	406	16
* 25	1	* 450	
30	1 3/16	457	18
* 32	1 1/4	* 500	
* 40	1 1/2	508	20
* 50		* 600	
51	2	610	24
* 63	2 1/2	650	
75		660	26
76	3	700	
* 80		710	28
82	3 1/4	* 750	
* 100		762	30
102	4	* 800	
* 115	4 1/2	813	32
* 125		* 900	
127	5	914	36
* 150		* 1000	
152	6	1016	40
* 175		* 1060	
178	7	1067	42
* 180		1100	
* 200		1118	44
203	8	* 1250	
* 225			

\* ISO DIN 603-1 to 603-12

## 2. Standard Thicknesses - T

mm	Inches	mm	Inches
* 0,5		38	1 1/2
* 0,6		* 40	
* 0,8		* 50	
1		51	2
* 1,2	3/64	* 63	
* 1,6	1/16	64	2 1/2
* 2	5/64	76	3
* 2,5	3/32	* 80	
3	1/8	* 100	
* 3,2		* 102	4
3,5	9/64	* 125	
* 4	5/32	127	5
* 5	3/16	150	
* 6		152	6
6,4	1/4	* 160	
7		* 200	
* 8	5/16	203	8
9,5	3/8	* 250	
* 10		** 254	10
12,7	1/2	300	
* 13		305	12
* 16	5/8	* 315	
* 20		* 400	
21	13/16	406	16
* 25	1	* 500	
* 32	1 1/4	508	

\*\* Grinding wheels with thickness from 254 up are made of two or more assembled wheels.

## 3. Standard Holes - H

mm	Inches	mm	Inches
* 1,6	1/16	* 40	
* 2,5	3/32	* 50,8	2
* 4	5/32	(51)	
* 6		* 60	
6,4	1/4	(76)	
* 8		* 76,2	3
9,5	3/8	* 80	
* 10		* 100	
12,7	1/2	* 127	5
* 13		* 152,4	6
15,9	5/8	* 160	
* 16		(203)	
19,1	3/4	* 203,2	8
* 20		* 250	
* 22,2	7/8	254	10
* 25		* 304,8	12
25,4	1	(305)	
31,8	1 1/4	* 400	
* 32		* 508	20
38,1	1 1/2		

\* ISO DIN 603-1 to 603-12



## When ordering, please specify the following:

- The grinding wheel type\*
  - Dimensions in mm
  - Specification, containing the following data:
    - Abrasive
    - Grain size
    - Grade of hardness
    - Structure
    - Bond
  - Wheel operating speed or spindle rotational speed
  - Type and trade mark of the grinding machine
  - Specification of the workpiece and its thermal treatment state, the required surface finish and the designated performance.
- If possible, please enclose the marking label of the grinding wheel you had successfully used before.

Ordering example:

Product code		D x T x H			
1	14192	250	x	25	x
Type	No.	Dimension of the wheel (mm)		Specification	Operating speed

In case you have already purchased the product from us and you know its product code it is sufficient to quote only this code in your purchase order.

\* For non-standard types please add a sketch of the grinding tool!

### Grinding process

The grinding process depends on a number of factors. By optimum conditions a high grinding effect is achieved and we get the required accuracy and surface finish.

#### Factors affecting the grinding process:

- |  |   |
|--|---|
| <ul style="list-style-type: none"> <li>• Grinding conditions:                     <ul style="list-style-type: none"> <li>- Wheel peripheral speed</li> <li>- Workpiece peripheral speed</li> <li>- Feed speed</li> <li>- Depth of cut</li> </ul> </li> <li>• Grinding machine:                     <ul style="list-style-type: none"> <li>- type of machine, stability of the construction accuracy, flexibility, vibrations,</li> <li>- accuracy of the workpiece-mounting device,</li> <li>- forming device</li> </ul> </li> </ul> | <ul style="list-style-type: none"> <li>• Workpiece:                     <ul style="list-style-type: none"> <li>- Specification (composition, state...)</li> <li>- Dimension and shape</li> </ul> </li> <li>• Grinding tool:                     <ul style="list-style-type: none"> <li>- Shape and size</li> <li>- Specification</li> </ul> </li> <li>• Cooling liquid                     <ul style="list-style-type: none"> <li>- Type, composition</li> <li>- State</li> </ul> </li> </ul> |
|--|---|

The specification selection guide is of a general character only since the grinding process is specific for each combination of the above listed factors and therefore a grinding tool with the same specification performs differently in different conditions.

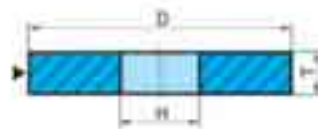




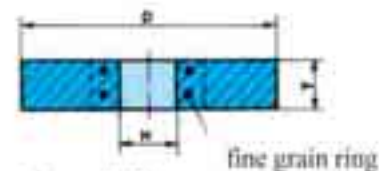
## SNAGGING AND CUTTING

### Rough Grinding – Snagging on Swing Frames and Stationary Grinding Machines

Grinding wheels  
Type: 1, 1FK, 1A, 1AO

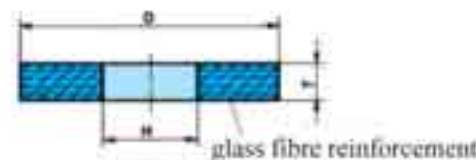


Type: 1  
Designation: 1-DxTxH

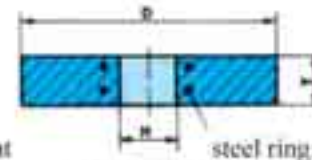


Type: 1FK  
1FK-DxTxH

Standard dimensions  
D max = 600 mm  
T max = 80 mm  
H max = 305 mm



Type: 1A  
Designation: 1A-DxTxH



Type: 1AO  
1AO-DxTxH

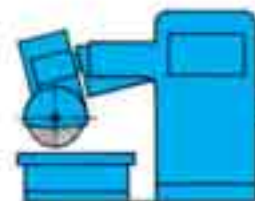
They are used for snagging castings and dies (forgings) and materials after they have been cut or welded on stationary and swing frame grinding machines. The grinding operation is hand guided. A high grinding effect is demanded, independent of the surface finish. The operating peripheral speed can be 50, 63 or 80 m/s.

For grinding on stationary grinding machines somewhat softer wheels are used than those applied on swing frame machines.

For grinding at operating speeds up to 50 m/s wheels **type 1** are used, while for rough grinding (grain size up to 36) wheels **type 1AO** are applied. Grinding wheels for the use at an operating speed of 63 m/s are designed with a fine grain ring which provides for a higher wheel strength (**type 1FK**). Wheels with an operating peripheral speed of 80 m/s are reinforced (**type 1A**), the specifications being 52A16-24M-P6BF05.

Application	Recommendations					
	Abrasive	Grain size	Grade	Structure	for 50 m/s	for 63 m/s
Non-ferrous material	9C	16-24	O-P	4	B04	B03
Steel casts	S2A, 3A, 7A	14-24	O-R	3-4	B04	B69
High alloyed steels	S2A, 7A	16-24	O-R	4	B04	B03
Gray cast iron	ZA, 33C	14-24	O-R	3-5	B68	B69
	ZA	16-20	O-Q	5-6	B78	B78
Spheroidal graphite iron	ZA, S2A	14-24	N-M	4	B04	B03
<b>Malleable cast iron</b>						
• before tempering	ZA, 53C, 9C	16-24	O-R	3-4	B68	B69
• after tempering	ZA, S2A	16-24	N	4	B04	B03

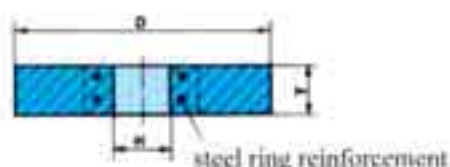
Ordering example: 1 500x60x127 53C 12/3 R4 B68, 50 m/s or 63 m/s  
 1FK 450x52x150 2ZA 16/3 Q4 B18, 50 m/s or 63 m/s  
 1FK 500x70x203 2ZA 16/1 R7 B27, 50 m/s or 63 m/s  
 1FK 600x60x203 2ZA 16/1 Q4 B18, 50 m/s or 63 m/s  
 1A 500x60x127 2ZA 14/9 R4 BF33, 80 m/s  
 1A 600x60x203 S2ZA 16/4 J7 BF05, 80 m/s for high alloyed steels



## High – Pressure Grinding (Fettling) Hot pressed snagging wheels

Hot pressed high density grinding wheels for working speed 80 m/s or 60 m/s.

Type: **IVS**  
Designation:  
IVS D x T x H



These wheels are designed to be used on automatic grinding machines (for example: Centro-Maskin, Schlütter, Sket etc.) and are ideal for snagging of billets, ingots, blooms and slabs – for steel works in rolling mills, smithies, and steel foundries. Hot pressed wheels are renowned for their high rate of stock removal and extremely long life. Diprotex hot pressed wheels are manufactured to the highest standard and are covered by DSA safety certificate for speeds up to 80 m/s. This standard is also in conformity with F.E.P.A. safety codes.

Grinding wheels are produced in the following dimensions (mm), whereby special tolerances for holes are implemented:

610 x 76 x 203,2 mm	for 80 m/s	hole tolerance	+ 0,55
			+ 0,26
610 x 76 x 304,8 mm	for 63 m/s	hole tolerance	+ 0,65
			+ 0,33

Wheels are manufactured of special aluminium oxides (for example zirconium aluminium oxide), respectively mixtures of special aluminium oxides in grain sizes 8 to 24.

Ordering example : IVS 610x76x203,2 XA12ZB80, 80 m/s



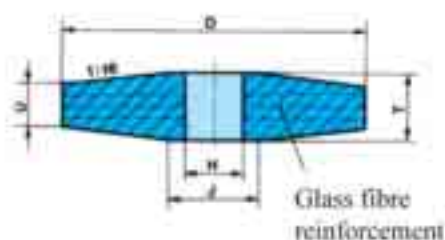
Grinding wheels for ironworks and foundries in types: 1, 1VS, 15, 11P, 17R and 18R.





## Grinding on Portable Straight Grinding Machines

Grinding with wheels tapered both sides, Type 4KA



Grinding wheels tapered both sides for grinding without safety guard.

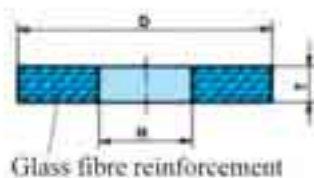
Designation:  
4KA D x T/U x H

Non-standard dimensions:  
4KA D/J x T/U x H

**4KA**

APPLICATION	Recommendation				
	Abrasive	Grain size	Grade	Structure	Bond
Non-ferrous metals					
For 50 m/s	9C	24-36	N-Q	4-5	B
For 63 m/s	9C	24-36	N-Q	6-8	BF
Steel and cast steel					
For 50 m/s	3A, 7A	20-36	N-Q	4-5	B
For 63 m/s	3A, 52A, 7A	20-36	N-Q	6-8	BF
High-alloyed steels					
For 50 m/s	52A, 7A	24-36	N-Q	6-8	B
For 63 m/s	52A, 7A	24-36	N-Q	6-8	BF
Stainless and acid resistant steels					
For 50 m/s	52A	24-36	N-Q	4-5	B
For 63 m/s	52A	24-36	N-Q	6-8	BF
Chilled cast iron					
For 50 m/s	ZA, 9C	20-36	N-Q	6-8	B
For 63 m/s	ZA, 9C	20-36	N-Q	6-8	BF

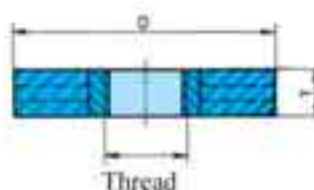
Grinding with fibre-reinforced wheels, Type 1A, 1AM



Designation:  
1A D x T x H

**1A**

For peripheral speeds  $V = 80$  m/s



Designation:  
1AM D x T x H

**1AM**

APPLICATION	Recommendation				
	Abrasive	Grain size	Grade	Structure	Bond
General application	3A, 52A, 7A, ZA	24-36	N-S	6-8	BF

## Reinforced straight grinding wheels Type 1A for grinding on portable straight grinding machines for 80 m/s

Table of dimensions (mm):

D	T				H			
	4	6	8	10	6	9,5	10	13
50	4	6	8	10	6	9,5	10	13
65	4	6	8	10	6	9,5	10	13
75	4	6	8	10	6	9,5	10	13
80	4	6	8	10	6	9,5	10	13
100	10	16	20	25		13		20
125			20	25			16	20
150			20	25	32		16	20
175			20	25	32		16	20
200			20	25	32			20
225			20	25	32			20
								25
								22,2

Ordering example:

1A 125 x 25 x 25 mm 3A 16/1N4BF, 80 m/s  
 1A 150 x 25 x 25 mm 52A 24/3P6 BF05, 80 m/s  
 1A 200 x 25 x 25 mm 7A 24/3P5 B12, 80 m/s



Reinforced grinding wheels for snagging, type 1A and 27.

## Grinding cones with nuts

Grinding cones with inserted nuts are suitable for snagging of castings and forgings and for rougher cleaning operations.

Grinding cones are used for off-hand grinding. Maximum peripheral operating speed for resinoid bonded grinding cones is 50 m/s, and 32 m/s for vitrified bonded cones.

Application	Specification
Steel	3A24/3Q4B
Gray cast iron	52C24/3Q4B
Non-ferrous metals	9C16/6P2V

Marking of types and sizes:  
D x T x thread

Ordering example:  
16 - 32x50xM10

Upon special request the inserted nuts can be made with Whitworth instead of metric threads:  
 $\frac{1}{8}''$ -10,  $\frac{5}{8}''$ -11,  $\frac{3}{4}''$ -12,  $\frac{1}{2}''$ -16.

Table of types and sizes in mm:

Type	Sketch	D	T	Thread	L	T1	J	R	R1
15		40	63	M10, M12	20	40		32	
		40	80	M12, M10	25	48		38	
		50	100	M12, M16	25	65		51	
16		32	50	M10	16			6	118
		40	63	M12	20			10	190
		50	80	M12	20			10	190
		63	80	M16	25			10	165
		80	100	M16	30			16	150
17		32	30	M10	16		10		
		40	63	M12	20		10		
		50	100	M12	20		13		
17R		63	100	M16	30		16		
		80	80	M16	25		20		
		80	100	M16	30				
18		32	40	M10	16				
			30		20				
			63		16				
		40	40	M12	20				
		50		25					
18R		50	50	M12	20				
			80		25				
			100		30				
		63	80	M16	25				
		80		25					
19		32	63	M10	16		10		
		40	63	M12	16		10		
		50	100	M12	25		13		
19R			80						
		63	100	M16	25		16		
			80		25				
		80		30		20			

## Grinding with mounted wheels

Mounted wheels are used in toolrooms for manufacturing of various tools and for snagging of castings and forgings (dies).

The maximum permissible peripheral speed for mounted wheels is to be calculated in relation to dimension and type of mounted wheel and in relation to the shaft and the way of mounting.

