

VITRIFIED BONDED GRINDING TOOLS



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NEW

The most common errors resulting from inappropriate selection of grinding wheel quality or incorrect machine settings:

If grinding has not yielded satisfactory results, an unsuitable grinding wheel was selected or certain machine related errors may have occurred. Most common errors during grinding, reasons for their occurrence and their elimination:

For each grinding method, the recommended grinding tool quality for machining of standard materials is given below.

The stated recommended qualities refer to general applications, while for special grinding applications and grinding of special materials it is recommended that the user should consult expert staff of the grinding tool manufacturer.





INCORRECT HANDLING

1. **DON'T** store wheels in a damp atmosphere or in extreme temperatures.
2. **DON'T** handle wheels roughly.
3. **DON'T** mount a damaged wheel.
4. **DON'T** ever exceed the maximum operating speed marked on the wheel.
5. **DON'T** force a wheel onto a machine spindle.
6. **DON'T** use mounting flanges which are incorrect, damaged, dirty or worn out.
7. **DON'T** tighten the mounting nut or locking flange excessively. This can distort the flanges.
8. **DON'T** use a machine which is not in good mechanical condition.
9. **DON'T** use the machine without a safety shield.
10. **DON'T** use wheels without proper ventilation or dust protection equipment.
11. **DON'T** exert side pressure on thin grinding wheels.
12. **DON'T** stop the wheel after use by applying pressure to the wheel edge or side. Always switch the machine off and allow the wheel to stop revolving.
13. **DON'T** apply excessive pressure onto the wheel that the driving motor slows down.
14. **DON'T** drop portable machines or lower to the floor by the cable or air hose. A wheel can be easily cracked by the weight of the machine if it is put down hard. This is a common cause of wheel breakage.
15. **DON'T** use a machine in a position where you do not have full control of the machine and you are not well balanced.

CORRECT HANDLING

1. **DO** always follow instructions for correct storage.
2. **DO** always visually inspect grinding wheels before mounting for possible damage during transport and eliminate damaged ones.
3. **DO** always use a safety guard, which should cover nearly one half of the grinding wheel.
4. **DO** always switch off the power at the supply and/or unplug the machine before changing the wheel.
5. **DO** always use the tools supplied by the machine manufacturer while changing the wheel.
6. **DO** always ensure that the spindle speed of the machine doesn't exceed than the operating speed marked on the wheel.
7. **DO** always use the correct wheel mounting flanges for grinding wheels and check that they are undamaged, clean and free of burrs.
8. **DO** always use cardboard backing pads for soft clamping of grinding wheels into the clamping flanges.
9. **DO** always allow newly mounted wheels to run at operating speed with the guard in place for at least one minute before cutting or grinding.
10. **DO** always wear protective gear: safety clothing, dust masks, eye protection (glasses or shield), gloves and ear protection!
11. **DO** always check the speed of the machine, especially after maintenance or repair.
12. **DO** always check tension of the driving belt, where fitted, on a regular basis: belts must be kept tight in order to ensure optimum power transmission.
13. **DO** always secure the workpiece firmly before beginning cutting or grinding.
14. **DO** store portable machines appropriately when not being used, to avoid accidental physical damage to the wheel.
15. **DO** always use portable machines in a comfortable position, where the body is well balanced and the machine is well supported.
16. **DO** always keep the work space around cutting and grinding operations clear. It is very dangerous if an operator slips or falls during cutting or grinding operations.

LA VITRIFIED BONDED GRINDING TOOLS

In grinding applications with low pressure on abrasive grains the grains of ceramic corundums do not break, therefore the grinding wheel soon loses the grinding ability and frequently becomes clogged. This significantly reduces the efficiency of grinding wheels made from ceramic corundums.

When LA products are used, however, self-sharpening of abrasive grains begins already at much lower forces and this preserves the efficiency of the grinding tool.

ADVANTAGES:

- greater stability and lower adherence of molten metals (less clogging),
- better achievement of workpiece tolerances,
- less frequent dressing cycles,
- less workpiece overheating and thermal damage,
- better stability of grinding wheel profile,
- less tool blunting,
- higher G factor,
- longer tool life,
- improved self-sharpening (in cases when clogging usually occurs),
- improved abrasive grain hardness at high temperatures,
- lower wheel price.

Excellent grinding characteristics with:

- stainless steel,
- nitriding steel,
- hard chrome-plated steel,
- high-speed steel (HSS),
- thermally sensitive steels and alloys.

LA product applications:

- precision grinding,
- creep feed grinding,
- high speed grinding,
- tool-making industry,
- automotive industry,
- aerospace industry,
- production of bearings,
- production of engine valves,
- production of gears and threads.

Dense structure

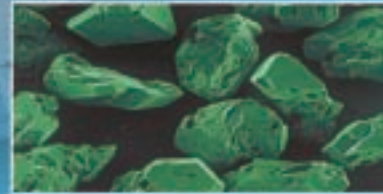
Selfsharpening

VITRIFIED BONDED GRINDING TOOLS with **CBN** and **DIAMOND** grits

Highly productive grinding of hard-to-work materials, such as high-speed steels, tool steels, high-alloy chromium, titanium and nickel steels, and very hard tungsten carbides, requires appropriate grinding tools to ensure cost-efficient machining of these materials, as well as fulfill their greater dimensional accuracy and ground surface quality requirements.



CBN abrasive grit

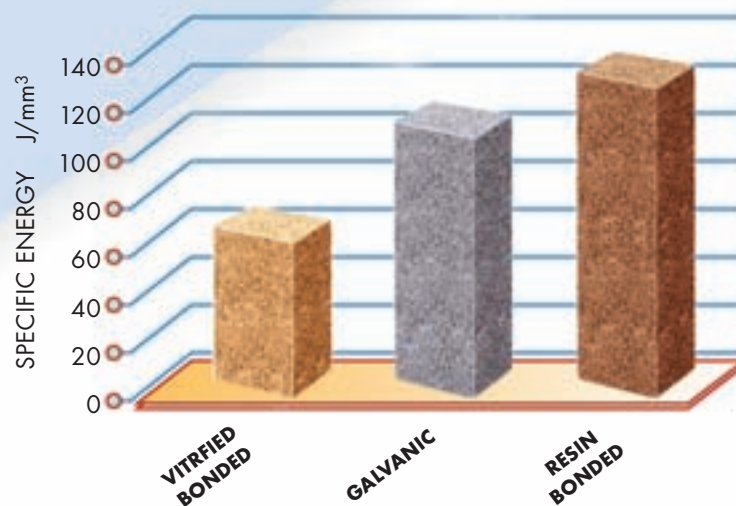


Diamond abrasive grit

ADVANTAGES:

- They can be profiled.
 - They do not require frequent dressing with diamond dressing tools, as do conventional vitrified bonded grinding tools, or additional opening of their grinding surface structure.
 - They can be manufactured with controlled porosity.
 - The pores serve as openings for chip removal and also feed the coolant into the grinding zone, preventing heating of the workpiece.
- , creep-feed grinding, tool grinding, etc.

These tools consume less specific energy (a criterion of grinding operation efficiency)!



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INTRODUCTION

Grinding belongs among those cutting procedures in which the tool has many cutting edges that are irregular in shape and act as turning knives during grinding. Grinding is performed at very high speeds, from 20 to 100 m/s. It can be divided into coarse, fine, honing and finishing. The following effects can be achieved:

- High material removal rates
- High dimensional accuracy
- Very smooth surfaces
- ability to work very hard materials

The main motion involved is tool rotation. With regard to the type and feed of workpiece and tool motion, grinding is divided into:

- High material removal rates
- Cylindrical grinding
- Surface grinding
- Profile grinding
- Tool sharpening

Grinding tools are artificial abrasives. The quality and applicability of an abrasive depend on the quality and the quantity ratios of abrasive grit, the bonding material and pores. The quality of an abrasive is determined by:

- Abrasive grit quality
- Abrasive grit size
- Hardness
- Structure
- Bonding material

COMET - PRODUCT RANGE:

- For surface grinding with wheel face
 - For surface grinding with grinding segments, rings and cups
 - For external cylindrical gear centered grinding
 - For centerless external cylindrical grinding
 - For internal cylindrical grinding
 - For tool grinding and sharpening
 - For manual grinding on stationary grinding machines
 - For manual grinding with mounted points
 - For cutting
 - For honing
-

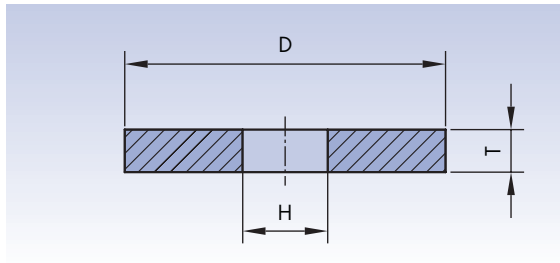
APPLICATIONS:

- The ironmaking industry
 - Foundries
 - Shipbuilding
 - The automotive industry
 - Toolmaking
 - Civil engineering and construction
 - Agriculture
 - The food industry
 - Glassmaking
 - Stonecutting
 - Arts and crafts
-

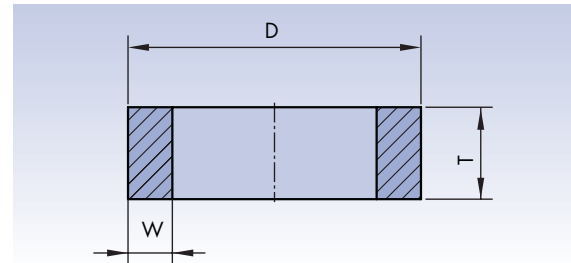
GRINDING WHEEL TYPES



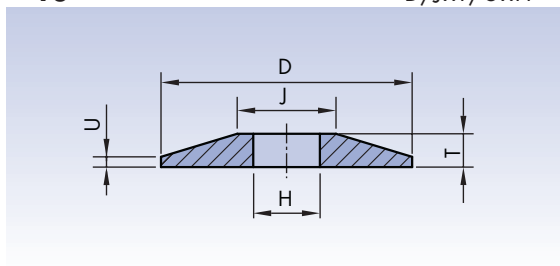
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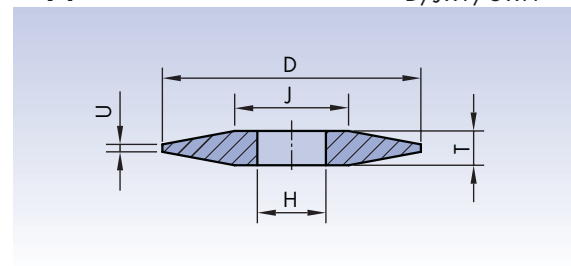
F2 $D \times T - W$



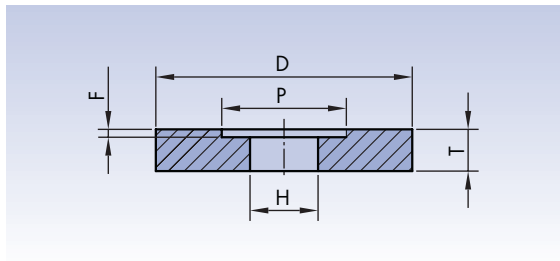
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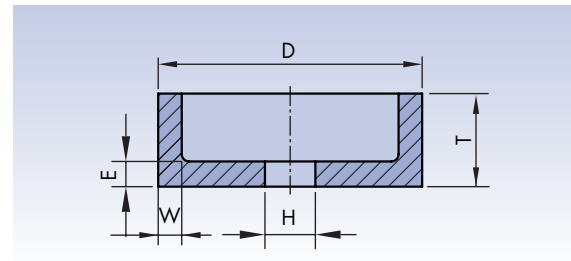
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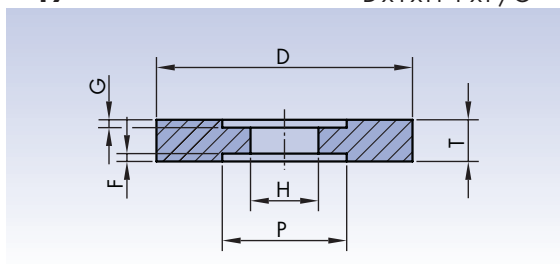
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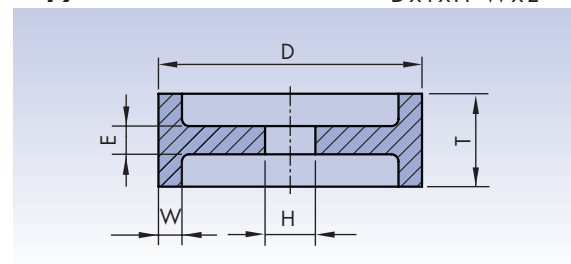
F6 $D \times T \times H - W \times E$