The range of mounted wheels we produce is rather wide. It includes types A, B, and W according to ISO standard, Diprotex basic programme types and also nonstandard types.

Standard dimensions:

- Diameter D 2,5 to 80 mm
- Length T 2 to 70 mm
- Shank diameter S from 3 to 12 mm or diameter of a shank with thread from M 2,5 to M 10

### Set of mounted wheels

Set 52 GAR



Set 52GAR includes 30 pieces of mounted wheels

Set 52 GAR 1



Set 52GAR 1 includes 10 pieces of mounted wheels

Special selection guide:

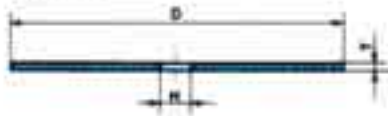
Application	Wheel diameter		
	< 8mm	8 - 20 mm	> 20 mm
General application	4A100/4O9V	4A60/4P6V	4A46/4P5V 4A36/4P5V
Deburring	4A120/3T9V	4A80/3T7V	4A60/3S6V
<b>Snagging wheels</b>			
• Forgings (dies)		52A60/3O6B	52A36/3O4B 52A46/3O5B 52A36/3R5V
• Sand and casting		52A60/3R6V C60/3R6V C24/3R3V	C46/3R4V
Special steels		2A60/3P6V	2A46/3P5V

Specifications listed in the table are for offhand grinding.



# Thin non-reinforced resinoid cut-off wheels

Type: **41**



Designation:  
41 D x T x H

Non-reinforced straight cut-off wheels for manual cutting on stationary cutting machines with operating peripheral speeds 50 m/s, 60 m/s, and 80 m/s. They are manufactured in specifications for metallographic tests, for non metal work pieces, and for special cutting.

Table of dimensions (mm):

D (mm)	T (mm)	H (mm)
50	0.8-2.0	10
65		10
75		10
80		10
100		10
125	1.0-3.0	20 (16)
150		13 16 20 22.2 25 30 32
150		
200		
200		

Commercial specification for universal steel and cast iron: A60PB

Ordering example:

41 150 x 1.5 x 20 A60PB, 50 m/s for cast iron

41 175x1.5x16 72 A60/1 08 B83 for bowden cables (covered by PVC)

41 200x1.5x20 72 A60/1 08 B83 for bowden cables (covered by PVC)

Packing: 25 pcs. in a carton

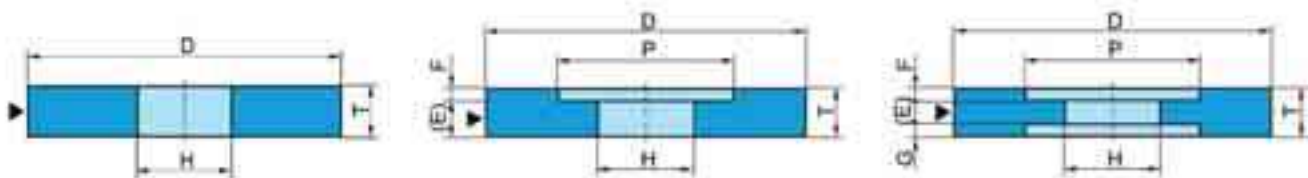






## PRECISE GRINDING

### Cylindrical Grinding



Type:

1

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### Recomendations

Application	Abrasive	Grain size	Grade	Structure	Bond
Unhardened steels	52A, A	54-60	K-L	8	V
Hardened steels	<55 HRc	2A, 4A	J-L	8	V
	55-62 HRc	4A, 6A			
	62-64 HRc	6A, 8A			
Tool steel, high-alloyed	8A	60-80	J-K	8	V
Stainless steels	9C, C	54-60	J-L	7	V
			J-K	8	
High-speed steels	58A, 4A	60-80	K-L	8	V
Chromium-plated material finishing polishing	4A	60-80	J-K	7-8	V
	2A	100-120	K	9	B
	9C	500	I-J	12-16	B
Non-ferrous metals (soft bronze, aluminium, brass)	9C, C	36-60	J-K	5-7	V
Hard bronze	52A, 4A	46-60	K-L	7	V
Gray cast iron	9C, 52A	46-60	J-K	6-7	V
Plastics	9C, C	36-60	H-J	9-11	V
Carbide metals	C	60-100	H-K	7-8	V
	8A				
	Diamond				
Porcelain	9C	60-80	J	7	V
Stainless steel	2A, 52A	46-60	K-L	6-8	V

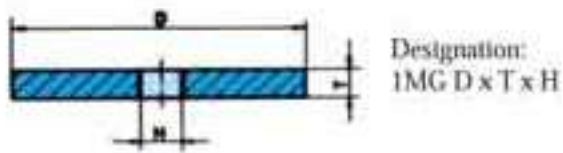
Table of dimensions of grinding wheels for cylindrical grinding

D (mm)	T (mm)	H (mm)
75	6-100	10 20 32
80	6-100	13 16 20 32
100	6-100	10 13 16 20 32
115	6-100	25,4 32
125	6-100	13 16 20 25 30 32 40 50,8 76,2
150	6-100	13 16 20 25 30 32 40 50,8 76,2
175	6-100	13 16 20 25 32 40 50,8
180	6-125	13 16 20 25 32 40 50,8
200	6-125	16 20 25 32 40 50,8 76,2
225	6-125	16 20 25 32 40 50,8 60
250	6-125	16 20 25 32 40 50,8 76,2 127
300	6-125	16 20 25 32 40 50,8 76,2 127 152,4 160
350	6-125	20 25 32 40 50,8 76,2 127 160 203,2
400	8-150	25 32 40 50,8 127 160 203,2
450	8-150	25 32 40 50,8 127 160 203,2 254 304,8
500	10-250	25 32 40 50,8 127 160 203,2 254 304,8
508	10-250	76
600	12-250	25 32 40 50,8 76,2 203,2 254 304,8
650	12-250	203,2 304,8
700	20-150	32 40 50,8 76,2 127 203,2 304,8
750	20-150	76,2 203,2 304,8
800	20-150	32 76,2 203,2 304,8
900	20-150	32 304,8
1000	25-100	76,2 304,8
1060	25-100	304,8
1250	25-100	304,8





## Crankshaft grinding



Type: **1MG**

Application	Abrasive	Grain size	Grade	Structure	Bond
Crankpin and main bearings grinding					
• Carburized and tempered steels					
- automobiles	52A, 2A	46-60	L-N	5-7	V
- trucks and tractors	52A 2A	46-60	K-N J-K	6-7	V
• Steel casting					
- pregrinding	A	36-46	M-N	6-8	V
- final grinding	52A, 42A, 7A	54-60	K-M	6-8	V
Grinding of crankshaft journal	4A, 52A	54-60	L-M	6-7	V

## Camshaft grinding - Type: 1MG

Application	Abrasive	Grain size	Grade	Structure	Bond
Carburized steels	52A, 42A 2A, 4A	54-60 70-80	J-M L-M	6-8 6-9	V V
Steel casting					
- Rough grinding	A	36-46	L-M	6-8	V
- Pregrinding	52A	54-60	K-M	6-7	V
- Final grinding	42A, 2A, 7A	54-60	J-L	6-7	V

## Range of dimensions of grinding wheels Type 1MG

D (mm)	T (mm)	H (mm)
500	16 20 32	127 203,2
660	19 20 25 32	127 203,2 304,8
750	20 25 32 40	203,2 304,8
800	16 20 40 63	203,2 304,8
813	20 25 32	203,2
900	20 25 32 40	304,8
914	20 25 32 38	304,8
1000	32 40 50	304,8
1016	32	304,8
1060	32	304,8
1140	32 40 50 51 70	304,8

Ordering example: 1MG 660x19x203,2 52A 60/3M7V35, 40m/s.

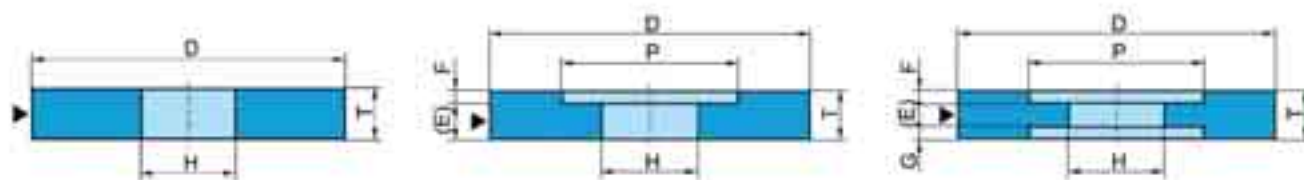


Crankshaft grinding

Camshaft grinding



## Roll grinding



Type:

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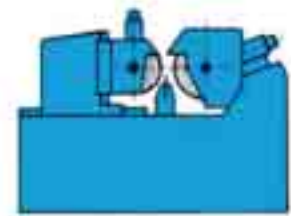
Application	Abrasive	Grain size	Grade	Structure	Bond
Cast iron rolls	9C, 2A	46-60	K-L	6-7	B
Chromium-casted rolls					
- roughing	8A	60-80	J	7-8	V
- finishing	8A	120-220	G-I	9	B
Rolls made of Cr-Ni steels					
- rough grinding	8A, C	80	J	8	V
- pregrinding	9C, C	120-280	H	10	
- polishing	9C	400	H	11	
Crushig rolls made of austenitic manganese steels	2A	24-60	K-N	5-7	V B
Copper					
- rough	9C, C	24-36	K	5-6	B
- finishing	9C, C C	60-80 46-60	J H	7-8 7-10	B V
Rubber soft					
- rough		2A	2A	J-K	4 B
- finishing	C	9C	46-60 H	J-L 7-10	5 B V
Rubber, hard	2A C	46-54 46-54	J-K Hi	13 6-10	V V
High-alloyed steels	2A	54-80	J-K	7-8	V
Hot mill rolls					
chilled cast iron	9C, 52A	24-36	J-K	4-5	B
steels	2A	24-36	J-L	4-5	B
Cold mill rolls					
forged steel	2A	36-46	L	5	B
live and cog rollers	2A, 52A	54-80	K-L	7-8	B

Ordering example:

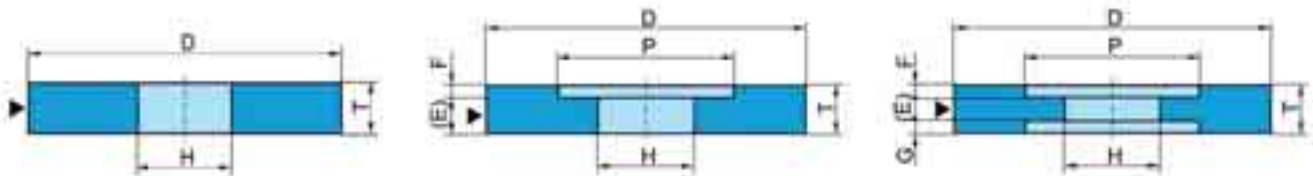
5 750x100x305-420x20 8A 54/3i36V35, 40 m/s for steel until 62 HRc for cold and hot mill rolls.

1 900x100x304.8 29 GC 36/2 J7 BX03, 50 m/s for live rolls for hot mill rolls on Hercules and Waldrich machine.

1 350x38x127 9C 220/1 F11 B50, 40 m/s for rolls renewal on Landis machine.



## Cylindrical Grinding — Centreless



Type:

1

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Grinding wheels for centreless grinding thicker than 154 mm are assembled from two or more straight (type 1 RS) or oblique (type 1 PS) pieces. At request they can be glued (types 1 RLS and 1 PLS). Each piece of the so assembled grinding wheel can be manufactured in another specification or bond.

Peripheral speeds are:

- 35 – 45 m/s by vitrified bonded wheels and
- 35 – 50 m/s by resinoid bonded wheels.

Ordering example:

1RSL 600 x 400 x 304,8 4A 60/2 J 6V35, 40 m/s

Cylindrical grinding - centreless





By this type of grinding the workpiece is not fixed in the machine but it lies between the grinding wheel, the regulating wheel and the rigid workpiece rest blade. Depending on the type of loading of the workpiece into the machine we differ among the following types of grinding:

1. Through-feed grinding
2. Plunge cut grinding
3. Grinding with a stop

By through-feed grinding the workpiece, which has to be of cylindrical shape without shoulders or heads, traverses through the machine between the grinding and the regulating wheel.

By plunge cut grinding the workpiece, which can be profiled (more diameters with shoulders) is infed between the two wheels, whereby the regulating wheel is less skewed than the grinding wheel.

Grinding with a stop is used for grinding of tapered workpieces, as are for example tapered heads on spiral drills. The workpiece is infed into the machine and is ground into the desired shape by the moment it reaches the stop.

Specification of grinding wheels for grinding of different materials by through-feed grinding:

Application	Recommendations					
	Material	Abrasive	Grain size	Grade	Structure	Bond
Unhardened steels		52A	60-80	L-M	7-8	V
Hardened steels		2A, 52A	60-80	K-M	7-8	V
Stainless steels		9C, 4A	54-60	J-M	7-8	V
High-speed steels		52A, 6A	60-80	K-M	8	V
Non-ferrous metals (soft bronze, aluminium, brass)		9C, C	36-46	L	5-6	V
Hard bronze		52A,		L		
		2A, 8A	46-60	M	7	V
Gray cast iron			52A	54-60	K	8 V
		9C	46-60	L	7	
Plastics		9C, C	46-60	K	6	V
Porcelain		9C	36-60	J-K	6-7	V
Drill grinding		2A, 42A	54-60	L-M	6-8	V
Valve-stem grinding		52A, 2A	54-60	L-M	6-8	V
Grinding of bearings (external grinding of rings)		6A, 8A	100-120	M-N	7	V
Grinding of bars at passing		52A, 2A	46-80	K-N	5-7	V
Chromium plated material		2A	60-80	J-K	8	V

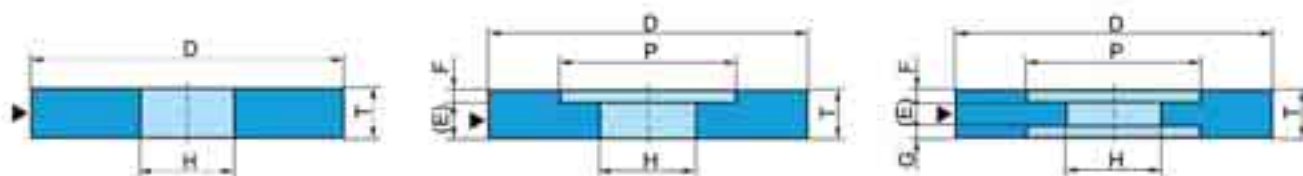
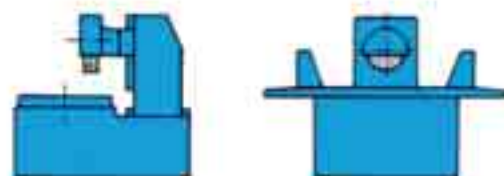
By the same roughness of the material surface grinding wheels for infeed grinding have to be for 2 to 3 grades finer than grinding wheels for through-feed grinding.