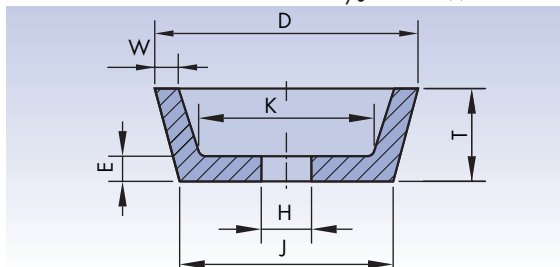
F7 $D \times T \times H - P \times F/G$



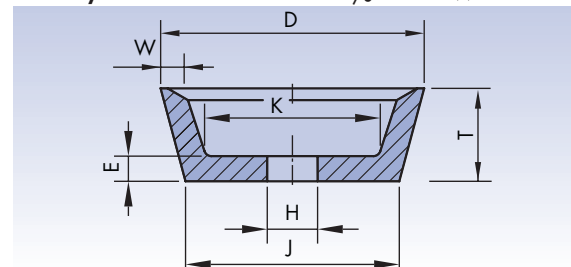
F9 $D \times T \times H - W \times E$



F11 $D/J \times T \times H - W \times E \times K$



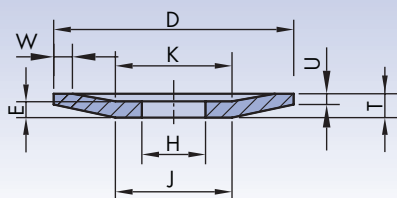
F11/E $D/J \times T \times H - W \times E \times K$



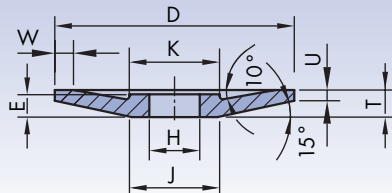


GRINDING WHEEL TYPES

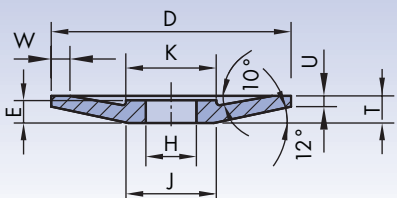
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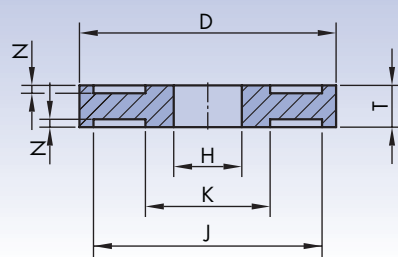
FB $D/J \times T/U \times H - W \times E \times K$



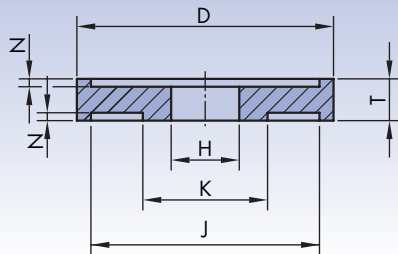
FBH $D/J \times T/U \times H - W \times E \times K$



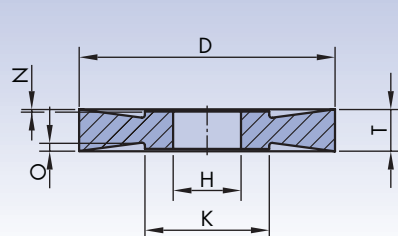
FF1 $D/K \times T \times H - J \times N/N$



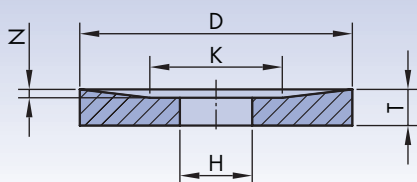
FF2 $D/K \times T \times H - J \times N/N$



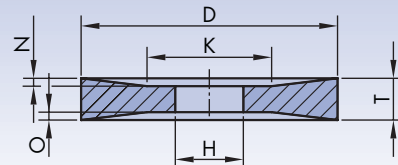
FF3 $D/K \times T \times H - N/O$



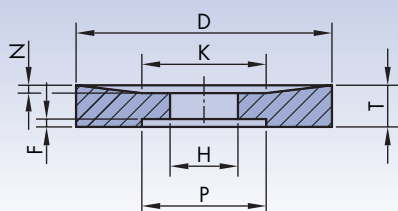
F20 $D/K \times T/N \times H$



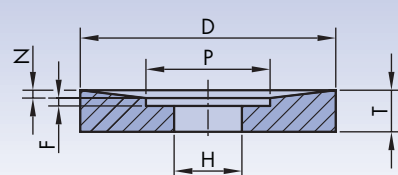
F21 $D/K \times T/N/O \times H$

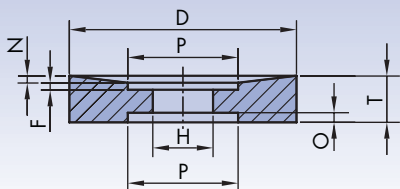
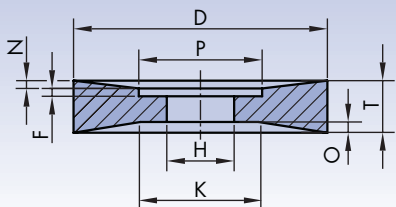
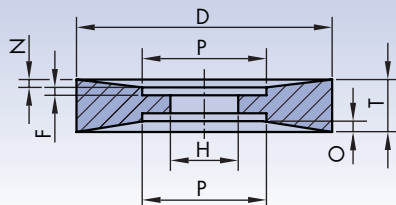
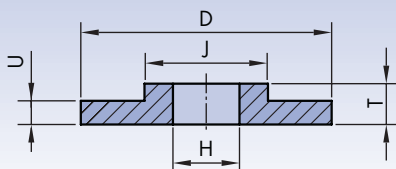
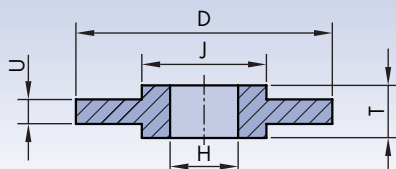
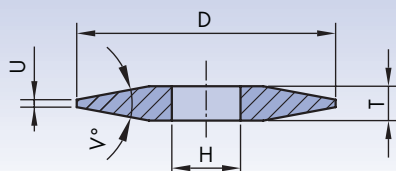
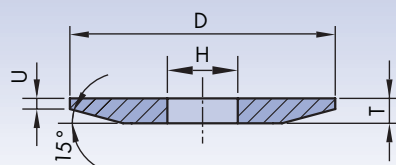
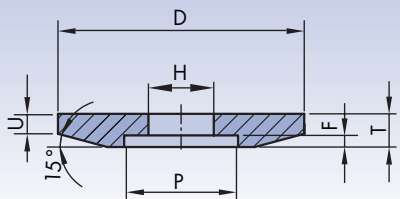
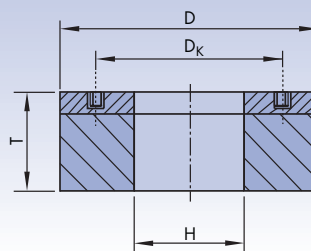
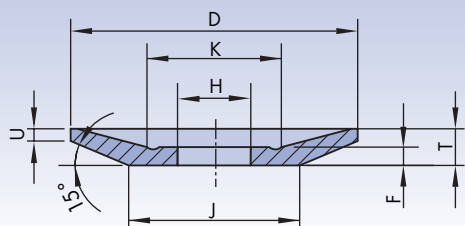
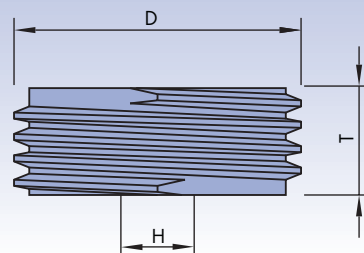


F22 $D/K \times T/N \times H - P \times F$



F23 $D \times T/N \times H - P \times F$



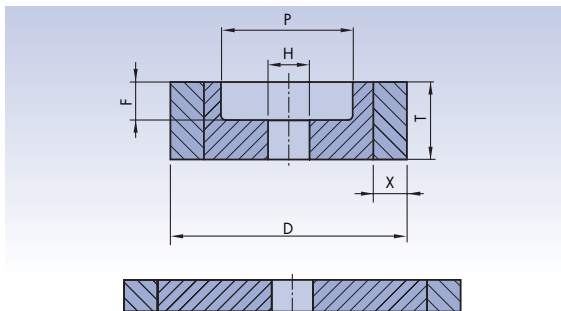
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 $D \times T / N \times H - P \times F / O$

F25
 $D / K \times T / N / O \times H - P \times F$

F26
 $D \times T / N / O \times H - P \times F$

F38
 $D / J \times T / U \times H$

F39
 $D / J \times T / U \times H$

NILES
 $D \times T / U \times H \times V$

KLINGELNBERG-1
 $D / J \times T / U \times H$

KLINGELNBERG-2
 $D / J \times T / U \times H - P \times F$

F36
 $D \times T \times H$

MAAG
 $D / J \times T / U \times H - P \times F$

REISHAUER
 $D \times T \times H - M$




GRINDING WHEEL TYPES FOR INTERNAL GRINDING

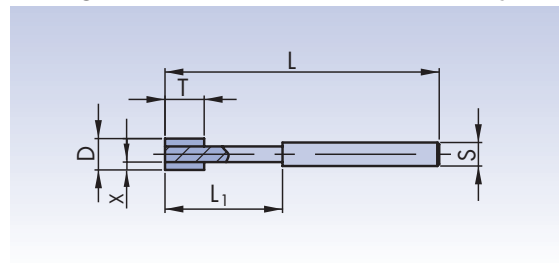
1A1

$D \times T \times X \times x$



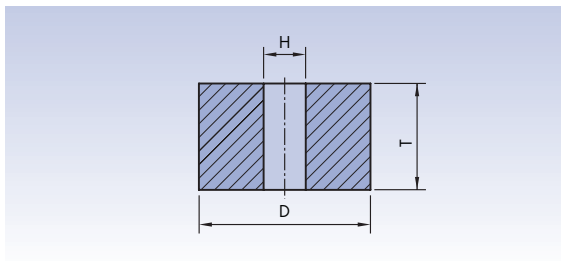
1A8W

$D \times T \times X \times S \times L$



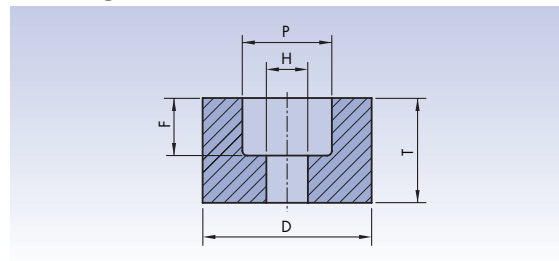
NB F1

$D \times T \times H$



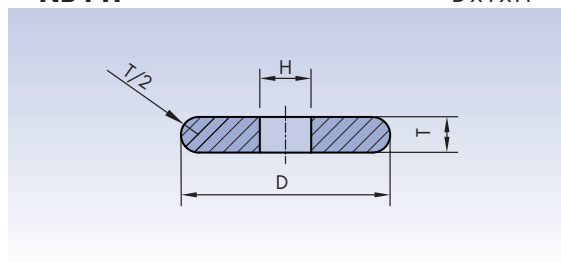
NB F5

$D \times T \times H - P \times F$



NB F1F

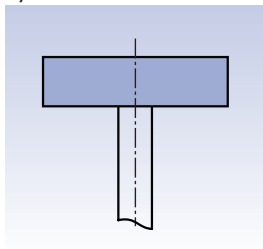
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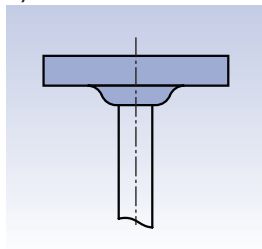
MOUNTED POINT TYPES



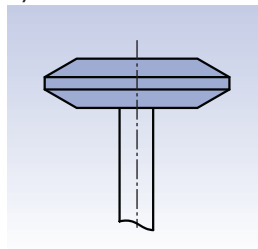
OA
cylindrical-short



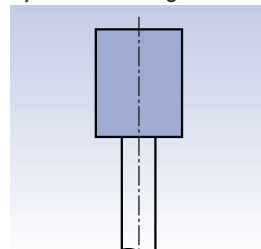
OA1
cylindrical-convex



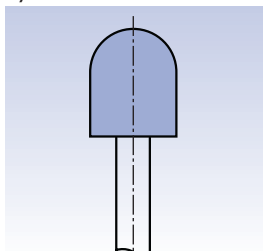
OA3
cylindrical-conical



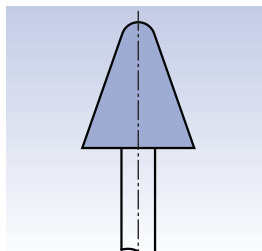
OB
cylindrical-long



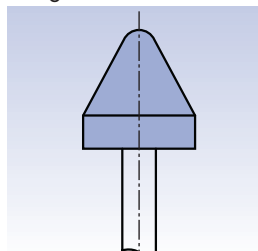
OC
cylindrical-circular



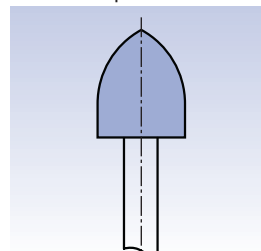
OD
conical-circular



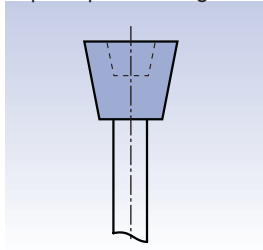
OD1
straight-conical-circular



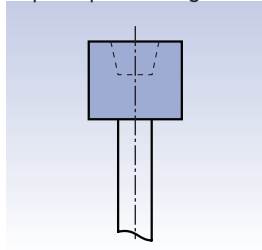
OE
rounded-pointed



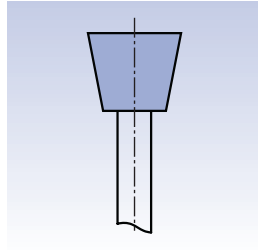
OF
cup shaped-flaring



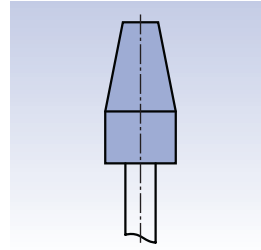
OF1
cup shaped-straight



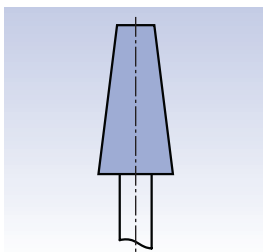
OF2
conical



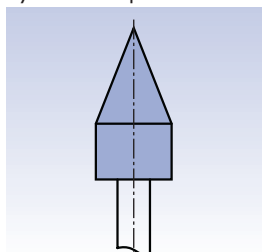
OG
cylindrical-conical



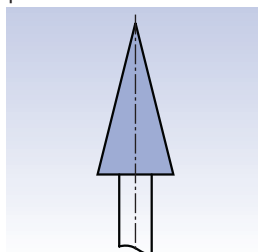
OG1
conical



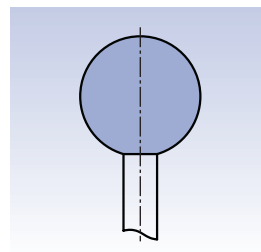
OG2
cylindrical-pointed



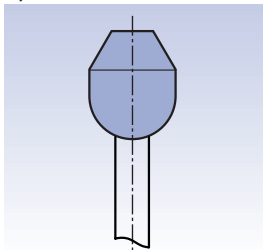
OG3
pointed



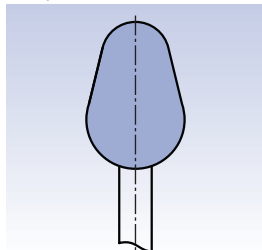
OH
ball



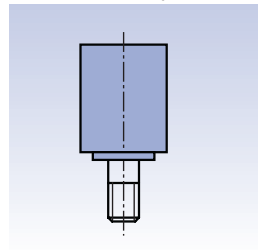
OH1
cylindrical-conical



OI
drop



OJ
with threaded pin

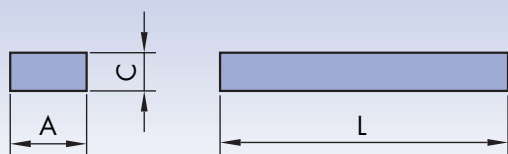




FILE TYPES

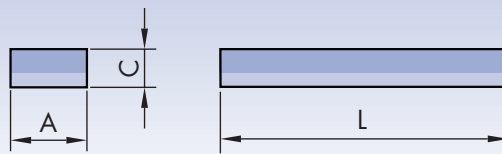
PPR

$A \times C \times L$



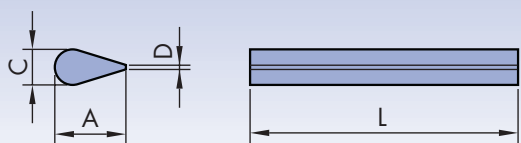
PKB

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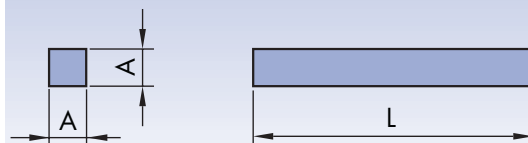
PDL

$A \times C/D \times L$



PKV

$A \times L$



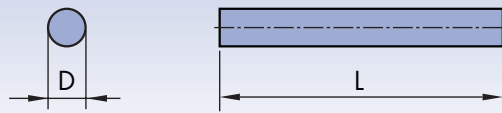
PTR

$A \times L$



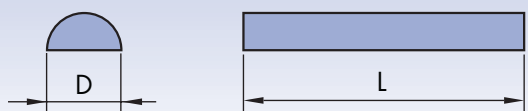
POK

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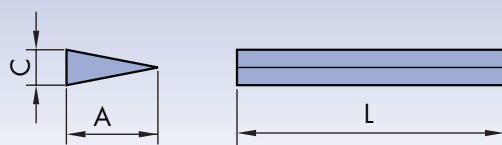
PPO

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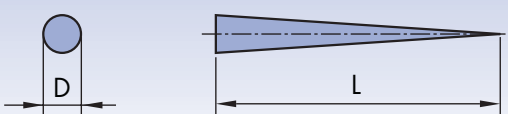
PNO

$A \times C \times L$



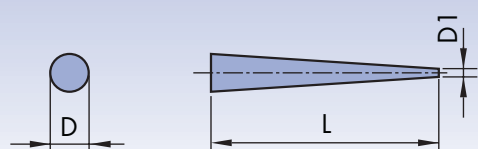
PŠI

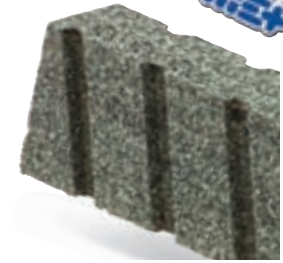
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PKO

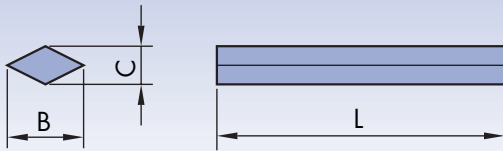
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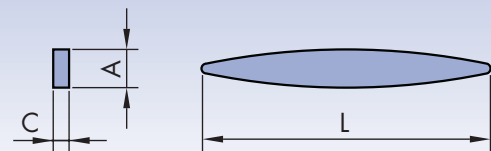
PRO