- For grinding of bars Ø 9-18 mm at passing of high grade steel or low alloyed steel we recommend:  
1 600x250x355 S5 7C 60/9 08 B00, 50 m/s, for Lindköping machines.
- For grinding rotors of electrical motors at passing:  
1RS 610x508x304.8 7A 36/1 L6V35.

Regulating wheels are produced in vitrified in resinoid and rubbed bond in the following specifications:

- A80-120 T-8 V
- 3A 80-120 T7-8 B
- A80-100 TR 11

# Surface Grinding with Straight Grinding Wheels



Type:

1

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Application	Abrasive	Grain size	Grade	Structure	Bond
Steel - unhardened	52A	36 - 46	K - M	6	V
Steel - hardened	2A, 4A 4A, 6A 6A, 8A	<55HRC 55-62 HRC 62-64 HRC	H - J	6 - 7	V
Tool steel, high-alloyed	8A	46 - 60	H - J	6 - 7	V
Chromium plated	8A	46 - 80	I - J	8	V
Stainless and chemically resistant	8A	46 - 60	I - J	7 - 8	V
	C		I	6	
Carbide metal	C	46 - 60	H	6 - 7	V
	6A, 8A	46 - 60	H - I	6 - 7	V
Castings	52A	36 - 60	J	6	V
	C	36 - 60		6	
	8A	36 - 60		5	
	C	36 - 60		6	
- spheroidal graphite iron	8A	36 - 60	J	5	V
- chilled iron	C	36 - 46		6	
Aluminium, brass, soft bronze	9C, C	36 - 46	J	6	V
Hard bronze	52A	36 - 46	J - K	6 - 7	V
Copper and alloys	C	36 - 46	J	6 - 8	V
Plastics	9C, C	46 - 54	J	6 - 7	V
Stainless steel, soft	2A, 52A	46 - 60	K - L	6 - 8	V



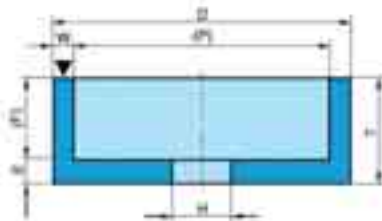
**Grinding Wheels for Grinding Skating Surface of Skis.**  
 1 350x140x223 1A 14/9 S7 VX44  
 1 350x140x223 N8A 30/3 K12/3 VX35T4



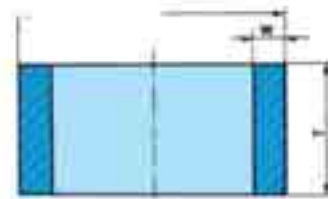
## Surface Grinding with Cup Wheels, Cylinders and Segments



Type:



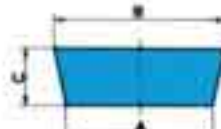
6



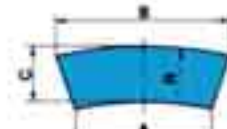
2



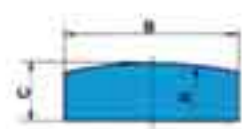
31A



31B



31C



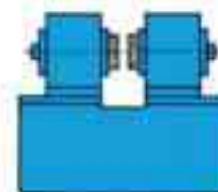
31AA

Additionally to the above types we can manufacture segments in many other shapes and dimensions.

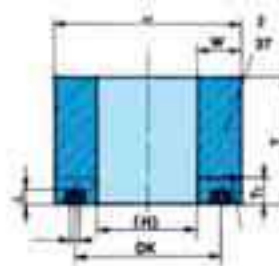
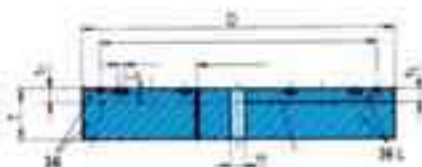
- 31B17 100/85x35x150 42A 30/1 18/3 V20 for knives
- 31S16 160x60x200 S4A 46/1 E8 B11 for knives
- 31S30A 166/150x75xT248 1ZA 20/9 OP2 B37/71 for rails.

Application	Abrasive	Grain size	Grade	Structure	Bond
Steel - unhardened	52A	24-46	I - K	6	V
<55 HRc	2A, 8A				
- hardened 55-62 HRc	4A, 6A	36 - 46	E - I	7 - 12	V
62-64 HRc	6A, 8A				
Tool steel, high-alloyed	8A	36 - 46	E - I	7-12	V
- high-speed	2A - 42A	46	G-H	7	V
- stainless	2A, 8A	46-60	F-J	7-12	V
	C	36-46	J	5	V
Gray cast iron and chilled iron	9C, C	24-36	H-K	5	V
	2A, 42A, 52A	46	I	12	V
Aluminium and non-ferrous metals, brass	9C, C	24-36	H-J	5	V
Chromium plated surfaces	2A, 8A	46-80	G-I	12	V
	C		H	5	V
Marble	9C	24	L	4	B
Plastics	9C	24-54	K	4	B
Hard fire clay (refractories)	9C	16-36	S	3	B

Ordering example: 31B51 120/106x41x250 3GA 30/2 K8 BO3  
 6 250x100-W9E20 52C 180/2 K11 BO3 for bearings



## Double wheel Surface Grinding with Wheels with Inserted Nuts



Type:

**36**

**37**

Designation: 36 D x T x H — number of nuts

37 D x T — W — number of nuts

Surface grinding with grinding wheels and ring wheels with inserted nuts, type 36 and 37.

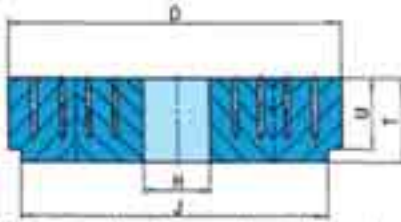
Application	Abrasive	Grain size	Grade	Structure	Bond
Side grinding of bearing rings	52A	80-100	K-N	8	V
	S52A, 52A	54-100	J-N	6-8	B
Grinding of (roller) bearing straight grinding	2A	70-120	K-N	6-8	B
	6A, 2A	80-120	K-N	8	V
Clutch discs	9C	16-24	K-N	4	B
Grinding of brake lining	9C	16-24	K-N	4	B
Gears	2A	46-60	H-K	6	V
Piston rings gray cast iron	9C, C	24-100	K-M	6-8	B
	52A	24-100	K-M	6-8	B
Grinding of valve seats	9C	60-120	J-L	6-8	V
					B
Grinding of piston rods	52A	46-60	J	5	B



Ordering example for surface grinding of circular saw:  
 37L11 404x140-W37 S2A 70/1 C9 B08  
 For front grinding of circular saws:  
 1 500x50x203,2 S2A 46/9 K6 B08/174



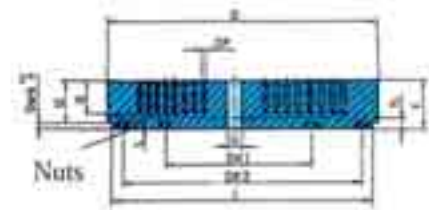
## Grinding wheels for spring grinding



Perforated and stepped grinding wheel

Designation:

35UP -- D/J x T/U x H



Perforated grinding wheel with nuts

Designation:

36UP -- D/J x T/U x H - n

n = number of nuts

They are used for two-wheel side grinding on special machines such as WAFIOS, SCHENKER, and OMD. Grinding wheels are fixed on support wheels by special glues or by screws. In this case grinding wheels must be furnished with inserted nuts. Concerning the kind and distribution of nuts the buyer and the producer must previously agree about their position in the wheels.

As to the purpose and kind of use these grinding wheels are produced in different design: as straight grinding wheels, as straight grinding wheels without hole, and as stepped grinding wheels. Possible are designs with cooling holes. On special demand we deliver grinding wheels with strengthened peripheral zone.

On principle, grinding wheels for spring grinding are made of mixed aluminium oxide (52A) in vitrified bond (V35).

When a mild cut is required we recommend resinoid bond (B04, B08, B10).

The peripheral speeds usually do not exceed 32-35 m/s.

The most frequently used grinding dimensions are specified in the table below.

Spring wire	Recommendations				
	Abrasive grain	Grain size	Grade	Structure	Bond
Thick wire	GA, 52A	16-24	N-Q	4, 5, 6	V B
Medium wire	GA, 52A	24-46	L-N	4, 5, 6	V
Thin wire	GA, 52A, 2A	46-60	K-M	4, 5, 6	V

Ordering example:

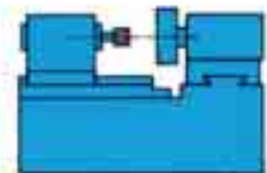
35 UP 650/618x90/75x350 52A 16/3 NO 4 V 35, 35 m/s

Dimensions D x T x H (mm)	Cooling holes	Nuts
150 x 30 x 20		
175 x 50 x 50		
175 x 50 x 0		X
225 x 50 x 50	X	
225 x 50 x 0		X
400 x 60 x 250		
450 x 60 x 200	X	X
450 x 60 x 0	X	X
450 x 65 x 200		
450 x 80 x 40	X, O	X
450 x 80 x 0	X, O	X
600 x 70 x 250	X	X
600 x 75 x 250	X	X
600 x 80 x 250	X	X
600 x 80 x 300	X	X
650 x 80 x 350	X	X
650 x 80 x 0	X	
650 x 90 x 350	X	X
660 x 100 x 150	X, O	X
660 x 120 x 150	X	X
650 x 100 x 350	X	
800 x 100 x 400		X
800 x 120 x 300		
915 x 120 x 200	X, O	X

O - perforation throughout the wheel

We offer these wheels made of Submicron crystal structured sinterized alumina (our internal marking GA) which we produce in different Specifications regarding the percentage of GA in the mixture.





# Internal Grinding

Types of grinding wheels for internal grinding:  
**1, 5, 5NA, 5NB, 5NC**

Ordering example:  
**1 16x16x6 2A80/3 K8 V22, 40 m/s**

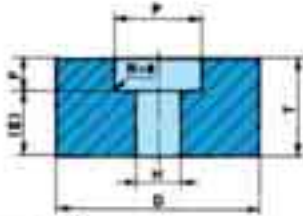
Application	Recommendations				
	Abrasive	Grain size	Grade	Structure	Bond
Heat treated steels, unhardened	52A 4A	46-80	K-L J-L	6-8	V
Hardened, low-alloyed steels (up to 62 HRC)	2A, 4A	46-80	J-K	6-8	V
Hardened, high-alloyed steels (62 HRC and more)	2A, 4A, 6A	46-80	I-J	6-8	V
Chromium steels	C	46-70	J-K	6-7	V
	8A	46-80	I-J	6-8	V
High-speeds steels (over 64 HRC)	2A, 8A	46-80	H-I	6-8	V
Hardened high-speed steels (over 64 HRC)	8A	46-80	I-J	6-8	V
Nitrited steels (over 64 HRC)	C	60-100	J-K	6-8	V
Alloys, friction resistant	C	60-100	I-K	6-8	V
Stainless, acid resistant steels (Cr-Ni 18/8)	9C,C	46-60	I-J	6	V
	6A, 8A	46-60	H-J	6-7	V
Carbide metals	Diamond				
Chromium-plated metals	8A	54-80	I-J	8-11	V
Plastics	9C	36-60	I-J	5-6	V
Gray cast iron (up to 70 SHORE)	9C	46-60	K-L	5-6	V
Chilled cast iron (over 70 SHORE)	9C	46-60	J-L	5-6	V
Hard bronze	9C, C	36-60	J-K	5-6	V
Aluminium and non-ferrous metals	9C, C	36-60	I-J	5-6	V
Steel, soft, stainless	52A	80	L	8	V
Internal grinding	2A, 52A	46-60	J-K	6-7	V



Internal grinding

For internal grinding of high speed, tool, bearing, and high-alloyed steels with hardness over 50 HRC, for surface hardened steels, cast iron, and NiCo super alloys with hardness over 35 HRC, by serial production the application of grinding tools made of boron nitride in vitrified bond is recommended due to more economical grinding.

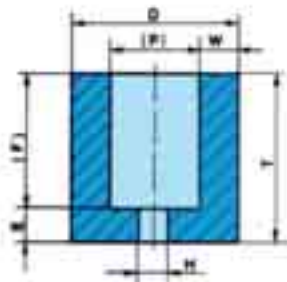
Tables of wheel types and dimensions for internal grinding in mm.



Type: **5NA**

Designation:  
5NA D x T x H

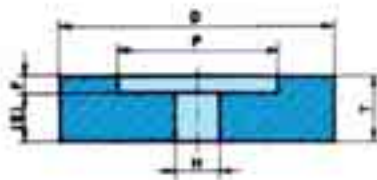
D	T								H	P	r
	16	20	25	32	40	50	63	80			
	F										
	8	8	9	12	15	18	25	30			
20	•	•	•	•					6	12	0.2
25	•	•	•	•					8	14	0.3
32	•	•	•	•	•				10	18	0.3
40		•	•	•	•	•			13	22	0.4
(45)		•	•	•	•	•			16	28	0.5
50			•	•	•	•	•		20	32	0.5
63				•	•	•	•	•	25	38	0.8
80					•	•	•	•	25	48	0.8



Type: **5NB**

Designation:  
5NB D x T x H

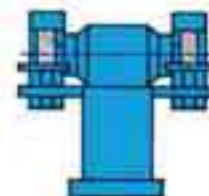
D	T						H	P	r
	25	32	40	50	63	80			
	F								
	17	22	27	34	45	55			
20	•	•					6	12	0.2
25	•	•					8	14	0.3
32	•	•	•				10	18	0.3
40		•	•	•			13	22	0.4
(45)		•	•	•			16	28	0.5
50			•	•	•		20	32	0.5
63				•	•	•	25	38	0.8
80				•	•	•	25	48	0.8



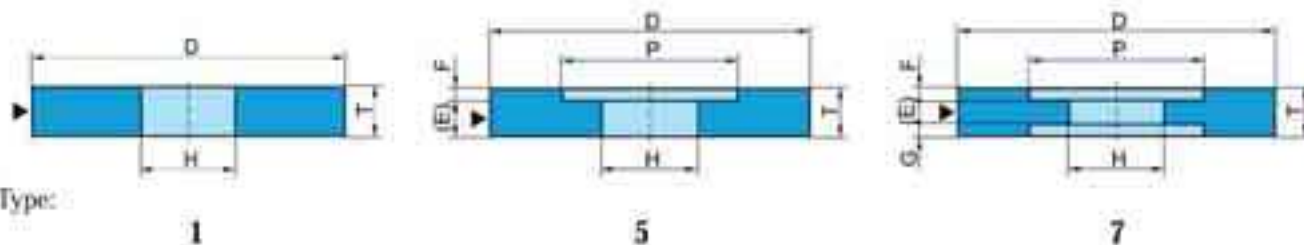
Type: **5NC**

Designation:  
5NC D x T x H

D	T							H	P	r
	13	16	25	32	40	50	63			
	F									
	5	8	9	12	15	18	25			
32	•							13	21	0.3
36		•						16	26	0.3
40		•						16	26	0.4
45		•						20	32	0.5
50			•					20	32	0.5
56			•					25	41	0.6
69			•					25	41	0.8
63			•					32	52	0.8
80			•					32	52	0.8
80				•				32	60	0.8
100				•				32	60	1.0
100					•			51	76	1.0
125					•			51	76	1.2
125						•		51	88	1.2
150						•		51	98	1.6
150							•	76	116	1.6
200							•	76	118	2.0