$B \times C \times L$



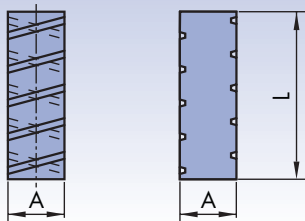
PBK

$A \times C \times L$



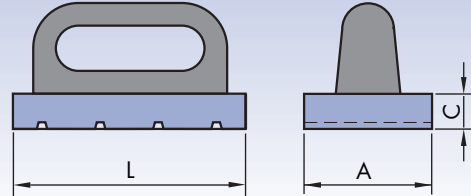
PKV-F

$A \times L$



PPR-G

$A \times C \times L$

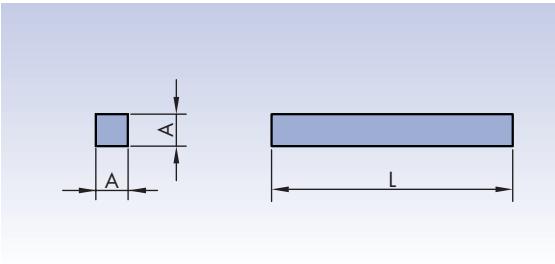


HONING TOOL TYPES



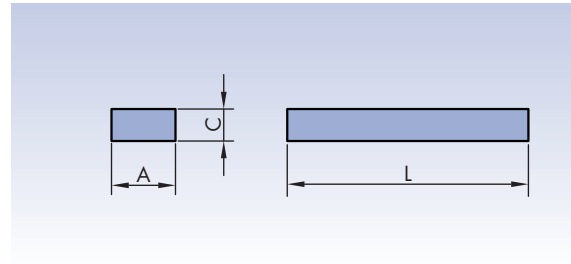
HON-A

A x L



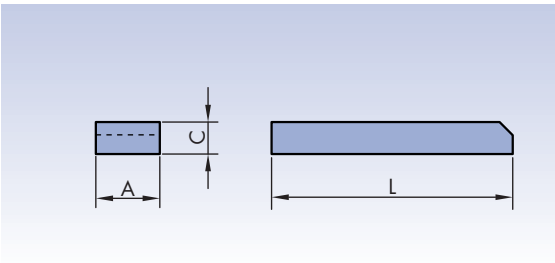
HON-B

A x C x L



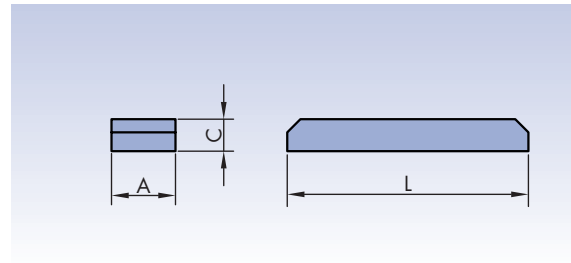
HON-C

A x C x L



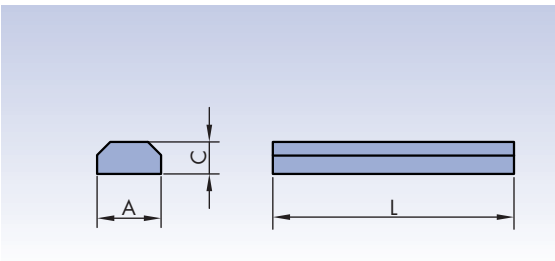
HON-D

A x C x L



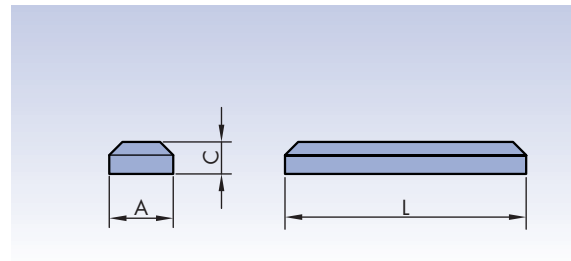
HON-E

A x C x L



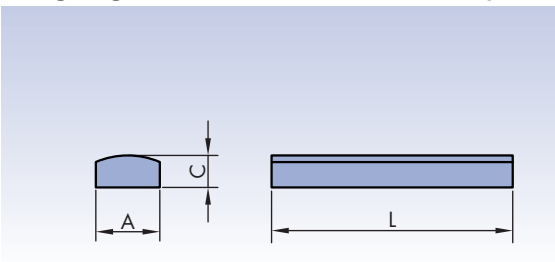
HON-F

A x C x L



HON-G

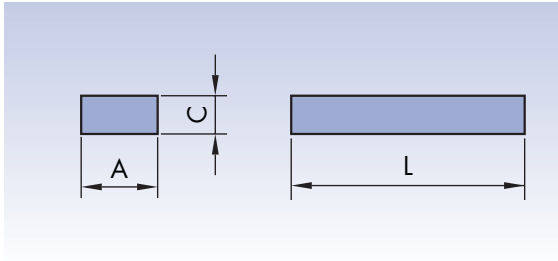
A x C x L



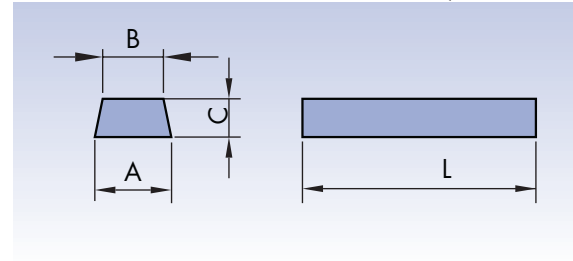
GRINDING SEGMENT TYPES



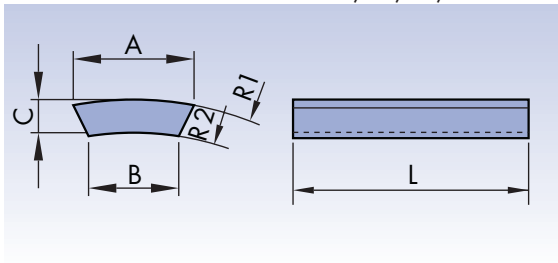
S-A $A \times C \times L$



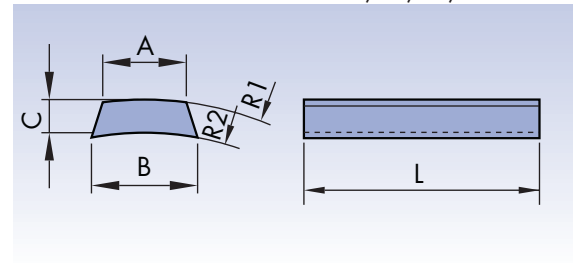
S-B $A/B \times C \times L$



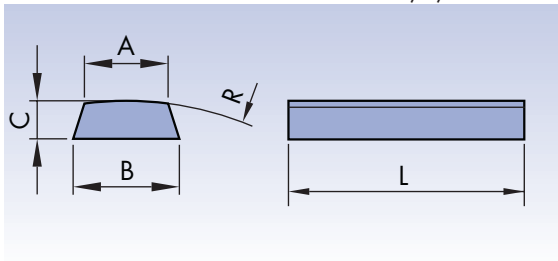
S-C $A/R1/R2/B \times C \times L$



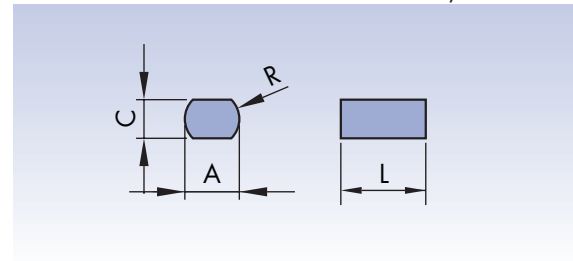
S-D $A/R1/R2/B \times C \times L$



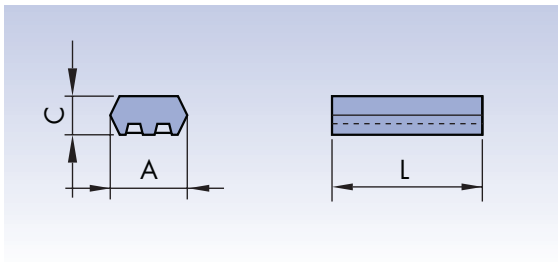
S-DR $A/R/B \times C \times L$



S-ARR $A/R \times C \times L$



S-BBU $A \times C \times L$



QUALITY AND PROPERTIES OF GRINDING TOOLS

Designation of grinding wheel quality - standard abrasive grit

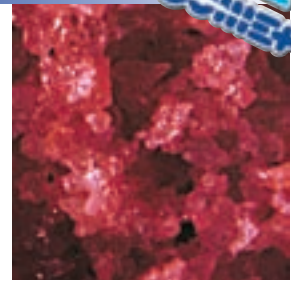
22A		60/3		K		16 / 2S		V		12R63L	
Abrasive grit quality		Abrasive grit size		Hardness		Structure/ Porosity		Bond		Internal designation	
10A	12	Coarse	D	Soft	1	Closed	V B Mg	Vitrified Resin Magnesite	12	Type of bond	
11A	14		E		2						
12A	16		F		3						
13A	20		G		4						
21A	24		H		5						
22A	30		I		6						
23A	36		J		7						
24A	40		K		8						
25A	46		L		9						
30A	54		M		Highly porous						
40A	60		N	10	1 N	W	Impregnated				
41A	70		O	11	2 N						
42A	80		P	12	3 N						
45A	90		Q	13	4 N						
48A	100		R	14	1 S						
50A	120		S	15	2 S						
58A	150		Hard	16	3 S						
60A	180			17	4 S						
62A	220			18	1 V						
64A	240			19	2 V						
70A	280	20		3 V							
80A	320	4 V									
82A	360					63 m/s 50 m/s 80 m/s	Maximum peripheral speed				
84A	400										
SA	500										
LA	600										
10C											
90C											
		Fine							L	Low-temperature bonding material	

Designation of grinding wheel quality - standard abrasive grit

01B	126	P	4	V	C100
Abrasive grit quality	Abrasive grit size	Hardness	Structure/ Porosity	Bond	Concentration
01B	427 Coarse	L Soft	3 Closed	V-Vitrified	50
02B	301	M	4	B-Resin	75
03B	252	N	5		100
04B	181	O	6		125
01D	151	P	7 Open		150
02D	126	R			175
	107	S			200
	91	T Hard			
	76				
	64				
	54				
	46 Fine				

Abrasive grit quality

In the manufacture of vitrified bonded grinding wheels, we use SiC and Al-oxide abrasive grit and various grit mixtures.



Abrasive grits and its properties

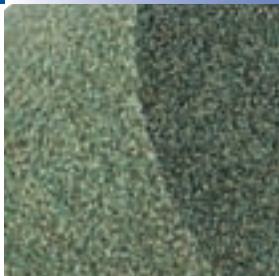
Hardness			Toughness		
CBN	Cubic boronitride	HARDNESS ↑	SA	Al-oxide, special ceramic	TOUGHNESS ↑
SA	Al-oxide, special ceramic		50A	Al-oxide, special Mg	
80A	Al-oxide, special monocrystalline		13A	Al-oxide, normal blue	
22A	Al-oxide, pure white		10A,11A	Al-oxide, normal	
45A	Al-oxide, special "dirty pink"		30A	Al-oxide, semi-pure	
60A	Al-oxide, special ruby		80A	Al-oxide, special monocrystalline	
40A	Al-oxide, pure pink		45A	Al-oxide, special "dirty pink"	
30A	Al-oxide, semi-pure		40A	Al-oxide, pure pink	
13A	Al-oxide, normal blue		60A	Al-oxide, special ruby	
10A,11A	Al-oxide, normal		22A	Al-oxide, pure white	
LA	Al-oxide, special		LA	Al-oxide, special	
50A	Al-oxide, special Mg				
D	Diamond				
10C	Silicon carbide, green	HARDER			
90C	Silicon carbide, black	TOUGHER			

Abrasive grit mixtures

Designation	Description
12A	Al-oxide, normal + Al-oxide, pure white
21A	Al-oxide, pure white - red bond
23A	Al-oxide, pure white - blue bond
41A	Al-oxide, pure pink + Al-oxide, normal
42A	Al-oxide, pure pink + Al-oxide, pure white
48A	Al-oxide, special "dirty pink" + Al-oxide, special monocrystalline
58A	Al-oxide, special Mg + Al-oxide, special "dirty pink" + Al-oxide, special monocrystalline
62A	Al-oxide, special ruby + Al-oxide, pure white
64A	Al-oxide, special ruby + Al-oxide, pure pink
82A	Al-oxide, special monocrystalline + Al-oxide, pure white
84A	Al-oxide, special monocrystalline + Al-oxide, pure pink
1SA...5SA	Al-oxide, pure white + Al-oxide, special ceramic SA
1LA...5LA	Al-oxide, pure white + Al-oxide, special LA
CSA	Silicon carbide + Al-oxide, special ceramic SA

Properties of diamond and CBN grit

Property	Unit	Diamond	CBN
Density	g/cm ³	3.52	3.48
Hardness (Knoop)	kg/mm ²	7000	4700
Hardness (Mohs)	-	10	9/10
Temperature stability	° C	600 - 700	1100 -1400



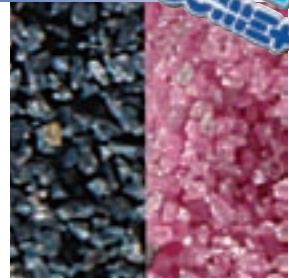
Abrasive grit applicability

Type of grinding, material, condition of material

Abrasive grit	Type of grinding	Ground material	Hardness, strength
Aluminium oxide, normal	Coarse grinding, surface grinding	Low-alloy steel, iron materials	Tensile strength between 300 and 500 N/mm ²
Aluminium oxide, semi-pure	Surface grinding, cylindrical grinding, multipurpose	Alloy steel	Tensile strength approx. 500 N/mm ² , hardness up to 60 HRc
Aluminium oxide, pure, white	Surface grinding, external and internal cylindrical grinding, profile grinding	Alloy steel and high-alloy steel	Hardness up to 62 HRc
Aluminium oxide, pure, pink	Tool grinding, saw blade and knife sharpening, profile grinding, gear grinding	Hardened steel, alloys	Tensile strength over 500 N/mm ²
Aluminium oxide, special	All types of grinding	Hardened steel, tool steel, high-speed steel	Hardness over 62 HRc
Aluminium oxide, vitrified SA	All types of grinding	Alloy steel, high-alloy steel, tool steel	Hardness between 58 and 65 HRc, universal applicability
Aluminium oxide special LA	Finishing Universal applicability	All types of steel, alloys	Hardness up to 65 HRc
Corundum zirconium (only resin bonded)	Universal applicability	Alloys, low-alloy steel, tool steel, gray alloy, nodular alloy	
Silicon carbide, green	All types of grinding	Tungsten carbides, gray alloy, non-ferrous metals, plastic materials, nitriding steel, acid resistant steel	
Silicon carbide, black	All types of grinding	Gray alloy, plastic materials, non-ferrous metals, ceramics, glass	
CBN	All types of grinding	Steel	Hardness over 50 HRc
Diamond	All types of grinding	Hard metal alloys, ceramics	

Abrasive grit size

Abrasive grit size complies with international standards and requirements. It is designated with numbers according to the FEPA standard. The number indicates the number of holes per inch length (25.4 mm) in a wire sieve that permits the grit to pass through. Macro grits have a granulation up to 200, and micro grits have a granulation of over 240.



FEPA	Dimensions (mm)	
8	2.83 - 2.00	Very Coarse
10	2.38 - 1.68	
12	2.00 - 1.41	
14	1.68 - 1.19	Coarse
16	1.41 - 1.00	
20	1.19 - 0.84	
24	0.84 - 0.60	
30	0.71 - 0.50	
36	0.60 - 0.50	Medium
40	0.50 - 0.40	
46	0.40 - 0.30	
54	0.35 - 0.25	
60	0.30 - 0.21	
70	0.25 - 0.18	Fine
80	0.21 - 0.15	
90	0.18 - 0.13	
100	0.150 - 0.110	
120	0.130 - 0.090	
150	0.110 - 0.060	
180	0.090 - 0.050	
220	0.075 - 0.045	
240	0.047 - 0.043	
280	0.038 - 0.035	
320	0.031 - 0.028	
400	0.018 - 0.016	
500	0.014 - 0.012	
600	0.010 - 0.008	
800	0.008 - 0.006	
1000	0.005 - 0.004	Very fine
1200	0.004 - 0.003	

	FEPA	ASTM E 11 70 (Mesh)	Dimensions (mm)
Coarse	427	40/50	0,425-0,300
	301	40/60	0,300-0,250
	252	40/80	0,250-0,180
Medium	181	80/100	0,180-0,150
	151	100/120	0,150-0,125
	126	120/140	0,125-0,106
	107	140/170	0,106-0,090
	91	170/200	0,090-0,075
Fine	76	200/230	0,075-0,063
	64	230/270	0,063-0,053
	54	270/325	0,053-0,045
	46	235/400	0,045-0,038

The abrasive granulation determines the grinding effect and the quality of machined surface. It is most cost-effective to select the coarsest granulation that still yields the required quality of machining.

When higher material removal rates are required, a combination of coarse grinding and finishing is cost-effective. When a vitrified bonded grinding wheel with CBN and diamond grit is used instead of a standard one, a considerably finer granulation has to be used to achieve the same surface quality (Al-oxide 100 replaces B76). In addition to granulations according to the FEPA standard, the comparative table below also states values according to the US ASTM standard and grit size in mm.

	Coarse	Medium	Fine	Very fine
Standard	20 - 36	46 - 80	90 - 220	240 - 600
Superabrasive	427 - 252	181 - 91	76 - 54	46

Large material removal rates

Good durability, fine surface

Roughness of ground surface after grinding with vitrified bonded grinding wheels with SiC and Al oxide grit

Roughness							Grit size									
Ra(μm)	CLA (μ")	Rt (μm)	Rz (μm)	French designation	Russian designation	Grade	36	46	60	80	120	180	320	500		
1.6	63			15	Δ7	N7									Coarse grinding	
1.5	60															
1.25	50	10	6													
1	40															
0.80	32			14	Δ8	N6									Medium fine grinding	
0.63	25	5	3													
0.50	20	4	2.5													
0.45	18	3.5	2.25													
0.40	16	3	2	13	Δ9	N5									Medium fine grinding	
0.35	14		1.36													
0.32	12.5															
0.30	12	2.5	1.6													
0.25	10	2	1.2	12	Δ10	N4									Medium fine grinding	
0.20	8	1.6	1													
0.18	7.2															
0.16	6.3	1.3	0.85													
0.14	5.6			11	Δ11	N3									Fine grinding	
0.125	5	1.05	0.6													
0.10	4	0.9	0.5													
0.09	3.6															
0.08	3.2	0.8	0.4	10	Δ12	N2									Fine grinding	
0.063	2.5	0.63	0.32													
0.06	2.4	0.6	0.3													
0.05	2	0.5	0.25													
0.04	1.6	0.4	0.20	9	Δ13	N1									Polishing	
0.032	1.25															
0.03	1.2	0.3	0.15													
0.025	1	0.25	0.12													
0.02	0.8	0.2	0.1												Polishing	
0.016	0.63	0.16	0.08													
0.012	0.50	0.12	0.06													
0.01	0.40	0.1	0.05													

Roughness of ground surface after grinding with vitrified bonded grinding wheels with CBN and diamond grit

Grit size acc. to FEPA		Medium profile deviations	Surface quality	Grinding method
Diamond	CBN	Ra (micron)	Grade	
	B181	1.12	N7 - N6	Very coarse
	B151	0.75	N6	
	B126	0.66	N6	
D181	B107	0.53	N6 - N5	
D151	B91	0.50	N6 - N5	
D126	B79	0.50	N6 - N5	
D107	B64	0.40	N5	
D91	B54	0.33	N5 - N4	Medium fine
D79	B46	0.25	N5 - N4	
D64	B35	0.18	N4	
D54		0.16	N4 - N3	
D46		0.15	N4 - N3	Polishing
Micron sizes			N3 - N2	

Hardness

Hardness is the resistance with which the bond prevents break-out of abrasive grits from the abrasive surface. Degrees of hardness are designated with letters of the Latin alphabet. Hardness depends on the type and amount of the binding agent, grinding wheel structure and method of grinding wheel production.

Designation	Hardness
D E F G	Very soft
H I J K	Soft
L M N O	Medium
P Q R S	Hard
T U V Z	Very hard

A general rule for determining abrasive hardness is that grinding of harder materials requires a softer abrasive and vice versa. It is also a rule that smaller contact surfaces between the workpiece and grinding tool require a slightly harder grinding tool and vice versa: larger contact surfaces require a slightly softer, more porous grinding tool. It is possible to determine the approximate hardness of vitrified-bonded abrasives for general grinding of steels of specific hardness.

Hardness	Material hardness			
	Up to 42 HRc	42 to 50 HRc	50 to 57 HRc	Over 57 HRc
G				X
H				X
I				
J			X	
K	X	X		

When selecting quality, the grinding tool hardness should be:

- reduced by one to two hardness degrees at high material removal rates or when workpiece overheating needs to be prevented.
- increased by one to two hardness degrees when longer grinding tool life is a priority.

In the case of thinner grinding wheels, finer grit of higher hardness should be selected.

Structure

The structure of a grinding tool determines the ratio of tool volume to abrasive grit volume. A normal structure is designated with numbers from 1 to 9, while an artificially created porous structure is designated from 10 to 20. The following needs to be designated for structures 11 to 20:

		Artificial porosity		
	Pore number	N - Low	S - Medium	V - Large
Pore size	1 Very small pores	1 N	1 S	1 V
	2 Small pores	2 N	2 S	2 V
	3 Medium pores	3 N	3 S	3 V
	4 Large pores	4 N	4 S	4 V

Normal structure 1 - 9



Porous structure 10 - 20



High-porosity grinding wheels provide the most favorable grinding procedure: self-sharpening, cold cutting, better chip removal, smaller force.

Grinding wheel bond

The purpose of a bond is to bind abrasive grit and thus create the grinding wheel shape. The hardness, structure and grinding properties of grinding wheels depend on the type and amount of the bond.

A vitrified bond is a bond based on clay, kaolin and other materials/fillers. It is thermally treated at temperatures between 900 and 1300 °C. In case of vitrified bonded grinding wheels, the range of hardness values is very broad. The vitrified bond is sensitive to quick temperature changes and impacts, while various chemicals and duration of storage do not affect them. Normally, vitrified bonded grinding wheels are used at operating speeds of up to 40 m/s; they maintain their shape very well and can be used for all grinding applications (from very coarse grinding to the finest types of grinding).

A resin bond is an organic bond based on phenole formaldehyde resins and fillers. It is obtained by condensation of phenole and formaldehyde with an addition of hexa, and for some types also with a modifier such as epoxy or caoutchouc. It gives the grinding wheel excellent mechanical properties and allows high peripheral speeds. It is also appropriate for reinforcement (using knitted glass fibres) in order to improve the mechanical properties of the grinding wheels. Compared to the vitrified bond, it is much less sensitive to quick temperature changes and impact, but more so to chemical influences and prolonged storage.

Concentration of superabrasive grit

Concentration indicates the amount of superabrasive grit in a grinding wheel. For example, a concentration of 100 means 4.4 carat of grit per 1 cm³ of grinding wheel volume. The 100 concentration is the one that is most commonly used. The concentrations suitable for internal grinding range between 100 and 200. Increasing of superabrasive grit concentration in a grinding wheel also increases its grinding capacity, stability and productivity.


Concentration	CBN and diamond grit		
	Carat/cm ³	g/cm ³	Vol (%)
50	2.2	0.44	12.5
75	3.3	0.66	18.8
100	4.4	0.88	25
125	5.5	1.10	31.3
150	6.6	1.32	37.5
175	7.7	1.54	43.8
200	8.8	1.76	50

Core material

of vitrified bonded grinding wheels with CBN and diamond grit:

Core material	Designation
Vitrified bonded	/
Sintered aluminium	S
Aluminium alloy	A
Steel	J

Comparative table of abrasive grit designations

Grain type		Atlantic	Baystate	Burka Kozmos	Butzbacher	Carborundum CZ	Dilumit	Dornerwerk	Efesit Cerasiv	Elbe	Elsass	Gosweiler	Granit H	KINIK Taiwan	Krebs & Rieder	Meister	Molemab	Naxos - Union	Noritake	Norton	Oemmeta/Hermes	Pferd	Rapold Winthertur	Slip - Naxos	Simat Italia	Swaty	Theleico leisse & Co.	Tyrolit	Universal
Normal Al oxides																													
Non-calciated Al oxide	10A	NK1 - NK9	A	NK	10A	96A	10A		10A, 13A	11A	10A	10A	1A	A	10A, 11A	72A	A	NK	A	A	NK	AN	A	21	A	1A	10A - 20A	10A	11A
Calciated Al oxide	11A	NK1 - NK9	A	NK	10A	96A	10A		10, 13A	11A	10A	10A	1A		10A, 11A	72A	A	NK		A	NK	3A	21		1A		10A	11A	
Semi-pure Al oxide	30A	HK6 - HK9	3A	HK	20A	97K A	30A		45A, 20A	41A	50A		5A		15A		15A	HK		57A	HK	5A			7A	30A - 39A	50A	MA	
Pure Al oxides																													
White Al oxide white bond	22A	EK1 + EK3	9A		30A	99B A	40A	2A	22A, 30A	81A	30A	20A	6A	WA (38A)	35A	62A	9A	EK	WA	38A	EKW	AW	42A	43A	WA	2A	40A, 42A	89A	WA
White Al oxide red bond	21A					99A									35A braun							53A		RA	2A				
White Al oxide blue bond	23A	EK1Y										25A			35A blau								49A		PA	2A			
Pink Al oxide	40A	EK8 + EK9	5A		40A	98A	50A	1A	21A, 31A	82A	31, 32A	30A	7A	PA	40A	61A	11A	EKD, EKR	PA	25A	EKR	AR	57A	41A	RRR	4A	49A, 40A	88A	41A
Mg Al oxide	50A					A98M																							
Ruby Al oxide	60A	EK6			50A		60A	3A	26A, 33A			40A	8A	RA	47A	64A	31A	FF				EKD	AD	68A		SR	6A	44A + 48A	91A
Zirconium Al oxide	70A	ZK1 - ZK9			A97E								3A	ZA												ZA		50A - 73A	
Monocrystalline Al oxide	80A	EK7			A97M	70A	5A	5A	27A, 32A	89A		50A	2A	32A	31A	71A		Ela		32A	EKE		29A		HA	8A	46A - 49A	90A	
Dirty pink	45A																								PA				
Al oxide balls	25A								29A						33A							AH							
Special Al oxides																													
Special ceramic Al oxide	SA	EC	47A	SK13	914A		43A	83A	20A5	71A	80A		4A		70NA	500A-550A	5A	KSB		SG	CB					GA	21A-28A	40A	73A
Special Al oxide	LA																												
Blends																													
Al oxide + PAOW	12A		2A		31A				41A, 21A			12A		FA (57A)	22A	92A				23A		AWN	35A	31A	AWA	52A			47A
PAOP + NAO	41A				41A										21A		33A					ARN							
PAOP + PAOW	42A														45A		91A					EWR	60A		RWA				
Dirty pink + monocryst.	48A																						64A						
Ruby + PAOW	62A															81A					AWD	ADW	62A		SWA			93A	
Monocryst. + PAOP	82A										25A												25A		WHA			92A	
Silicon carbides																													
Green SiC	10C	SC9	1C	SCG	60C	C49	10C	SC	20C, 31C	1C		10C	2C	GC	57C	31C	6C	SCg	GC	39C	SCG	CN	11C	24C	CW	C	85C - 89C	C	C
Black SiC	90C	SC7	C	SCS	66C, 68C	C48	20C		10 - 12C, 32C	C		20C	1C	C	50C	32C	4C	SCd	C	37C	SCS	CU	C	11C	C	9C	80C - 84C	1C	BC
Cubic boronitride																													
	B					BN											B												
Diamond	D																D												



USE OF GRINDING TOOLS

Responsibility for safety during grinding

Grinding machine manufacturer

The machine manufacturer must ensure machine stability, strength of the protective housing, as well as the possibility of setting machine strokes and displacements to enable the desired grinding precision, and should also attach instructions for precise and safe work.

Grinding tool manufacturer

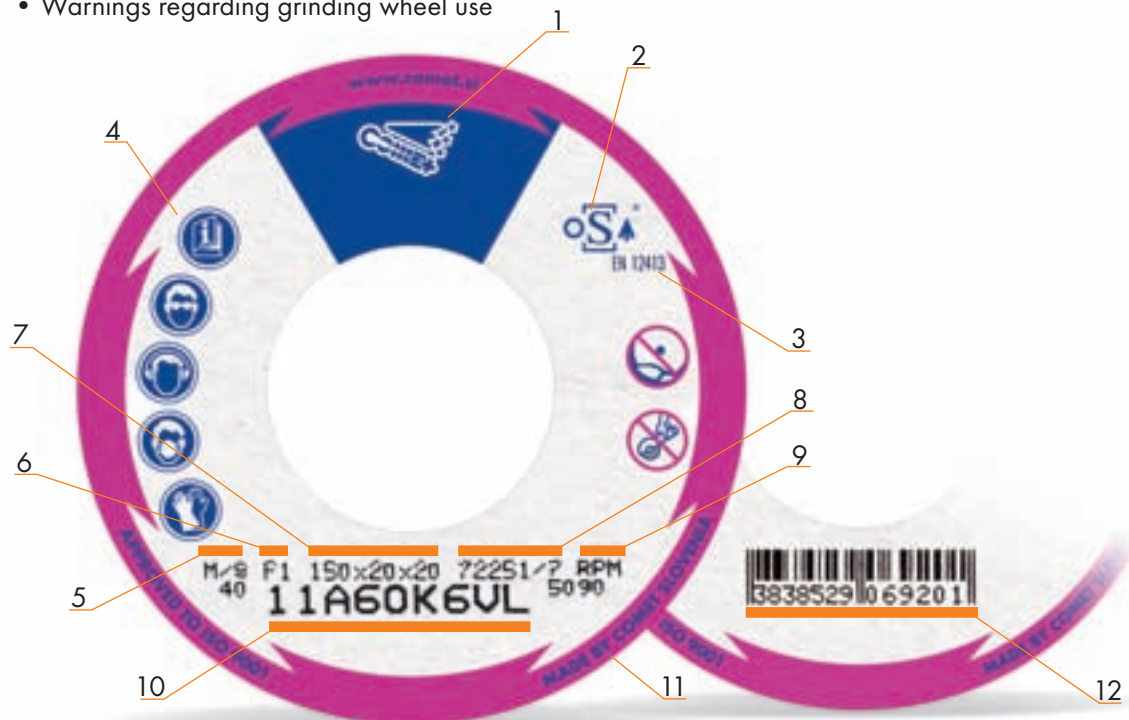
The tool manufacturer must produce safe grinding wheels and ensure that the ingredients are properly selected, including correct technological manufacturing procedure and the necessary product control:

- safety control (increased peripheral speed, sound, cracks)
- quality control (dimensions, hardness, whipping and balance)

The control methods are prescribed in the international standards EN 12413, FEPA and ISO.