## Tool Grinding



Tool grinding with straight grinding wheels  
type 1, 5, 7 (on stationary grinding machines)

Application	Recommendation				
	Abrasive	Grain size	Grade	Structure	Bond
Hand tools - unhardened tools	A, 4A, 52A	46-60	L-M	6-7	V
	A, 4A	80	K-L	8	
- tool steels	2A, 4A	46-60	K-L	7	V
		80	K	8	
- high-speed steels	2A, 6A	46-60	K-L	7	V
		80-100	J-K	8	
Cutting tools and planing tools - tool steels - high-speed steels	2A, 4A	46-60	K-M	6-7	V
		80-100	J-K	6-7	V
	8A, 82A and CBN	46-60	J-K	7	V
		80-100	I-J	8	
Carbide coated materials	C and diamond	46-60	J-K	6-7	V
		60-120	J-K	6-7	V

Range of dimensions:

D (mm)	T (mm)	H (mm)
125	20	20 (16)
150	20	32 (20) (16)
175	20	32 (20) (16)
200	20	32 (20)
200	25	32 (20) (25)
250	25	25

Ordering example:

1 200x20x20 2A60/3K7V20, 40 m/s



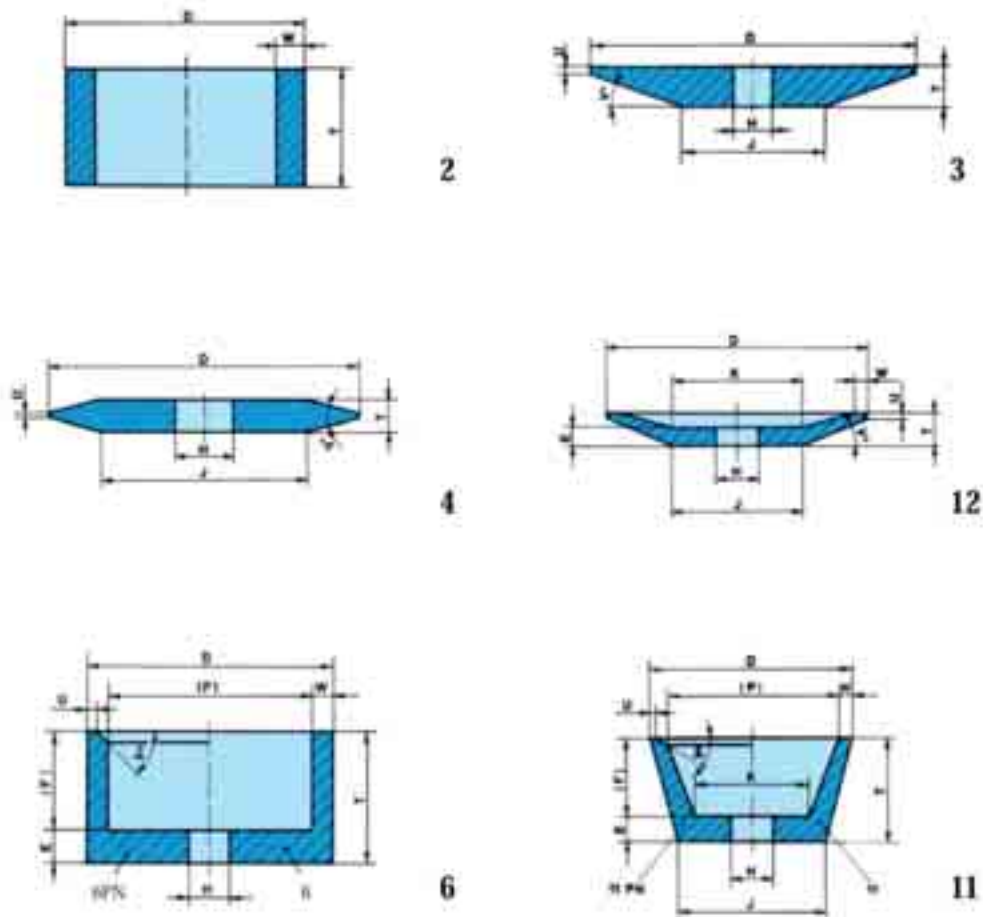


## Tool grinding with straight grinding wheels, types 1, 5, 7 (on universal grinders)

Application	Recommendation				
	Abrasive	Grain size	Grade	Structure	Bond
Twist drills					
Tool steels					
< 10 mm	2A, (4A)	60-80	J-K	7-8	V
> 10 mm	2A, (4A)	46-60	K	7	V
High-speed steels					
< 10 mm	8A, 2A	60-80	J-K	7-8	V
> 10 mm	8A, 2A	46-60	K	7	V
Carbide coated materials					
< 10 mm	C	60-80	J-K	6-7	V
> 10 mm	C	46-60	K	6	V
Mining drills		C	46-60	J-K	6 V



## Tool grinding with grinding wheels type 2, 3, 4, 6, 11, 12 (on universal grinding machines)

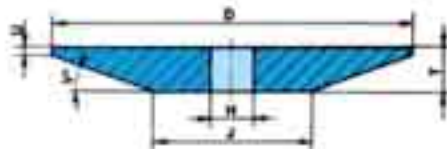


Application	Recommendation				
	Abrasive	Grain size	Grade	Structure	Bond
Cutting tools - tool steels	2A, 4A	46-60	J-K	6-7	V
		70-80	I-K	8	
- high-speed steels	2A, 4A 8A	46-60 70-80	J-K	6-7 8	V
Hobs (grinding wheel type 3)	2A, 42A	46-60	J-K	7-9	V
Cutters and planning tools (Type 2, 6)	2A, 42A	46-60	I-K	7	V
Wood-cutters made of high-speed steels (Type 12)	2A	54-80	I-K	7	V

## Table of dimensions for standard wheel shapes

### Wheel tapered one side

Type: **3**



Designation:

3 DxTxH

Ordering example: 3 250 x 14 x 40

Designation of non-standard dimensions:

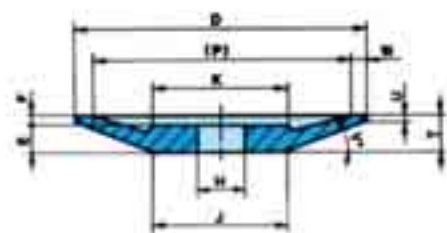
3 D/JxT/UxH-V

Table of standard dimensions (mm)

D	T	H	J	U
75	5	13	30	1
80	5	20	30	1
100	6	20	50	1,5
125	7	20	68	2
150	8	20	82	2
175	10	20	95	3
200	12	32 (20)	95	3
250	14	32	125	3

### Dish wheel

Type: **12B**



Designation:

12B DxTxH

Ordering example: 12B 100 x 12 x 20

Designation of non-standard dimensions:

12B D/JxT/UxH-W./E./K./V.

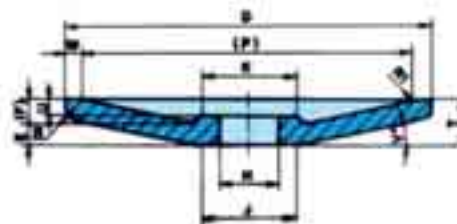
Limiting dimensions:  $W=0,05 D$ ,  $E \geq 0,5 T$

Table of standard dimensions (mm)

D	T	J/K	U	E	W	P	F	H
75	8	28	2	6	4	67	2	10, 13, 16, 20
80	8	30	2	6	4	72	2	16, 20, 25
100	12	35	3	8	6	88	4	16, 20, 25
125	14	40	3	9	6	113	5	16, 20, 25, 30, 32
150	15	50	3	10	7	136	5	16, 20, 25, 30, 32
175	18	60	3	11	8	159	7	20, 25, 30, 32, 35, 40
200	19	70	3	12	10	180	7	20, 25, 30, 32, 35, 40
250	21	100	3	14	12	226	7	20, 25, 30, 32, 35, 40

### Dish wheel

Type: **12BH**



Designation:

12BH DxTxH

Ordering example: 12BH 175 x 22 x 20

Designation of non-standard dimensions:

12BH D/JxT/UxH-W./E./K./V.

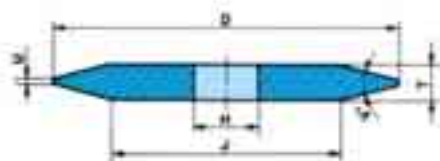
Limiting dimensions:  $W=0,05 D$ ,  $E \geq 0,5 T$

Table of standard dimensions (mm)

D	T	K/J	U	E	W	P	F	R/R1	H
175	22	50	10	10	10	155	12	4/2	20, 25, 30
200	25	60	11	11,5	8	184	13,5	4/2	20, 25, 30, 35, 40

### Wheel tapered both sides

Type: **4**



Designation:

4 D<sub>x</sub>T<sub>x</sub>H-V<sub>..</sub>

Ordering example: 4 100 x 9 x 20 - 15°

Designation of non-standard dimensions:

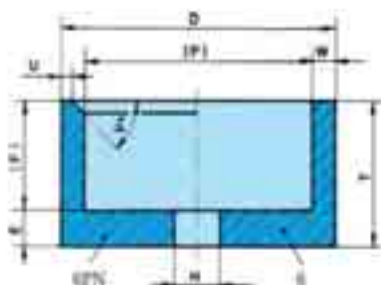
4 D/J<sub>x</sub>T/U<sub>x</sub>H-V<sub>..</sub>

Table of standard dimensions (mm)

D	T	H	U	V
75	8	13	2	15°
80	8	20	2	15°
100	9	20	2	15°
125	10	20	2	15°
150	12	20	2	15°
175	14	20	3	15°
200	16	32 (20)	3	15°
250	19	32	4	15°

### Cylinder cup wheel

Type: **6, 6PN**



Designation:

6 D<sub>x</sub>T<sub>x</sub>H

Ordering example: 6 100 x 50 x 20

Designation of non-standard dimensions:

6 D<sub>x</sub>T<sub>x</sub>H-V<sub>..</sub>/E<sub>..</sub>

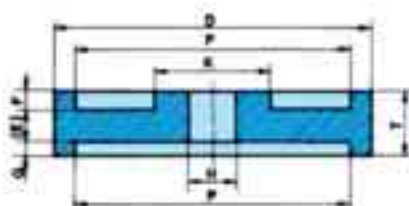
Limiting dimensions: 0,5T > E 0,2T, W < 0,17 D

Table of standard dimensions (mm)

D	T	W	E	P	H
40	25	4	6	32	13, 16, 20, 25
50	32	5	8	40	13, 16, 20, 25, 30
63	40	5	8	53	16, 20, 25, 30
75	40	6	10	63	16, 20, 25, 30
80	40	6	10	68	16, 20, 25, 30, 35, 40
100	50	8	10	84	16, 20, 25, 30, 35, 40, 50, 60
125	63	8	13	109	16, 20, 25, 30, 32, 35, 40, 50, 60
150	80	10	16	130	16, 20, 25, 30, 32, 35, 40, 50, 60, 75, 85

### Wheel recessed both sides, with hub

Type: **9P**



Designation:

9P D<sub>x</sub>T<sub>x</sub>H

Ordering example: 9P 100 x 10 x 20

Designation of non-standard dimensions:

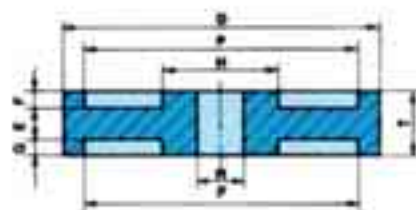
9P D/K<sub>x</sub>T<sub>x</sub>H-P<sub>x</sub>E/G

Limiting dimensions: 0,5 T > E 0,2T



### Wheel recessed both sides, with hubs

Type: **9PP**



Designation:

9PP DxTxH

Ordering example: 9PP 100 x 10 x 20

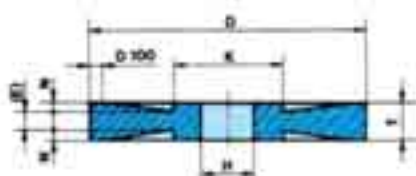
Designation of non-standard dimensions:

9PP D/KxTxH-PxH/G

Limiting dimensions:  $0,5 T > E$   $0,2T$

### Wheel recessed both sides, with hub

Type: **21P**



Designation:

21P DxTxH

Ordering example: 21P 100 x 10 x 20

Designation of non-standard dimensions:

21P D/KxT/NxH

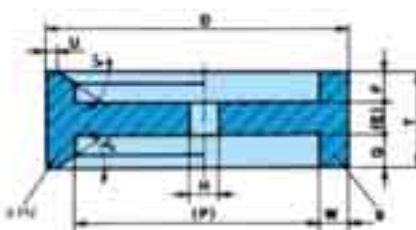
Limiting dimensions:  $H \geq 0,67D$   $E \geq 0,5T$

Table of standard dimensions for wheels type 9P, 9PP, and 21P (mm)

D	T	H	K	P	F	N
100	6	20	50	94	-	1,5
100	10	20	50	94	1,5	3
150	6	20	70	144	-	1,5
150	10	20	70	144	1,5	3
150	15	20	70	144	2,5	4,5
175	20	32 (20)	70	167	3	6
175	25	32 (20)	70	163	4,5	7,5

### Both sides cylinder cup wheel

Type: **9, 9PN**



Designation:

9 DxTxH

Ordering example: 9 100 x 40 x 13

Designation of non-standard dimensions:

9 DxTxH-W./F./G.

Limiting dimensions:

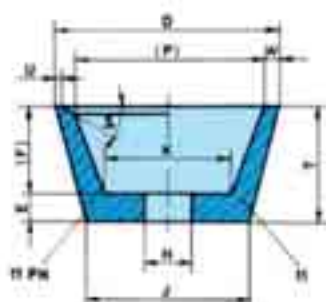
$0,5 T > E$   $0,2T, W < 0,17D$

Table of standard dimensions (mm)

D	T	H	P	F/G	E	U	W
100	40	13	88	16	8	1,5	6

### Flaring cup wheel

Type: **11, 11PN**



Designation:

11 DxTxH

Ordering example: 11 75 x 30 x 20

Designation of non-standard dimensions:

11 D/JxTxH-W./E./K.

Limiting dimensions:

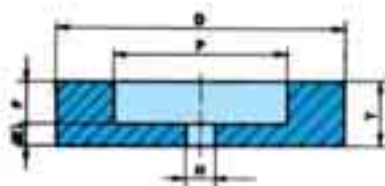
$0,5 T > E$ ,  $W < 0,17D$

Table of standard dimensions (mm)