The following must be marked on grinding tools by the manufacturer:

- Manufacturer's name
- Grinding wheel dimensions
- Grinding wheel quality (type and size of abrasive grit, hardness, structure and bond)
- Max. operating speed
- Warnings regarding grinding wheel use



- 1 - Trademark
- 2 - Certificate of Safety
- 3 - Standard
- 4 - Warnings for safe use
- 5 - Operating speed
- 6 - Type

- 7 - Dimensions
- 8 - Batch number
- 9 - Max RPM
- 10 - Specifications
- 11 - Manufacturer's name
- 12 - Bar code

Warnings for safe use



Please read the instructions carefully



Free hand grinding or cutting prohibited



Use a safety shield or protective eyewear



Use of damaged products prohibited



Use ear protection



Use a dust mask



Use protective gloves

Applications (materials)



Steel



Steel alloys



Stainless steel



Hard metals



Non-ferrous metals



Wood



Nonmetals



Plastic materials

The data are marked on the product and a cardboard flange (for circular grinding wheels) or on adhesive labels (for noncircular products), which are attached to the product or to the packaging.

Grinding tools without special designations are intended for operating speeds of up to 40 m/s.

Grinding wheels for greater operating speeds must be designated with a diagonal color line, as follows:

50 m/s

63 m/s

80 m/s

100 m/s

125 m/s

For individual grinding wheel diameters and operating speeds, the number of revolutions per minute (rpms) is determined from the table below.

D (mm)	Peripheral speed (m/s)												
	12	16	20	25	32	35	40	45	50	63	80	100	125
3	76390	101860	127320	195160	203720	222810							
6	38200	50290	63360	79580	101860	114410	127320	143240	159160	200540	254650		
8	28650	38200	47750	59680	76390	83560	95490	107430	119370	150400	190990	238730	
10	22920	30560	38200	47750	61120	66850	76390	85940	95490	120320	152790	190990	238730
13	17630	23510	29380	36730	47010	51420	58770	66110	73460	92560	117530	146910	183640
16	14320	19100	23870	29840	38200	41780	47750	53710	59680	75200	95490	119340	149210
20	11460	15270	19100	23870	30560	33420	38200	42970	47750	60160	76390	95490	119340
25	9170	12220	15280	19100	24450	26740	30560	34380	38200	48130	61120	76390	95490
32	7160	9550	11940	14920	19100	20890	23870	26860	29840	37600	47750	59680	74600
40	5730	7640	9550	11940	15280	16710	19100	21490	23870	30080	38200	47750	59680
50	4580	6110	7640	9550	12220	13370	15280	17190	19100	24060	30560	38200	47750
63	3640	4850	6060	7580	9700	10610	12130	13640	15160	19100	24250	30320	37890
80	2870	3820	4780	5970	7640	8360	9550	10740	11940	15040	19100	23870	29840
100	2290	3060	3820	4780	6110	6680	7640	8590	9550	12030	15280	19100	23870
125	1830	2440	3060	3820	4890	5350	6110	6875	7640	9630	12220	15280	19100
150	1530	1040	2550	3180	4070	4460	5090	5730	6370	8020	10190	12730	15920
175	1310	1850	2180	2730	3490	3820	4370	4910	5460	6880	8730	10910	13640
180	1270	1700	2120	2650	3400	3710	4240	4775	5310	6680	8490	10610	13260
200	1150	1530	1910	2390	3060	3340	3820	4230	4780	6020	7640	9550	11940
230	1000	1330	1660	1080	2660	2910	3320	3740	4150	5230	6640	8300	10380
250	920	1230	1530	1910	2440	2670	3060	3440	3820	4810	6110	7640	9550
300	765	1020	1270	1590	2040	2230	2550	2865	3180	4010	5090	6370	7960
350	655	875	1090	1365	1745	1910	2180	2455	2730	3440	4370	5460	6820
400	575	765	955	1195	1530	1670	1910	2150	2390	3010	3820	4780	5970
450	510	680	850	1060	1360	1485	1700	1910	2120	2670	3400	4240	5300
500	460	610	765	955	1220	1335	1530	1720	1910	2410	3060	3820	4780
600	380	510	640	795	1020	1115	1270	1430	1590	2000	2550	3180	2980

The peripheral speed of a grinding wheel is determined according to the following equation:

$$v = \frac{d \cdot \pi \cdot n}{60000}$$

v – peripheral speed (m/s)
 d – grinding wheel diameter (mm)
 n – revolutions per minute (rpm)

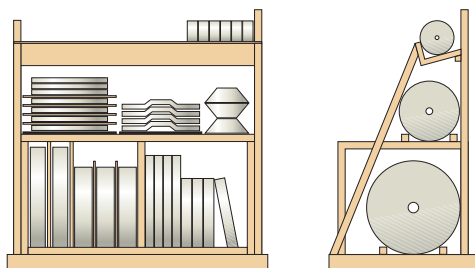
The necessary number of wheel revolutions per minute is determined according to the following equation:

$$n = \frac{60000 \cdot v}{d \cdot \pi}$$

During work, users must follow the instructions of the tool and machine manufacturer(s), and most importantly:

- Provide adequate storage for the grinding tools
- Inspect grinding tools before mounting
- If necessary, balance and correctly mount grinding tools
- Correctly prepare the grinding machine
- Test the grinding tool while unloaded

Storing of grinding tools



Vitrified bonded grinding wheels are not sensitive to atmospheric influences. Due to their fragility, they are however very sensitive to impact, because this causes cracks that are undetectable by the human eye, but may cause grinding wheel rupture at the beginning of work. Grinding wheels should be stored on wooden shelves that prevent rolling. The shelves need to be designed such that various grinding tool types can be arranged on them simple and safe manner.

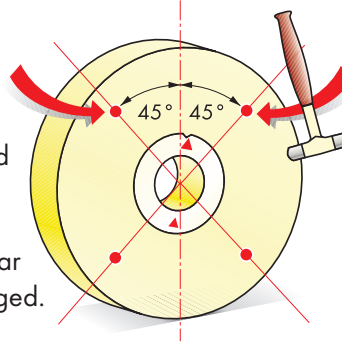
Easy and safe removal of grinding tools from the shelves should also be ensured, while maintaining the stability of those remaining on the shelves. Grinding tool shelving should be positioned as close to the grinding machine as possible.

On the other hand, the quality of resin bonded grinding wheels gradually deteriorates. This process may be accelerated by unsuitable storage conditions. Resin bonded grinding wheels should not be allowed to freeze. The storage temperature should be between 10° and 30° C, and the relative humidity should not exceed 70%. Under such conditions, the physical properties of these grinding wheels remain unchanged for a year. After prolonged storage, however, the mechanical properties of the grinding wheels may change, therefore safety checks should be performed prior to their use.



Inspection of the vitrified bonded grinding tool before mounting

Grinding tools are usually stored in cardboard packaging or wooden cases and shipped on wooden pallets. Packaging does provide for safe transport; nevertheless the cartons or cases must not be thrown during reloading. After their receipt at the warehouse and especially directly before mounting onto the grinding machine, the grinding tool must be inspected; circular grinding tools must also be ring tested to detect any damage that may have occurred during transport or storage. Ring testing of grinding tools is performed by lightly hitting a suspended tool in four places with a metallic or wooden hammer; the tool must yield a clear ringing sound. If the sound is dull, the tool is probably damaged.



Mounting of grinding tools

Grinding tools must always be mounted by properly trained and experienced personnel. In addition to visual inspection and ring testing, dimensions, quality and max. peripheral speed also need to be checked prior to mounting. Grinding tools should be mounted easily on the spindle or a clamping device (without the use of force or hammering) and must ensure safe clamping. The enclosed cardboard flange should be placed between a grinding wheel and the clamping part (steel flange or clamping jaw). The maximum permissible imbalance of grinding wheels is calculated using the following equation:

$$m_n = K \cdot \sqrt{M}$$

m_n = permitted imbalance

K = factor

M = grinding wheel mass in g

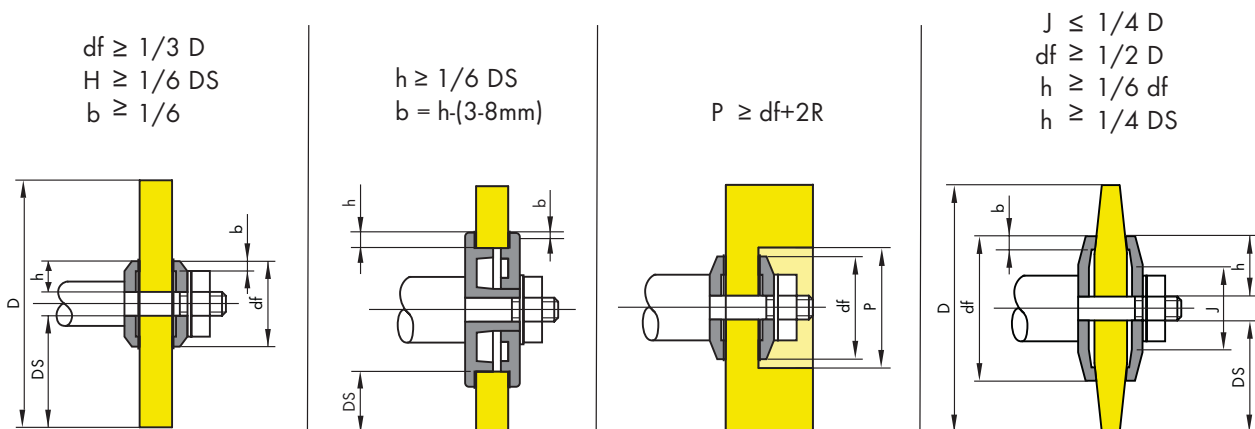
According to FEPA, ISO and DIN standards, factor K amounts to:

Diameter (mm)	K		
	40 m/s	63 m/s	100 m/s
up to 300	0.25	0.2	0.16
300 - 600	0.32	0.25	0.2
over 600	0.4	0.32	0.25

Grinding tools of greater dimensions, which are mounted on a flange and onto a machine spindle together with the flange, need to be statically balanced with flange weights. If the grinding wheel is not statically balanced, vibrations appear during grinding; this causes greater tool wear, lower ground surface quality, and shorter life of the main machine spindle bearings; the wheel may also split during work due to centrifugal force.

The procedure for static balancing of the grinding wheel involves manual positioning of weights into flange grooves, so that the total mass of the wheel and weights is evenly distributed along the circumference.

If wheel thickness exceeds 200 mm, dynamic balancing of the wheel is recommended.










Beginning of grinding

After mounting, and before grinding can begin, the following operations need to be performed:

- Set the machine so that it rotates at the maximum operating speed and appropriately protects the danger zone.
- Switch the machine on and leave the wheel to rotate for 1 minute prior to grinding.
- Prepare the coolant.
- Dress the grinding tool (diamond dressing tool).

Incorrect handling may cause damage to the grinding wheel or machine, or a work accident.

Recommended grinding parameters for individual types of grinding:

	Application	Grinding wheel periph.speed (m/s)	Workpiece periph.speed (m/min)	Longitudinal motion (m/min)	Transverse motion (mm/min)	Grinding depth (mm)
Surface grinding						
	- general applications - for high-alloyed steel - for gray alloy - for tungsten carbides - for non-ferrous metals	25 - 30 23 - 28 20 - 25 15 - 20 15 - 20	/	5 - 20	(0.25 - 0.33) * T	0.01 - 0.03
Circular grinding - external cylindrical grinding						
	- for coarse types of grinding intended for cleaning purposes - for dressing - for fine grinding - for the finest grinding	25 - 32 25 - 32 20 - 30 (63) 12 - 18	5 - 20	2 - 5 mm / workpiece revolution	/	0.005 - 0.03
Circular grinding - centerless grinding						
	- general applications	30 - 40 (63)	10 - 50	Guide plate angle $\alpha = \text{up to } 5^\circ$	/	0.005 - 0.03
Circular grinding - internal cylindrical grinding						
	- general applications - for high-alloyed steel - for gray alloy - for tungsten carbides - for non-ferrous metals - bearings	25 - 32 15 - 20 15 - 20 8 - 15 15 - 20 63 - 80	5 - 15	/	/	0.005 - 0.03
Tool sharpening						
	- for tool steels - for high-speed steels - for tungsten carbides	25 - 30 25 - 30 8 - 15	/	/	/	0.005 - 0.015

Grinding parameters

Recommended grinding parameters for vitrified bonded grinding wheels with CBN and diamond grit :

	Grinding wheel peripheral speed (m/s)	Workpiece peripheral speed (m/min)	Longitudinal motion (m/min)	Transverse motion (mm/stroke)	Grinding depth (mm)
External cylindrical grinding	30 - 35	10 - 25	0.5 - 1.0		0.01 - 0.05
Internal cylindrical grinding	8 - 35	10 - 30	0.3 - 1.0		0.002 - 0.005
Surface grinding with the grinding wheel face	30 - 35		8 - 10	0.3 - 0.6	0.04 - 0.1
Thread grinding	30 - 45	0.2 - 0.5			Up to 0.4/stroke
Tool sharpening (for machining of metals)	35 - 40		1.0 - 2.0		0.03 - 0.08
Groove grinding	25 - 30		2.0 - 2.5		0.01 - 0.06



SURFACE DRESSING OF GRINDING WHEELS

Constant cooling of the diamond tip is necessary during surface dressing and profiling in order to prevent changes of the diamond properties.

Surface dressing of grinding wheels:

Once the sharp edges of the grinding wheel cutting surface are worn out (as indicated by an increase in the normal force F_n , and an inefficient and loud grinding wheel), they need to be restored, i.e. surface dressed.

Various surface dressing tools are used for dressing of grinding wheels:

Manual surface dressing:

Depending on the required accuracy, surface dressing may be performed with:

- vitrified bonded dressing tools,
- little metal wheels,
- single grit diamond dressing tools,
- multigrit diamond dressing tools.



Machine surface dressing:

single grit dressing tools (with bases of different shapes),



dialettes (attached to holders of different shapes),



multigrit surface dressing tools (with bases of different shapes),



diamond rolls (attached to holders of different shapes)

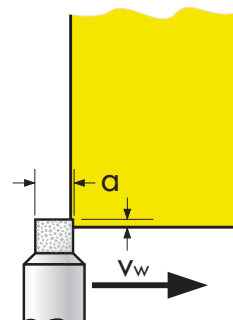


When a grinding wheel is mounted onto the machine spindle, it needs to be dressed for as long as it takes to level the entire grinding surface. If surface dressing is done during grinding, correct selection of the dressing parameters is important.

Dressing depth depends on the grit size in the grinding wheel, and is the same for all types of dressing tools.

Grit size according to FEPA	Dressing depth a (mm)
46	0.35
60	0.30
80	0.25
120	0.10
150	0.08
220	0.06
320	0.03
400	0.02

The other parameters are determined with respect to the dressing tool type.



Surface dressing with single grit diamond dressing tools

Selection of diamond grit size:

The grit size of a single grit surface dressing tool depends on the grinding wheel size, and is determined using an equation or a diagram.

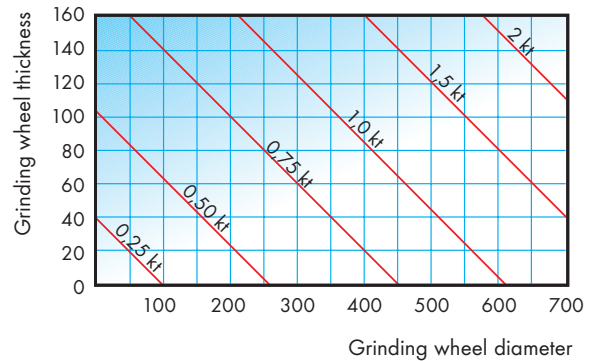
$$K_t = \frac{D + 2\check{S}}{400}$$

K_t – diamond grit size

D – grinding wheel diameter

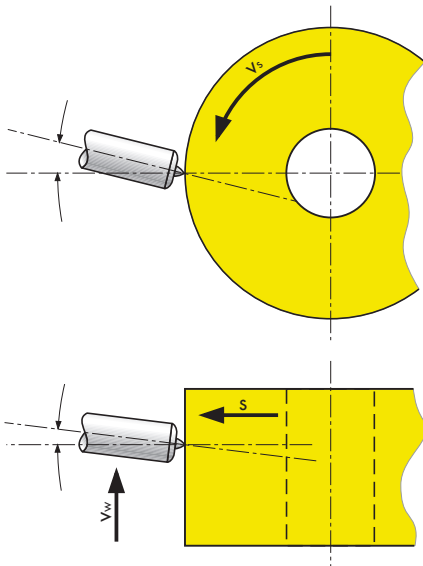
\check{S} – grinding wheel width

400 – constant

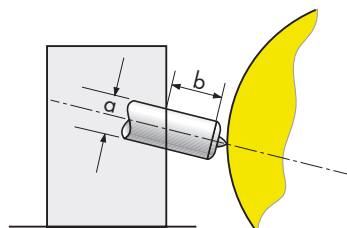


Depending on the shape, diamond grits for dressing tools are classified into four basic types.

No. of tips	Type
1 to 2	standard
2 to 3	extra
1 to 2 (one ground)	standard +
2 to 3 (one ground)	extra +



$$b = \max(2 \cdot a)$$



Dressing tool's transverse stroke:

Transverse stroke during dressing (mm/min) with single grit surface dressing tools depends on the type of grinding and the external grinding wheel diameter. The recommendations are as follows:

At operating speed of 35 m/s

Type of grinding	Grinding wheel diameter (mm)				
	Ø 200	Ø 300	Ø 400	Ø 500	Ø 600
Coarse grinding	780	520	400	300	260
Normal grinding	380	260	200	150	130
Fine grinding	280	150	120	100	80

At operating speed of 50 m/s

Type of grinding	Grinding wheel diameter (mm)				
	Ø 200	Ø 300	Ø 400	Ø 500	Ø 600
Coarse grinding	1000	730	560	420	360
Normal grinding	530	360	280	210	180
Fine grinding	390	210	170	140	110

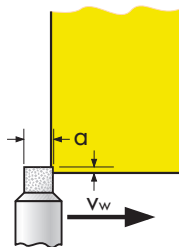
Restoration of single grit surface dressing tools

Once the surface dressing tip has become worn out (i.e. when the contact surface area exceeds 1 mm^2), the dressing tool needs to be restored. Restoration turns the grit around or grinds it and turns it around.

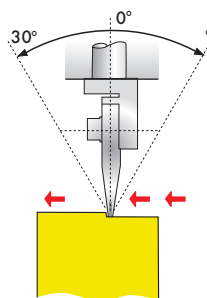


Surface dressing with multigrit surface dressing tools

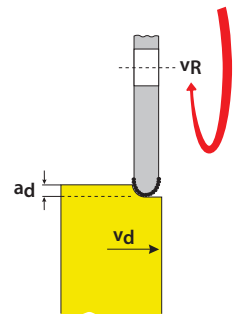
Multigrit dressing tools:



Dialettes:



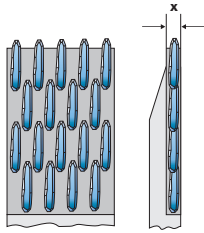
Diamond rolls:



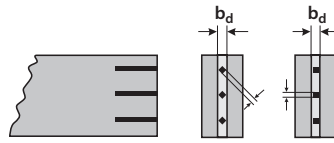
Profiling of grinding tools

Single grit surface dressing (profiling) tools: These are used for profiling vitrified bonded grinding wheels and are named according to the profiling device or machine.

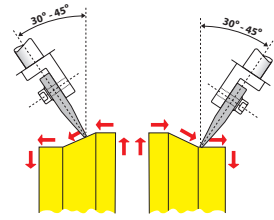
Flat surface dressing tools-Dialettes: These are classified according to the shape and quality of the integrated diamond grit.



Dialette with pins



Dialette with MCD
(monocrystalline diamond) pins:



Dialette position in relation to the grinding wheel during dressing.

Rotating diamond surface dressing tools:

Rotating diamond surface dressing tools:

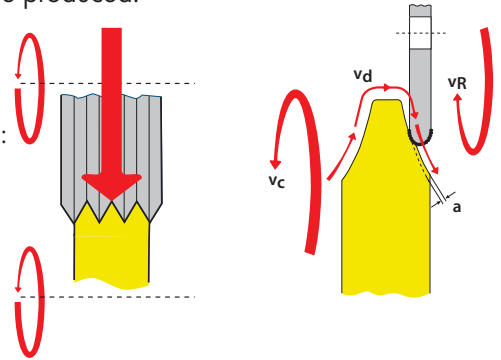
Depending on the dressing method, rotating diamond surface dressing tools are produced:

- with the entire profile shape (without transverse motion):
- with the same profile as the model (with transverse motion):

Depending on the bond type, rotating surface dressing tools may be produced with:

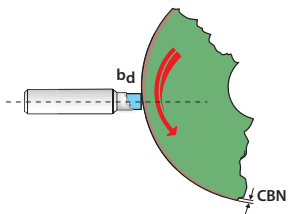
- galvanic bond,
- metal bond.

When profiling is done using a template (programme), the dressing wheel's profile must be the same as that of the model. The dressing tool moves along a template, creating the same profile along the grinding wheel circumference.

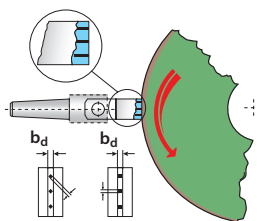


Dressing of vitrified bonded diamond and CBN grinding tools

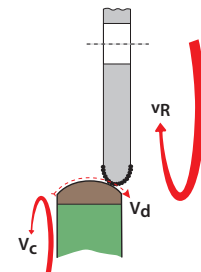
Vitrified bonded grinding wheels may be dressed with:



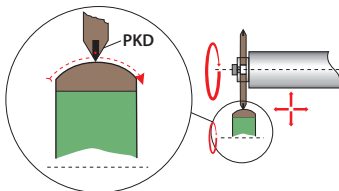
Multigrit sintered dressing tools



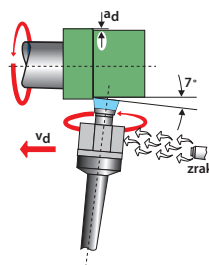
Dialettes with MC grit



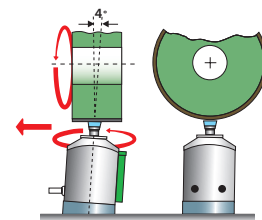
Diamond rolls



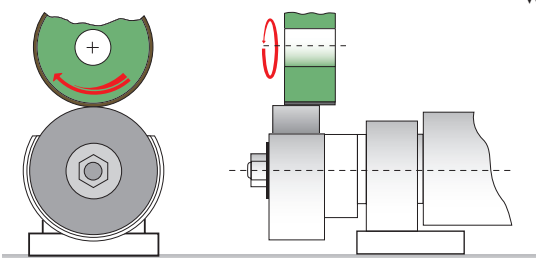
PKD profiling grinding wheels



Dressing tools
with rotating wings



Universal WST surface dressing
tools

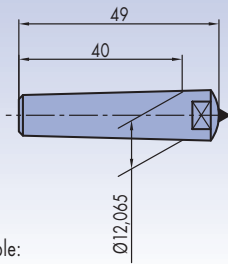


Dressing tools with centrifugal brake



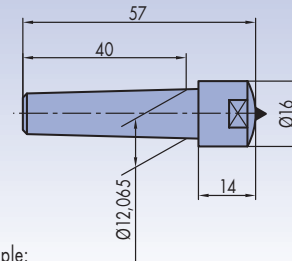
SINGLE GRIT DIAMOND SURFACE DRESSING TOOLS

K101 MK1



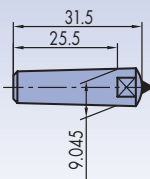
Order printout sample:
K101 MK1-2.5 kt - standard

K102 MK1- G



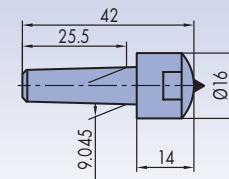
Order printout sample:
K102 MK1- G-2.5 kt - standard

K103 MK0



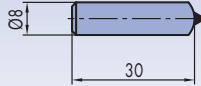
Order printout sample:
K103 MK0-1.0 kt - extra

K104 MK0 - G



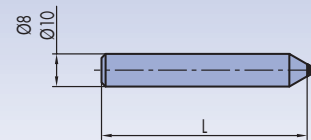
Order printout sample:
K104 MK1- G-2.5 kt - standard+