	D	T	H	J	W	E	K
11	50	32	13, 16	27	4	8	22 (4)
	63	32	16, 20, 25	45	5	8	35
	75	32	16, 20, 25	53	6	8	45
	80	32	16, 20, 25	57	6	8	46
	100	35	16, 20, 25	71	8	10	56
	125	45	16, 20, 25	96	8	10	81
150	50	16, 20, 25	114	10	13	96	
11 H	250	140	100	200	30	38	140

### Wheel recessed one side

Type: **5G**



Designation:

5G DxTxH

Ordering example: 5G 150 x 32 x 20

Designation of non-standard dimensions:

5G DxTxH-PxF

Limiting dimensions:

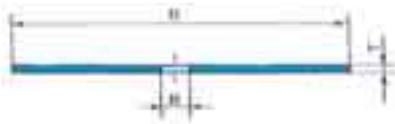
$0,5 T > E$ ,  $0,3T$

Table of standard dimensions (mm)

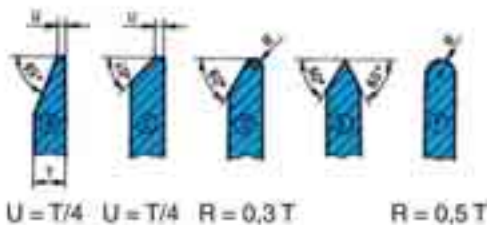
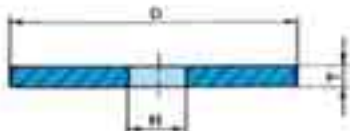
D	T	E	F	P	W	R	H
150	32	12	20	80	35	5	16, 20, 25
175	32	12	20	90	42,5	5	25, 30, 32, 35, 40, 50
200	40	15	25	110	45	5	25, 30, 32, 35, 40, 50
225	40	15	25	135	45	5	35, 40, 50
250	40	15	25	150	50	6	40, 50, 60, 75
300	50	20	30	180	60	6	50, 60, 75, 80, 125
350	63	22	41	210	70	6	125

## Grinding wheels for saw sharpening

Type 1 T



Type 1



Type 1 DS-B

Designation:  
1 D x T x H

Designation of sharpening wheels  
with peripheral shape:  
1-B, 1-C, 1-D, 1-E, 1-F

Designation of two layers  
wheels with peripheral shape:  
1DS-B, 1DS-C, 1DS-D

We manufacture grinding wheels for saw sharpening in several specifications, depending on the material to be sharpened and the operating conditions. Saws can be sharpened offhand on simple machines, or automatically on more perfect machines. For offhand sharpening it is better to use harder wheels, because the hand pressure is not equal and the consequence is an excessive consumption of the wheel. For automatic sharpening the use of softer wheels is advisable, because the pressure is equal and an overheating and burning of the teeth is prevented.

For offhand sharpening we advise the use of grinding wheels in aluminum oxide regular (A or 3 A), grade M-O, or in mixed aluminium oxide 52A. For automatic sharpening grinding wheels in special aluminium oxide (2 A, 4 A) are recommended.

Table of dimensions:

D (mm)	T (mm)	H (mm)
100	1 1,5 2 2,5	20 25 30
150	3 3,5 4 4,5 5 5,5 6 8 10	
175	1 1,5 2 2,5 3 4 6 8 10	32 51
200	1 1,5 2 2,5 3 3,5 4 4,5 5 5,5 6 8 10 13	20 25 30
250	1,5 2 2,5 3 3,5 4 4,5 5 5,5 6 8 10 13	20 25 30
300	6 8 10 13 15	32 100

Ordering example:

1-C 150x10x20 4A80/3N8V35, 40 m/s

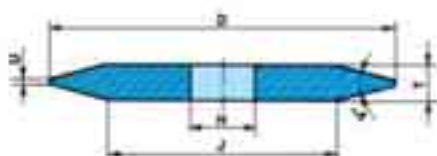
1 250x10x32 5GA60/1O10B33, 63 m/s

Grinding wheels with diameter 250 mm and less and with thickness 6 mm or less are considered thin grinding wheels and are marked with type 1T.

## Gear Grinding

### Biconical grinding wheels for gear grinding on “Niles”-system machines

Type: 4N



Designation:

4N D x T x H-V

Ordering example: 4N 250x20x51-30°

Designation of non-standard dimensions:

4N D/JxTx/UxH-V

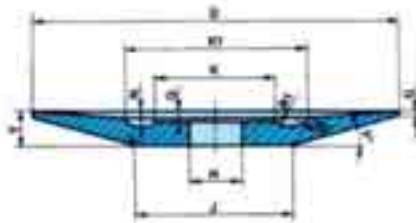
D	T	H	U	V
250	13	51	3	30°-40°
250	16	51	4	30°-40°
250	20	51	4	30°-40°
300	25	90	4	30°-40°
350	32	90	5	30°-40°

Application	Diameter D (mm)	Recommendations		
		Module 0,75 - 2	Module 2,5 - 4	Module more than 4
Heat-treated steels up to 120 kg/mm <sup>2</sup>	240	2A100/3K7V	2A70/3K7V	2A54/3K7V
	350		2A60/3J7V	2A46/3J7V
Carburized steels hardened, e.g.: 16MnCr5	240	2A100/2J7V	2A60/2I7V	2A54/2K7V
	350	2A100/3I9V	2A60/2K7B	2A54/2I6V 2A46/2I7/6V
Tool-steels, hardened and high-alloyed, (64 HRC) and high-speed steels	240	2A120/2H9V	2A70/2I7V	2A54/2I7/6V
	350	2A100/2H8V	2A60/2H7V	2A46/3H7/6V
Nitrided steels (70 HRC)	240	C100/3J7V	C80/3J7V	C60/3K6V
	350		C80/3K7V	C60/3J6V
Gray cast iron Chilled cast iron	240	2A100/1J8V	2A70/3K8V	2A54/3K8/6V
	350		2A60/3J7V 2A60/3J8/6V	2A54/2K7V 2A46/3J8/6V
Non-heat-treated steels	240	52A100/3J9V	52A60/3J7V	52A54/3J6V
	350	52A80/3J8V		

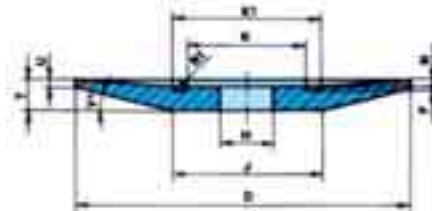


# Gear grinding on “Maag”-system machines

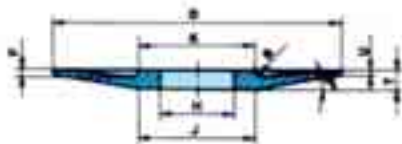
Grinding wheels type:  
12M1, 12M2, 12M3, 12M4



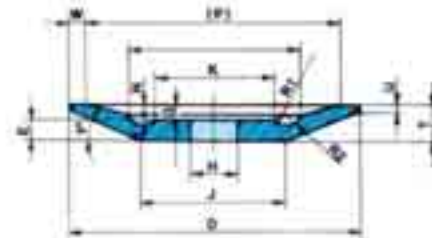
12M1



12M2



12M4

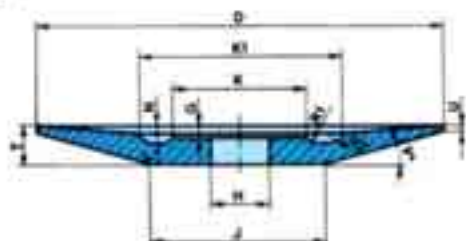


12M3

Application	Recommendations				
	Diameter D (mm)	Module 1 - 1,5	Module 1,5 - 2,5	Module 2,5 - 5	Module more than 5
Heat-treated steels	220-280	4A100/3K7V	4A80/3J7V	4A60/3K7V	4A46/3J7V
	340			4A60/3J7V	4A46/3I7V
Hardened steels	220-280	42A100/3K7V	42A80/3J7V	42A60/3K7V	42A46/3J7V
	340			42A60/3I7V	42A46/3I7V
High-speed steels hardened 64 HRc	220-280	2A100/3J7V	2A80/3I7V	2A60/3I7V	2A46/3I7V
	340			2A60/3H7V	2A46/3H7V
Tool-steels 64 HRc	220-280	8A80/3I7V	8A80/3I7V	8A60/3H7V	8A46/3I7V
	340			8A60/3H7V	8A46/3H7V
Nitrided steels	220-280	C100/3I7V	C80/3I7V	C60/3J6V	C60/3J6V
	340			C60/3J6V	C60/3J6V
Gray cast iron	220-280	2A100/3K14/4V	2A80/3J12/4V	2A60/3J12/3V	2A46/3J12/3V
	340			2A60/3I12/3V	2A46/3I12/3V

Dish wheel for gear grinding  
per "Maag" system

Type: **12M2**



Designation:

12 M2 D x T x H

Ordering example: 12 M2 220x18x40

Designation of non-standard dimensions:

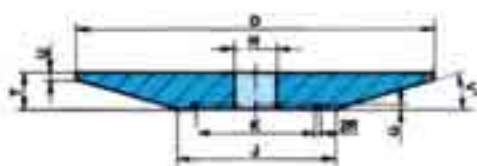
12 M2 D/J/KxT/UxH-V.

Table of standard dimensions (mm)

D	J	K	K1	H	F	N	T	U	R1	R2
220	120	80	140	40	8	2,2	18	2,3, 4,6	8	6
280	120	80	140	40	8	7	25	4,8	8	6
340	120	130	180	40	8	7	25	4,8	8	6

## Wheel tapered one side "Klingenberg"

Type: **3K1**



Designation:

3K1 D x T x H

Ordering example: 3K1 250x14x40

Designation of non-standard dimensions:

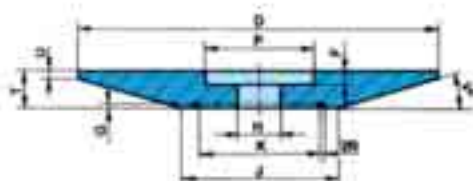
3K1 D/JxT/UxH-V.

Table of standard dimensions (mm)

D	J	K	T	U	2R	G	V*	H
250	170	110	14	3	10	5	15°	30, 32, 35, 40, 50
250	180	110	17	5	10	5	15°	30, 32, 35, 40, 50
250	190	110	22	8	10	5	15°	30, 32, 35, 40, 50

Wheel tapered one side,  
with a recession on the straight side  
"Klingenberg"

Type: **3K2**



Designation :

3K2 D x T x H

Ordering example: 3K2 250x14x40

Designation of non-standard dimensions:

3K2 D/JxT/UxH-PxF-V.

Table of standard dimensions (mm)

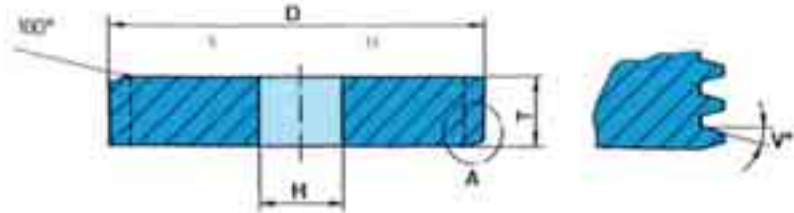
D	J	K	T	U	P	2R	G	V*	H
250	170	110	14	3	100	10	5	15°	30, 32, 35, 40, 50
250	180	110	17	5	100	10	5	15°	30, 32, 35, 40, 50
250	190	110	22	8	100	10	5	15°	30, 32, 35, 40, 50

# Gear grinding on “Reishauer”-system grinding machines

Grinding wheels type: **IZ, IZD**

IZ – wheel with module-thread  
 IZD – wheel with double module-thread

Designation:  
 D x T x H - module/V



Type: **IZ**

Dimensions (mm)	Module	Specification	Designation Reishauer
350x62x160	0,5-0,9	8A, 82A 240/1 H 11 V	SW 1
	1-1,75	8A, 82A 220/2 H 10 V	SW 2
	2-2,25	8A, 82A 180/2 I 10 V	SW 3
	2,5-3,5	8A, 82A 150/2 J 10 V	SW 4
104 350x84x160	1-1,75	8A, 82A 220/2 H 10 V	SWZ 5
	2-2,75	8A, 82A 180/2 H 10 V	SWZ 6
	3-3,75	8A, 82A 150/2 I 10 V	SWZ 7
	4-6	8A, 82A 120/2 I 9 V	SWZ 8
	more than 6-7	8A, 82A 100/2 J 9 V	SWZ 9
104 400x84x160	1,0-1,75	8A, 82A 180/2 H 10 V	SWT 11
	2-2,75	8A, 82A 150/2 I 10 V	SWT 12
	3-5	8A, 82A 120/2 I 9 V	SWT 13
	more than 5-7	8A, 82A 100/2 I 9 V	SWT 14
	more than 7	8A, 82A 90/2 J 8 V	SWT 15

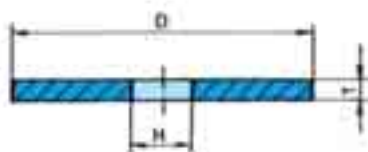
Indicated specifications are recommended for steels and gears of a grade higher than 55 HRC. For grinding gears with a grade of hardness up to 55 HRC the hardness of the wheel can be increased for one degree, according to the choice of specification. For special grinding requirements (high face stability), instead of white aluminum oxide (2A) single crystal aluminum oxide (8A) should be used.



# Thread Grinding

Grinding wheels type: **1NA**

Designation:  
1NA D x T x H



We manufacture single profile and multiprofile thread grinding wheels in shapes 1NA, 5NAV, and 7NAV. They are produced in vitrified bond with grain size from 150 to 400 and in diameters D 300 to 500 mm. Hole size H is 127 to 160 mm.

In relation to the size of the thread profile we recommend the use of the following specifications:

**Single profile thread grinding wheels T = 6 to 16 mm (T = 0,03D)**

Thread profile size		Recommendation	
Metric (mm)	Whitworth number of threads per inch	Hardened high-speed and tool steel	Construction steel
1 - 1,5	40 - 28	2A 400 13/6 V	2A 400/1 K 11 V
1,75 - 2,5	26 - 20	2A 320/1 J 13/6 V	2A 320/1 K 10 V
3,0 - 4,0	20 - 14	2A 280/1 J 13/6 V	2A 280/1 K 10 V
4,5 - 5,5	12 - 10	2A 240/1 J 13/6 V	2A 240/1 K 10 V
6,0	9 - 7	2A 220/1 J 9 V	2A 220/1 K 9 V
	6 - 4,5	2A 180/1 J 9 V	2A 180/1 K 9 V
	4 - 3	2A 150/1 J 9 V	2A 150/1 K 9 V

**Multiprofile thread grinding wheels T = 20 to 100 mm**

Thread profile size		Recommendation	
Metric (mm)	Whitworth number of threads per inch	Hardened high-speed and tool steel	Construction steel
1 - 1,25	40 - 28	C 400 V	2A 400 V
1,25 - 2,0	24 - 20	C 360 V	2A 320 V
2,0 - 3,0	20 - 16	C 320 V	2A 280 V
3,0 - 4,0	16 - 12	C 280 V	2A 240 V
4,5 - 6,0	10 - 6	C 240 V	2A 220 V
	5 - 4	C 220 V	2A 180 V
	4 - 3	C 180 V	2A 150 V

## Types and tolerances of thread grinding wheels

All thread grinding wheels, that is single and multiprofile wheels, are manufactured without profile which is later made by the user himself. The standard allowed wheel balance and the thickness tolerance of thread grinding wheels type 1NA, 5NAV and 7NAV are defined in our factory standard tolerances and do not need to be specified for each produced grinding wheel.

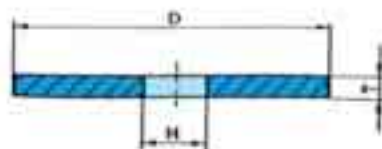
Ordering example: 1NA 350 x 35 x 160 2A220/119V40, 40 m/s

**For Medical Injection Needles:**  
1NA 450x40x127 C600JBX03, 50 m/s



## Grinding Wheels for Grinding Grooves of Cutting Tools at peripheral speed 80 m/s

Type: **1UT**



Designation: 1UT D x T x H

Cold pressed resinoid bonded grinding wheels used for wet grinding, for drill grooves shaping, etc., all made out of cylindrical workpieces.

Table of dimensions (mm):

D	T	H	
100	1,0 - 20,0 (every 0,5mm)	13	
150		44,5 32	
175			
200			
250			76
300			203,2
400			203,2 304,8
450			203,2 304,8
500			304,8



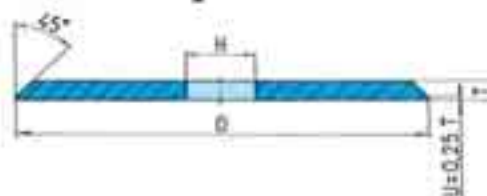
Thickness tolerance: TT  $\pm 0,2 - 0$

Specification: 8A (80)100-120 R-T 8-9 B18 (GA)

Ordering example: 1UT 200x6x32 8A 120/3S8B18, 80 m/s  
1UT 400x8x203,2 8A 120/2 S8B18, 80 m/s for HSS till 65 HRc on machines Hertline or Gohring.

## Profile Grinding on Cylindrical Workpiece, Saw Teeth Shaping

Type: **1, 1-C, 1T-C**



**1T-C**

Table of dimensions (mm):

D	T	H
350	8, 10	127
400	12, 14, 18	203,2

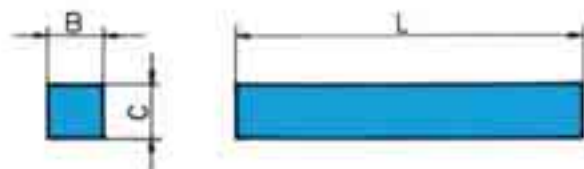
These are straight grinding wheels in vitrified bond, somehow softer and of a more opened structure, made of sharper aluminas. They are made for higher speeds of 50 and 63 m/s.

Ordering example: 1-C 400x8x127 NPA70/2LM9/6V40, 63 m/s



# Honing Hone Stones

Type: 54



Designation:  
54 B x C x L

Ordering example:  
54 A 13x13x20

Hone stones are actually grinding sticks, the difference is that they are only used for mechanical working on a machine - for honing the inside of various cylinders and tubes.

For working parts of gray cast iron hone stones in silicon carbide are used, for working steel parts they must be in white or pink aluminium oxide, mainly vitrified bonded.

When selecting the quality, it should be taken into account if working of new cylindrical surfaces or reconditioning of worn out cylindrical surfaces is concerned.

54 A		
54 B		
54 C		
54 D		
54 E		
54 F		
54 G		
54 H		
54 I		
54 J		
54 K		

Application	Abrasive	Grain size	Grade	Structure	Bond
<b>Cylinder Processing in Motor Industry</b>					
Prehoning	C, 9C	70-90	E-I	8-10	V
Final honing	C, 9C	120-600	E-I	10-14	V
<b>Cylinder Processing in Industry of Pneumatic Devices</b>					
<b>• Unhardened steels</b>					
Prehoning	52A	70-120	E-J	8-12	V
Final honing	2A	120-400	E-I	10-14	V
<b>• Hardened steels</b>					
Prehoning	2A, 8A	70-120	E-J	8-12	V
Final honing	2A, 8A	120-400	E-I	10-14	V
<b>• Gray cast iron</b>					
Prehoning	C, 9C	70-120	E-J	8-12	V
Final honing	C, 9C	120-400	E-I	10-14	V

# HAND GRINDING

## Grinding Sticks

Rectangular grinding stick



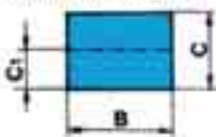
Type and designation: **90PR**

90PR BxCxL

Table of dimensions (mm):

<b>B</b>	6	10	12	25	30	25	40	50	30	50
<b>C</b>	3	5	6	6	13	6	20	25	13	25
<b>L</b>	100	100	150	100	200	100	125	150	200	200

Combination stone



**90KB**

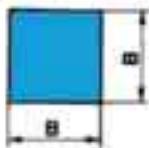
90KB BxC/C1xL

Table of dimensions (mm):

<b>B</b>	25	25	40	50	50
<b>C</b>	20	6	20	25	25
<b>L</b>	100	100	125	150	200



Square grinding stick



**90KV**

90KV BxL

Table of dimensions (mm):

<b>B</b>	6	8	10	10	15	20
<b>L</b>	100	100	100	150	150	200

Round stick



**90OK**

90OK DxL

Table of dimensions (mm):

<b>D</b>	6	8	10	10	15	20	25
<b>L</b>	100	100	100	150	150	200	200

Half-round stick



**90PO**

90PO DxL

Table of dimensions (mm):

<b>D</b>	6	10	12	15	20
<b>L</b>	100	100	150	150	200

Triangular stick



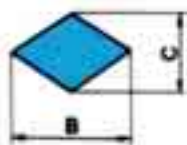
**90TR**

90TR BxL

Table of dimensions (mm):

<b>B</b>	6	8	10	10	15	20
<b>L</b>	100	100	100	150	150	200

**Rhomboid stick**

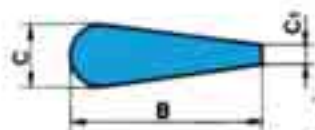


Type and designation:

**90RO**

90RO BxCxL  
Ordering example:  
90RO 10x5x100

**Carving tool stick**



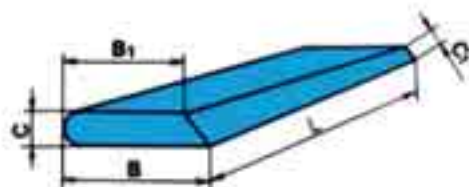
**90DL**

90DL BxC/C1xL

Table of dimensions (mm):

B	C	C1	L
25	6	1	100
35	10	3	100
45	10	0	100

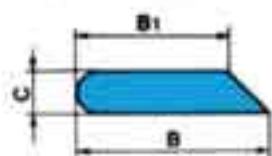
**Trapezoid shaped knifeblade stick**



**90TN**

90TN B/AxC/C1xL  
Ordering example:  
90TN 50/37x13/3x150

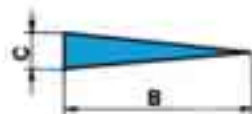
**Trapezoid shaped convex stick (halfround)**



**90TO**

90TO BxCxL  
Ordering example:  
90TO 45x13x50

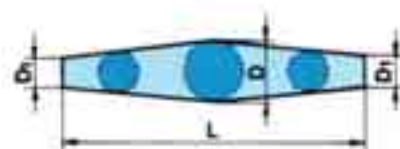
**Knife-blade stick**



**90NO**

90NO BxCxL  
Ordering example:  
90NO 25x3x100

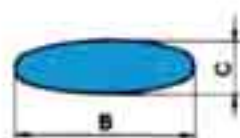
**Shoemaker stick (file)**



**90CE**

90CE D/D1xL  
Ordering example:  
90CE 25/15x230

**Smith stick (ellipse shaped)**

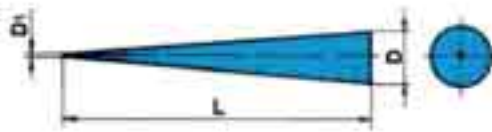


**90EL**

90EL BxCxL  
Ordering example:  
90EL 35x10x150



### Pointed stick



Type and designation:  
90SI D/D1xL  
Ordering example:  
90SI 8/1x75

**90SI**

Table of dimensions (mm):

D	D1	L
8	1	75
7	0	75

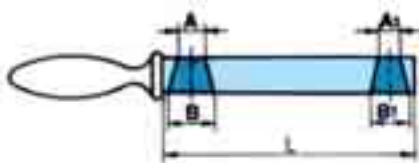
### Grinding stick, conical



90KO D/D1xL  
Ordering example:  
90KO 13/6x100

**90KO**

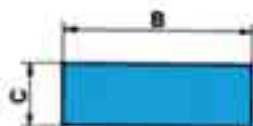
### Grinding stick with grip



90TZR B/AxCxL  
Ordering example:  
90TZR 45/30x30x230

**90TZR**

## Rubbing Bricks

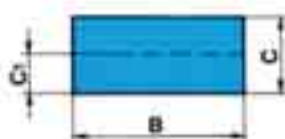


90BO BxCxL  
Ordering example:  
90BO 110x30x190

**90BO**

Rubbing bricks are used for manual grinding of stone, marble, terrazzo mosaic, concrete and similar materials. We produce them from vitrified bonded silicon carbide in grits C20, C36 and C60.

## Rubbing bricks combined

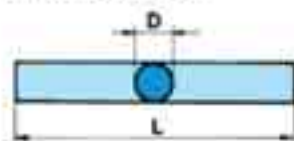


90K BxC/C1/C2xL  
Ordering example:  
90K 50x25/12.5x150

**90K**

## Dressing Tools for Grinding Wheels

Grinding dresser



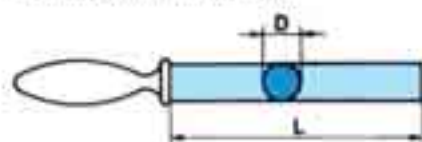
Type and designation:

**90OKP**

90 OKP DxL

Ordering example:  
90 OKP 30x200

Dressing bar with handle



**90PC**

90 PC DxL

Ordering example:  
90 PC 25x245

Flat dresser

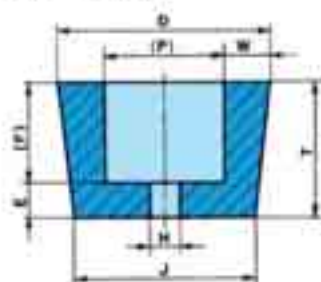


**90BP**

90 BP BxCxL

Ordering example:  
90 BP 50x30x200

Dressing cup



**11CL**

11CL D/JxTxH-PxF

Ordering example:  
11CL 80/75x60x20-50x40

## Reccomended specifications for grinding sticks, rubbing bricks and dressing tools

Grinding sticks and bricks, type: **90 ...**

Standard specifications			
Abrasive grain		From alumina, commercial designation "A"	From silicon carbide, commercial designation "C"
Coarse	16 - 24		(9) C24V
	30 - 46		(9) C36V
	54 - 70		(9) C60V
	80 - 90	(2) 4A80V	(9) C80V
Medium	100 - 120	(2) 4A120V	(9) C120V
	150 - 180	(2) 4A150V	(9) C150V
	220 - 280	(2) 4A240V	(9) C240V
Fine	320 - 500	(2) 4A400V	(9) C400V

Soft specification			
Abrasive grain		From alumina, commercial designation "A"	From silicon carbide, commercial designation "C"
Coarse	100 - 120	(2) 4A120JV	(9) C120HV
Medium	150 - 180	(2) 4A150JV	(9) C150HV
	220 - 280	(2) 4A240IV	(9) C240GV
Fine	320 - 500	(2) 4A400IV	(9) C400FV

### Combination sticks

Type: **90KB, 90KBR, 90KKR**

2/3 - coarse layer

1/3 - fine layer

Standard specification		Soft specification	
Specification	Commercial designation	Specification	Commercial designation
Coarse/fine „A“	4A 120/2A 400 V	Coarse/fine „A“	4A 120 J/2A 400 I V
Medium/fine „A“	4A 240/2A 400 V	Medium/fine „A“	4A 240 I/2A 400 I V
Coarse/fine „C“	9C 120/C 400 V	Coarse/fine „C“	9C 120 H/C 400 F V
Medium/fine „C“	9C 240/C 400 V	Medium/fine „C“	9C 240 G/C 400 F V

Combination sticks are available also in combination with white alumina (2A).

### Rubbing bricks combined

Type: **90K**

1/2 - coarse layer

1/2 - fine layer

Commercial designation "C"
9C16/C60V
9C24/C60V
9C36/C80V

### Dressing tools

Type: **90BP, 90OKP, 90PC**

Grain size		Commercial designation
16	Very coarse	C16RV
20 - 24	Coarse	C24RV
30 - 46	Medium	C36QV
54 - 70	Fine	(9) C60PV
80 - 90	Very fine	(9) C80PV

## General rules

For a safe grinding the following agents are responsible:

- The machine builder
- The grinding wheel manufacturer
- The user of grinding wheels and machines

The machine builder must guarantee for the proper stability of the grinding machine construction and for the adequate safety of the protection hoods. The grinding wheel manufacturer should ensure that the wheels are safe in grinding.

This can be achieved by selection of appropriate components and adequate technological procedures. Throughout the production process inspection of the wheels is performed whereby not only quality but especially safety in grinding is guaranteed since the safety test performed at the end is the essential part of the control. The instructions for safe use are either on the wheel itself or on the marking labels (indication of the permissible revolutions per minute or the class of grinding).

The safety test includes:

- Test-run at overspeed (determining wheel strength, centrifugal load),
- Visual inspection,
- Sound test by grinding wheels in vitrified bond with diameter bigger than 80 mm.

The test is carried out according to the DSA regulations.

The users of the grinding tools should provide for an adequate storage and transport of the grinding wheels to the grinding location. They must also provide correct mounting of the wheels. The user should never exceed the indicated maximum operating speed given on the label enclosed with each grinding wheel. The operating person must be fully familiar with rules concerning safe grinding.

When controlling the technical parameters of manufactured grinding wheels we keep to the following standards:

- to DIN ISO 603-1 to 603-12 as standard for standard dimensions
- to DIN ISO 13942 as standard for diameter tolerances (TD), thickness tolerances (TT) and hole tolerances (TH)
- to EN DIN ISO 6103 as standard for wheel balance tolerances
- to DIN ISO 13942 as standard for radial and axial stroke tolerances
- to EN DIN 12413, item 5, as standard for final control of the manufactured wheels.





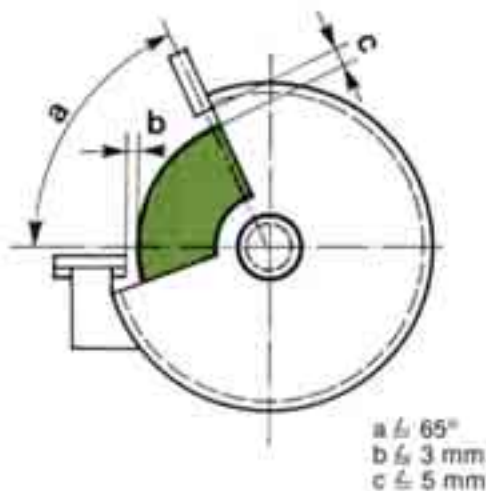
## Grinding on portable grinding machines

Portable grinders belong to the most commonly used grinding machines and it is therefore surprising that working with them is often accompanied by troubles. So, in addition to the general rules, the following should be considered:

- If the machine is air driven, the speed of the spindle (revolutions per minute) should be regularly checked and (re)adjusted to correspond with the machine builder's declaration.
- The machine should not be operated without safety guard. This requirement does not apply to the both sides tapered wheels with mounting flanges according to DSA.
- Side-grinding operations should never be performed with cutting-off wheels because they not withstand the excessive side pressure, so extreme caution should be paid here! Side grinding should only be performed with depressed centre grinding wheels with a thickness of at least 4 mm.
- Operators must always be protected by protection devices such as safety goggles, safety leather aprons, gloves and other protective clothing.



## Safety guards



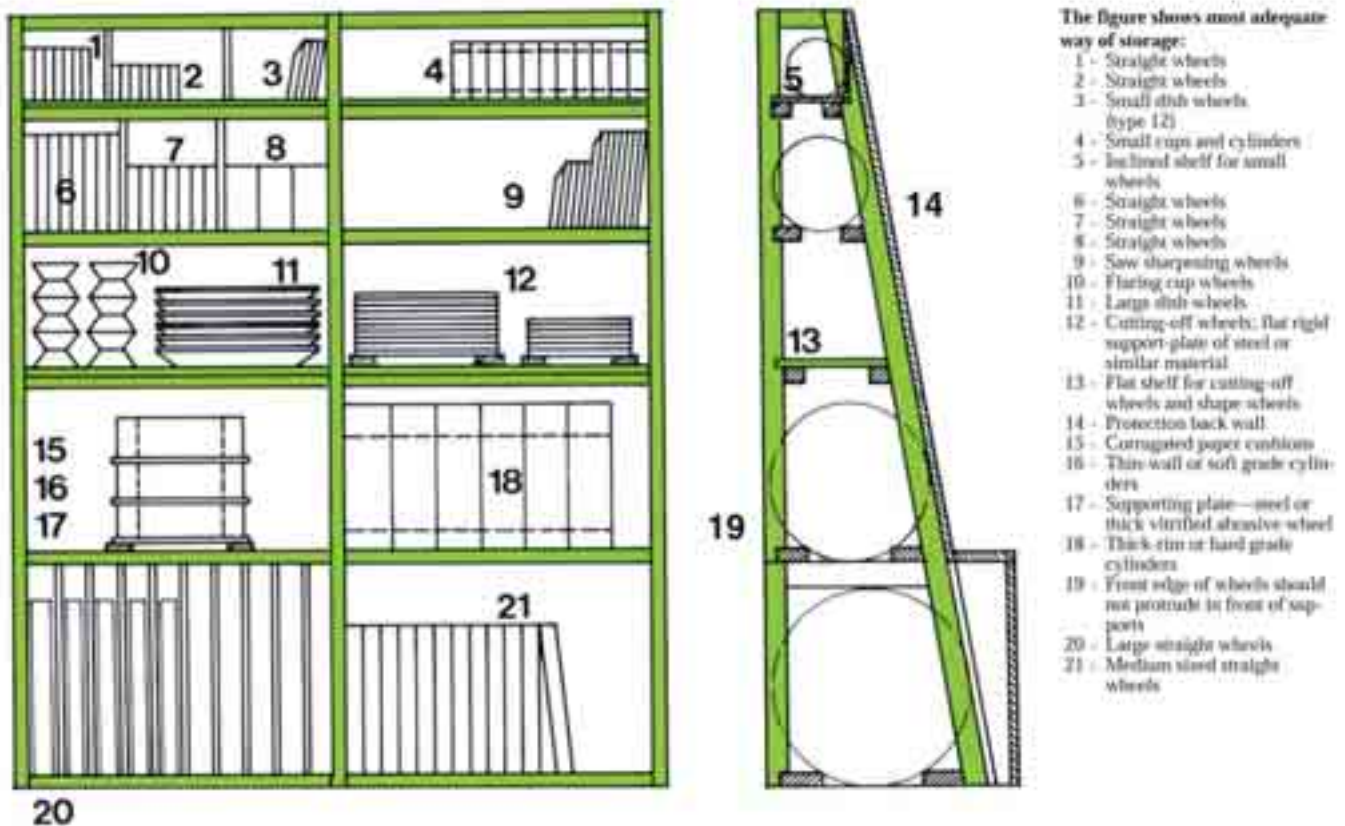
Example: Safety guard on stationary grinding machines with manual feeding.

All abrasive tools must be protected by means of safety guards made of steel or other suitable materials. Safety guards must fit the grinding machine and suit the conditions of work.

The distance between the work-support and the grinding wheel should never exceed 3 mm, the distance between the wheel and the top of the guard opening should not exceed 5 mm. The maximum exposure should not exceed 65°.

With hand-feed grinding machines the wheel wear should be considered by means of proper adjustment of the work support and the closing of the safety guard with the shield.

## Storage of the grinding tools



Abrasive tools should not be stored in rooms where they are subject to humidity (maximum allowed relative humidity is 75%). They should neither be exposed to various solvents and temperature changes, because all of these factors have a negative effect on the strength of the resinoid bonded abrasive tools.

All abrasive tools should be stored as near as possible to the grinding location in order to prevent damage such as breakage etc., and to avoid the concentration of humidity and dampness during winter transports.

Since abrasive tools break easily care should be taken by handling and trucks or other suitable conveyances which provide protected transporting of larger and heavier abrasive tools should be used. Suitable racks, shelves, drawers or boxes should be provided for storing various types of abrasive tools. The following suggestion should be paid attention to:

- Large diameter wheels are best stored in upright position on nether rack-shelves;
- Thick-wall wheels are also stored in an upright position, whereas thin-wall wheels should be laid flat on a flat surface: between wheels corrugated paper cushions should be placed as separator;
- Both thin wheels and cutting-off wheels should be laid on a flat surface to prevent twisting;
- On the upper shelves smaller grinding tools and standard shape abrasive wheels are stored;
- Abrasive sticks, mounted wheels and other small abrasive tools can be stored in boxes.

Such storage rooms should be available both for new wheels and partly used wheels. Shelf life of vitrified bonded wheels is unlimited.

All resinoid bonded wheels including resinoid bonded wheels reinforced with glass reinforcements can be stored for a limited time only because resinoid bonds age.

Shelf life of non reinforced resinoid bonded wheels is one year and of wheels with glass reinforcements 3 years. After the shelf life period expires resinoid bonded wheels must be tested for usage according to the safety standard regulations or they should be disposed of (destroyed).

## Recommendations

### Grinding can be:

- Wet - with use of coolants;
- Dry - without the use of coolants

Rough grinding (snagging) and cutting-off are as a rule dry grinding operations. Coolant is used in grinding non-metals, in precision grinding, and usually also in tool grinding.

Vitrified bonded grinding wheels are not affected by chemical influence of the coolants. When resinoid bonded grinding tools are used for wet grinding, special types of bond (less affected by the damaging influence of the cooling agents) should be used. In such cases customers should always indicate that the grinding tool is to be used for wet grinding.

Resinoid bonds designated for wet grinding are: B03, B08, B09, B10, B11.

By wet grinding the following rules must be observed:

- Always use plenty of coolant. The jet of the solution should have the same width as the grinding tool and it should run directly upon the workpiece at the grinding point, so that it can both wash the grinding tool and cool the workpiece simultaneously.
- The coolant must meet the following requirements:
- It must have a cooling and lubricating effect, detergent power and an anticorrosive effect;
- It should not foam;
- It should not be inflammable;
- It should not decay easily;
- It must be ecologically safe.

### Notice:

When wet grinding jobs are performed, the grinding tool should be obligatory centrifuged after the grinding operation. Coolant-soaked wheels are unbalanced, which can cause wheel breakage when the machine is run again. Resinoid bonded wheels should also be centrifuged, so as to avoid the damaging effect of coolant when the wheel is not in use.

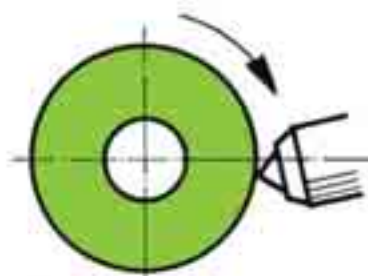
## Truing and dressing of grinding tools

If during the operation the wheel gets dull or is loading, or if it loses its geometrical form, the wheel should be dressed. When working with diamond dressers, the following should be considered:

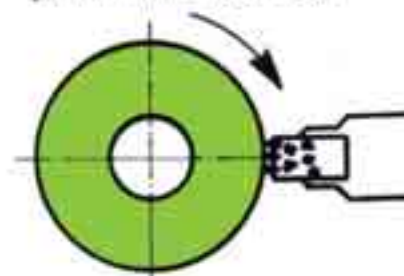
- When selecting a single point diamond dresser, the following chart should serve as a guideline:

Grinding wheel diameter D (mm)	Carat (1 Carat = 0,2 g)
100	0,25 - 0,5
150	0,3 - 0,6
200	0,5 - 1
300	0,8 - 1,2
400	1 - 1,5
500	1,2 - 2,5
600	2 - 3
800 and more	3

- The operating angle between the grinding tool and the single point of a diamond dresser should be between 10° - 15°.
- The depth of dressing should not exceed 0,03 mm.



- The operating angle between the grinding tool and multi-point diamond dresser is 90°.



- Prior to dressing, plenty of coolant should be provided for, directed exactly upon the diamond.

A finer surface can be obtained by a smaller depth of dressing or by a smaller feed.



# Mounting

## The procedure:

Skilled and well trained person only should be assigned to mounting of grinding wheels.

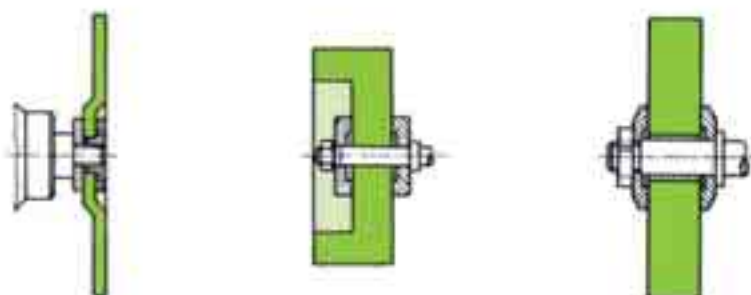
Prior to mounting, wheels must be suspended and given a ring test. Mounting of wheels upon the spindle or other mounting device must be performed without force or use of hammer and it must warrant for a safe and firm hold.

The grinding wheel should be fastened by means of flanges made of cast iron, steel or similar material, except when the class of grinding or type of operation require another kind of fastening.

Blotters made of compressible material (rubber, soft cardboard, felt, leather...) should always be used between flanges and wheels. After each remounting the grinding wheel should be test-run at full operating speed for at least five minutes, during which time the danger-area should be well protected. Only after the test has proven satisfactory, the wheel can be applied. The maximum permissible operating peripheral speed should never be exceeded. (The maximum operating speed is marked on the wheel or wheel label). Therefore prior to mounting, it must be ensured that the number of revolutions/min indicated on the machine does not exceed the maximum permissible rotational speed of the grinding tool. Special attention should be paid to machines with adjustable rotational speeds for grinding tools. With grinding tools that are mounted by means of screws and are therefore furnished with one or more nuts (grinding wheels, cylinders, segments), the screws should be checked for their length, because at mounting too long screws pull the nuts out.

## Mounting of straight grinding wheels

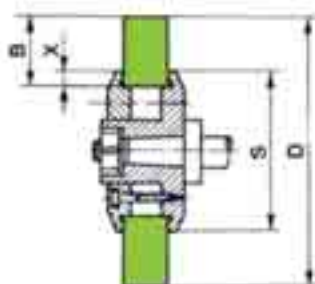
Straight grinding wheels with small holes



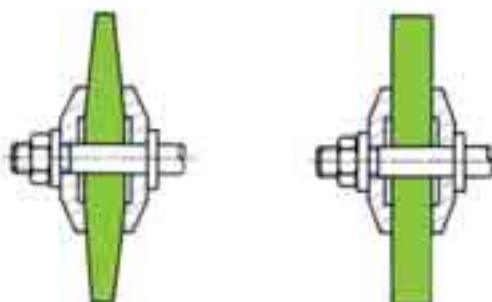
Mounting procedures and types of flanges for various types of grinding tools according to DSA standard regulations.

Straight grinding wheels with large holes

D=grinding tool diameter  
S=diameter of the mounting flange

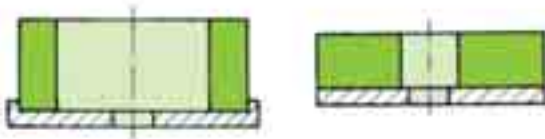


Grinding wheels without safety guards



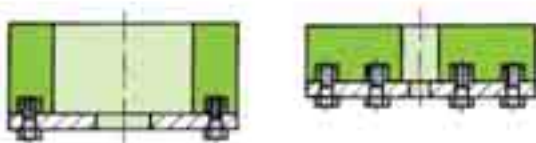


**Gluing to the mounting plate**



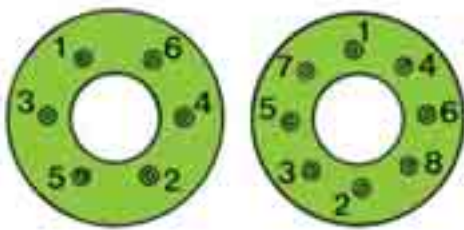
Grinding wheels and ring wheels for straight grinding, glued to mounting plates.

**Screwing to the mounting plate**



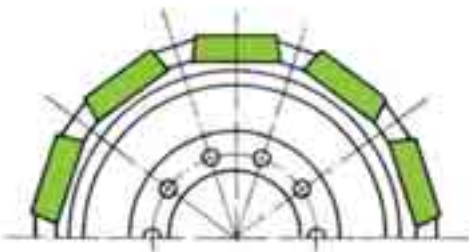
Grinding wheels and cylinders with inserted nuts for straight grinding, screwfastened to the plates.

**Sequence of tightening screws**



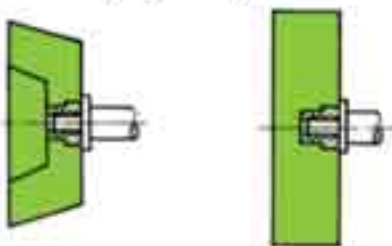
To tighten screws on multiple screw flanges, torque wrenches should be used. As a rule, the torque should not exceed 27 Nm. The tightening should proceed in a crisscross manner. (See figure!)

**Mounting of segments**



The chuck for mounting segments.

**Mounting of grinding tools with central inserted components.**



**Mounting of grinding tools with inserted nut or shank.**



After the wheel mounting, the safety guard should be secured in its place!

# Peripheral speeds

## Maximum operating peripheral speeds

The maximum operating speed of a grinding wheel depends upon:

- The wheel type and the dimension
- The specification of the wheel
- The type of grinding (forced mechanical guidance, offhand guidance)
- The grinding machine construction

The peripheral speeds are divided into normal (standard) and higher than normal speeds (special speeds).






Table of standard maximum operating speeds (m/s) dependent upon the shape and wheel specification and class of operating.

Bond	Designation	Class of operating	Wheel type	Maximum permissible operating speed (m/s)
Vitrified	V	Peripheral	1, 3, 4, 5, 7, 16, 17, 18(R), 19, 20, 21, 22, 23, 24, 25, 26, 38, 39, 52	40
		Side grinding	2, 6, 9, 11, 12, 31, 35, 36, 37	32
Resinoid	B	Peripheral	1, 3, 4, 5, 7, 16, 17, 18(R), 19, 20, 21, 22, 23, 24, 25, 26, 38, 39, 52	50
		Side grinding	2, 6, 9, 11, 12, 31, 35, 36, 37	40
Fibre reinforced	BF	Cutting	41	50

All our products are made in accordance with FEPA Safety Standards and with German VBG-UVV49 Safety Regulations.

## Higher operating speeds

All peripheral speeds higher than those listed in the table of standard peripheral speeds, including the operating speed 50 m/s, are considered higher speeds. Wheels approved for special (higher) speed application are accordingly marked by means of one or two stripes in different colours across the wheel diameter.

Maximum operating peripheral speed m/s		Colour stripe
50	1 x blue	
63	1 x yellow	
80	1 x red	
100	1 x green	
125	1 x green 1 x blue	

Application of grinding tools at higher speeds is allowed only in case if the grinding wheel is defined and declared for operations at higher speeds and this only on machines with appropriate constructions and guards. In countries with different regulations and safety requirements, usage declarations or authorizations from appropriate authorities must be obtained, such as SUVA (for Switzerland).

## Peripheral speeds table

Number of revolutions per minute dependent on the wheel diameter and the operating peripheral speed

D (mm)	v (m/s)													
	15	16	20	25	30	32	35	40	45	50	60	63	80	100
n (rpm)														
25	11500	12200	15300	19100	22900	24400	24700	30600	34400	38200	45800	48100	61100	76400
32	8950	9550	11900	14900	17900	19100	20900	23900	26900	29800	38500	37600	47700	59700
40	7160	7640	9550	11900	14300	15300	16700	19100	21500	23900	28600	30100	38200	47700
50	5730	6110	7640	9550	11500	12200	13400	15300	17200	19100	22900	24100	30600	38200
63	4550	4850	6060	7580	9100	9700	10600	12100	13600	15200	18200	19100	24300	30300
80	3580	3820	4770	5970	7160	7640	8360	9550	10700	11900	14300	15000	19100	23900
100	2860	3060	3820	4770	5730	6110	6680	7640	8590	9550	11500	12000	15300	19100
125	2290	2440	3060	3820	4580	4890	5350	6110	6880	7640	9170	9630	12200	15300
150	1910	2040	2550	3180	3820	4070	4460	5090	5730	6370	7640	8020	10200	12700
175	1640	1750	2180	2730	3270	3490	3820	4370	4910	5460	6550	6880	8730	10900
180	1590	1700	2120	2650	3180	3400	3710	4240	4770	5310	6370	6680	8490	10600
200	1430	1530	1910	2390	2860	3060	3340	3820	4300	4770	5730	6020	7640	9550
225	1270	1360	1700	2120	2550	2720	2970	3400	3820	4240	5090	5350	6790	8490
230	1250	1330	1660	2080	2490	2660	2910	3320	3740	4150	4980	5230	6640	8300
250	1150	1220	1530	1910	2290	2440	2670	3060	3400	3820	4580	4810	6110	7640
300	955	1020	1270	1590	1910	2040	2230	2550	2860	3180	3820	4010	5030	6370
350	819	873	1090	1360	1640	1750	1910	2180	2460	2730	3270	3440	4370	5460
400	716	764	955	1190	1430	1530	1670	1910	2150	2390	2860	3010	3820	4770
450	637	679	849	1060	1270	1360	1490	1700	1910	2120	2550	2670	3400	4240
500	573	611	764	955	1150	1220	1340	1530	1720	1910	2290	2410	3060	3820
550	521	556	694	868	1040	1110	1220	1390	1560	1740	2080	2190	2780	3470
600	477	509	637	796	955	1020	1110	1270	1430	1590	1910	2010	2550	3180
650	441	470	588	735	881	940	1030	1180	1320	1470	1760	1850	2350	2940
700	409	437	546	682	819	873	955	1090	1230	1360	1640	1720	2180	2730
750	382	407	509	637	764	815	891	1020	1150	1270	1530	1300	2040	2550
800	359	382	477	597	716	764	836	955	1070	1190	1430	1500	1910	2390
900	318	340	424	531	637	679	743	849	955	1060	1270	1340	1700	2120
1060	270	288	360	450	541	577	631	721	811	901	1080	1140	1440	1800
1250	230	245	305	380	458	488	534	610	685	760	915	960	1020	1525

Revolutions per minute for various diameters of abrasive wheels are calculated through the peripheral speed according to the following formula:

$$n = \frac{60 \cdot v \cdot 1000}{D \cdot \pi}$$

v = peripheral speed (m/s)

D = diameter of the wheel (mm)

π = 3,14

n = revolutions per minute (rpm)



### QUESTIONNAIRE/TEST GRINDING REPORT

9 bis, chemin des Prés ZIRST - 38944 Meylan - FRANCE  
 Tel. + 33 476 411 481 - Fax + 33 476 901 654  
 E-mail : diprotex.sa@diprotex.com



CUSTOMER: \_\_\_\_\_

**GRINDING TOOL:**

Manufacturer: \_\_\_\_\_ Type: \_\_\_\_\_ Wheel size: \_\_\_\_\_ Specification: \_\_\_\_\_ Ident No.: \_\_\_\_\_

Consumption per year: \_\_\_\_\_ Was the grinding tool suitable? YES NO

Workpiece surface:	The wheel:	The wheel:	Wheel face:	Wheel wear:
1. good	1. grinds well	1. remains open	1. stable	1. low
2. too rough	2. does not	2. loads a little	2. gets round	2. normal
2. too fine	3. burns	3. loads (much)	3. crushes out	3. high

Efficiency of grinding tool (number of pieces, number of cuts)

**GRINDING MACHINE - GRINDING PROCEDURE**

Grinding operation: \_\_\_\_\_

Machine type: \_\_\_\_\_

Grinding wheel operating speed: \_\_\_\_\_ m/s Revolutions: RPM \_\_\_\_\_

Workpiece speed: \_\_\_\_\_ m/s Revolutions: \_\_\_\_\_ RPM

Table feed speed: \_\_\_\_\_ m/min Feed \_\_\_\_\_  $\mu$ m Infeed:  $\mu$ m \_\_\_\_\_

Mounting of workpiece: \_\_\_\_\_ Dressing with: \_\_\_\_\_

Dressing speed: 1. slow 2. middle 3. quick or \_\_\_\_\_ m/min

Wet grinding with: \_\_\_\_\_  Dry grinding

Cooling amount: 1. slow 2. middle 3. quick or \_\_\_\_\_ l/min

Surface: Rugotest Ra: CLA-AA RZ  
 N \_\_\_\_\_  $\mu$ m \_\_\_\_\_ inch \_\_\_\_\_  $\mu$ m

WORKPIECE: \_\_\_\_\_

Material specification:  unhardened  hardened  heat treated steel:

Marking: \_\_\_\_\_ Hardness: \_\_\_\_\_ HB H<sub>rc</sub> HV SH<sub>c</sub>

Tensile strength: \_\_\_\_\_ N/mm<sup>2</sup> Elasticity Plasticity  
 +3 +2 +1 0 -1 -2 -3 +3 +2 +1 0 -1 -2 -3

Workpiece analysis: C Si Mn P S Co Cr Ni Cu Al Mo V W Ti \_\_\_\_\_

Dimensions of grinded surfaces of workpiece: \_\_\_\_\_ Sketch: \_\_\_\_\_

Condition of workpiece:  Not ground  Rough ground  Preground

Notes: \_\_\_\_\_

Date \_\_\_\_\_ Signature: \_\_\_\_\_

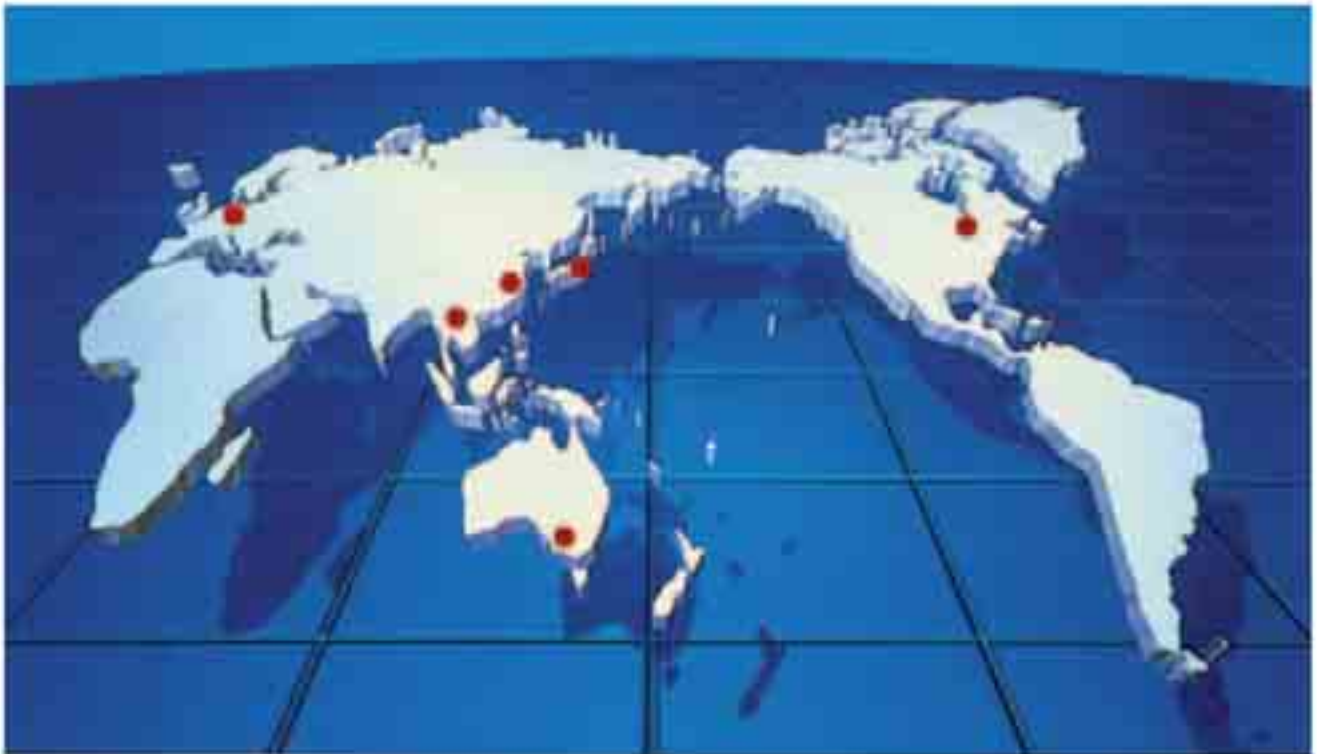
Manufacturer's recommendation:

## TYPES OF GRINDING AND APPROPRIATE TYPES OF GRINDING TOOLS

1		TYPE: 1, 5, 7, 20, 21, 22, 23, 24  CYLINDRICAL GRINDING BETWEEN CENTRES	14		TYPE: 1A  OFFHAND CUTTING
2A 2B		TYPE: 1, 5, 7 CENTRELESS GRINDING TYPE: 1, 5, 7 CENTRELESS GRINDING	15A 15B		TYPE: 1A, 1A0, 1FK GRINDING WITH SWING-FRAME MACHINES TYPE: 41, CUTTING-OFF WITH SWING-FRAME MACHINES
3		TYPE: 1, 5, 6, 11  INTERNAL GRINDING	10		TYPE: 41,  CUTTING-OFF, MANUAL INFEED OF WORKPIECE
4		TYPE: 1, 5, 7  SURFACE GRINDING WITH TRANSVERSATING TABLE	17		TYPE: 41,  CUTTING-OFF, MANUAL INFEED OF WHEEL
5		TYPE: 1, 5, 7  SURFACE GRINDING WITH ROTATING TABLE	18		TYPE: 41,  CUTTING ON STATIONARY GRINDING MACHINES
6		TYPE: 2, 6, 31, 35, 37  SURFACE GRINDING WITH TRANSVERSATING TABLE	19A 19B		TYPE: 1A FLOOR GRINDING TYPE: 41, FLOOR CUTTING
7		TYPE: 2, 6, 31, 35, 36, 37  SURFACE GRINDING WITH ROTATING TABLE	20		TYPE: 2, 31, 35, 36, 37  OFFHAND FLOOR GRINDING
8		TYPE: 2, 35, 35, 37  DOUBLE WHEEL STRAIGHT GRINDING	21		TYPE: 1VS  HIGH-PRESSURE GRINDING (SNAGGING)
9		TYPE: 3, 4, 5, 6, 11  TOOL GRINDING	22A 22B		TYPE: 52, SHARPENING TYPE: 52, OFFHAND TOOL GRINDING
10		TYPE: 1, 5  OFFHAND GRINDING	23A 23B		TYPE: 54, HONING TYPE: 90, OFFHAND SHARPENING
11A 11B		TYPE: 27, 28, 29, 30 OFFHAND GRINDING TYPE: 41, 42 OFFHAND CUTTING	24		TYPE: 54SF  SUPERFINISHING
12		TYPE: 4A, 4K  OFFHAND GRINDING WITHOUT SAFETY GUARDS	25		TYPE: 1NA, 12, 12D, 3, 12  GEAR AND THREAD GRINDING
13		TYPE: 1A  OFFHAND GRINDING	26	OTHER TYPES OF GRINDING:	TYPE:



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