K105 DECKEL



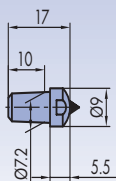
Order printout sample:
K105 DECKEL 1.0 kt - standard

K106 ZYLINDER



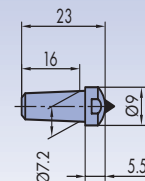
Order printout sample:
K106 CILINDER (Ø8x50) 1.5 kt - standard

K107 YUNG



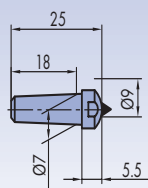
Order printout sample:
K107 YUNG 1.0 kt - extra+

K108 YUNG



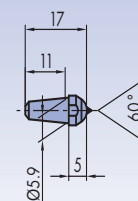
Order printout sample:
K108 YUNG 1.0 kt - extra

K109 YUNG



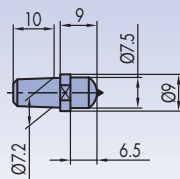
Order printout sample:
K109 YUNG 1.0 kt - standard

K110 YUNG



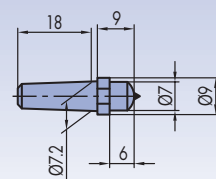
Order printout sample:
K110 YUNG 0.5 kt - standard+

K111 YUNG



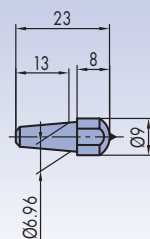
Order printout sample:
K111 YUNG - 0.75 kt - standard

K112 YUNG



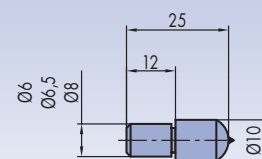
Order printout sample:
K112 YUNG - 0.5 kt - extra

K113 KOLB



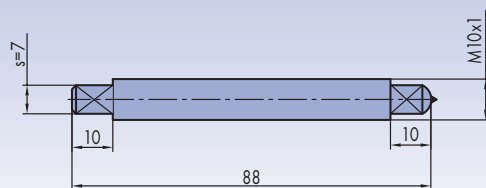
Order printout sample:
K113 KOLB - 1.0 kt - standard

K114 LANDIS



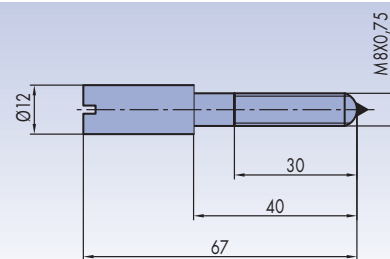
Order printout sample:
K114 LANDIS (06.5) - 1.5 kt - standard

K115 NILES



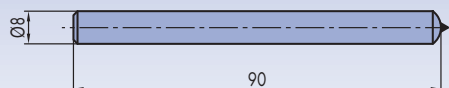
Order printout sample:
K115 NILES 0.5 kt - extra

K116 NILES



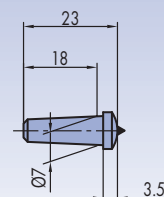
Order printout sample:
K116 NILES 0.75 kt - extra

K117 DECKEL



Order printout sample:
K117 DECKEL 1.0 kt - standard

K119

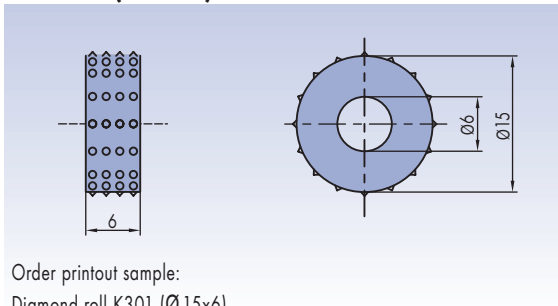


Order printout sample:
K119 1.0kt - standard

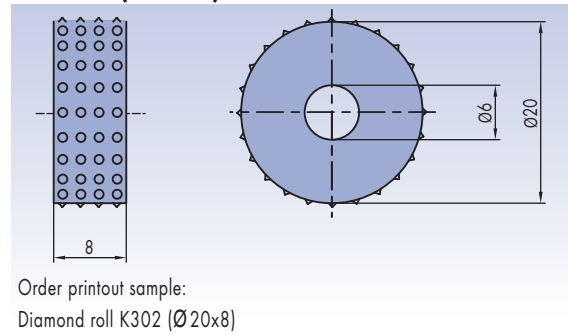


DIAMOND ROLLS

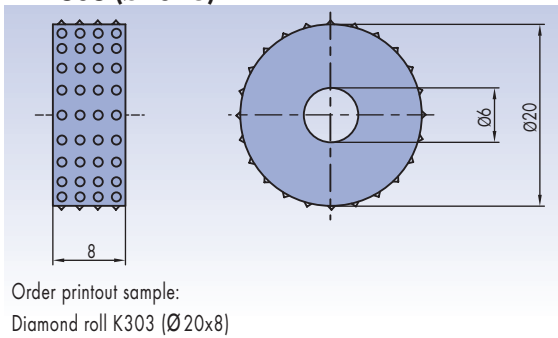
K301 (Ø15x6)



K302 (Ø20x8)

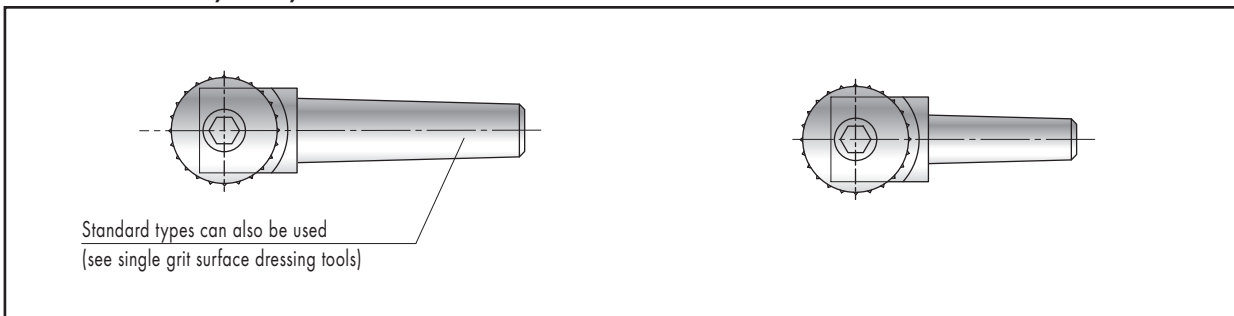


K303 (Ø20x8)



Diamond roll clamping

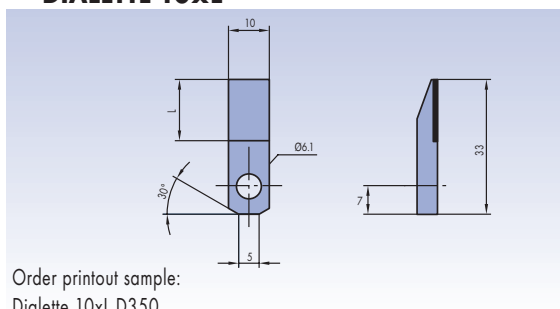
HOLDER MK1, MK0, ...



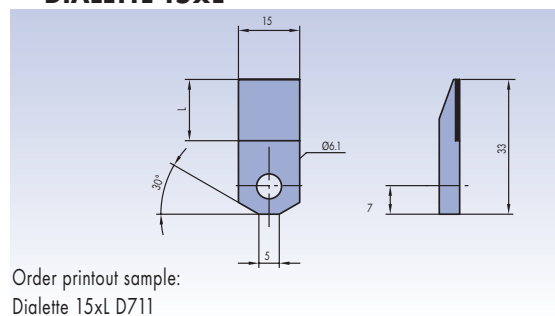


DIAMOND DIALETTES

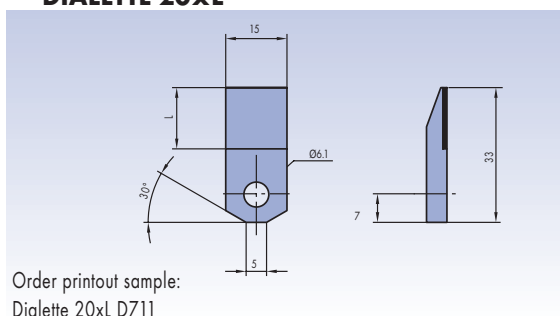
DIALETTE 10xL



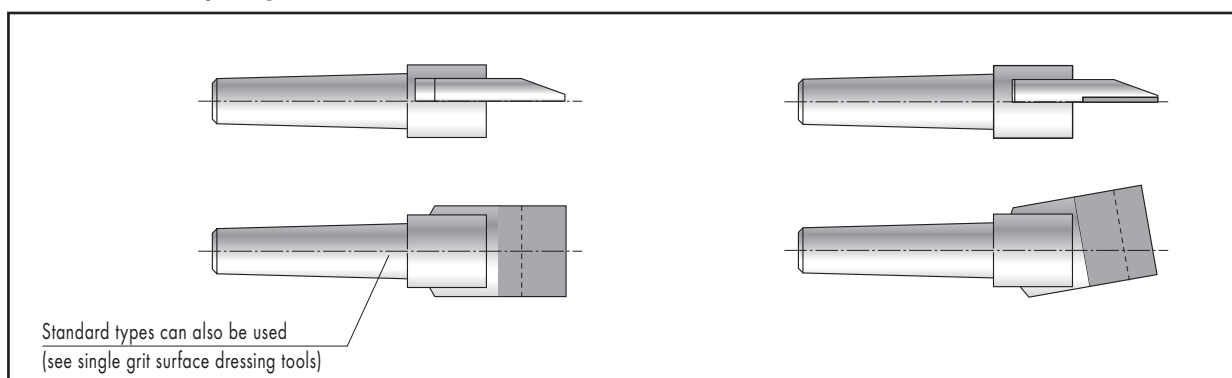
DIALETTE 15xL



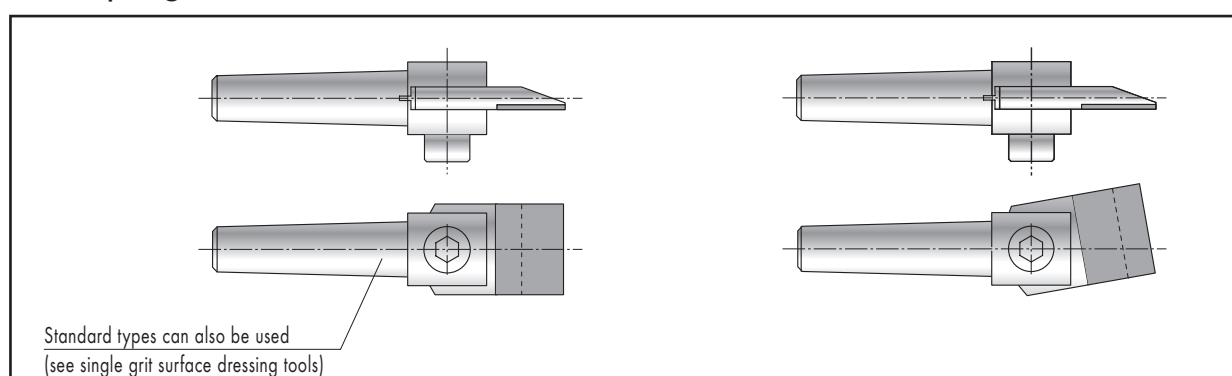
DIALETTE 20xL



Fixed clamping into a holder



Clamping into screw holders

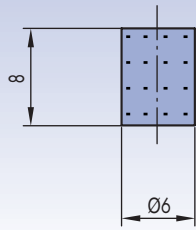




DIAMOND INSERTS FOR MULTIGRIT SURFACE DRESSING TOOLS

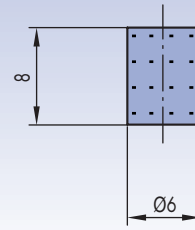
K401 Ø6x8

(Diamond grit size D 711)



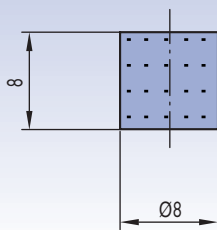
K402 Ø6x8

(Diamond grit size D 350)



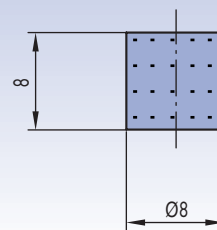
K403 Ø8x8

(Diamond grit size D 711)



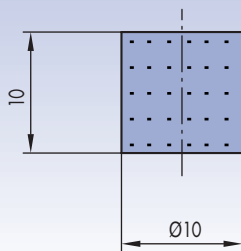
K404 Ø8x8

(Diamond grit size D 350)



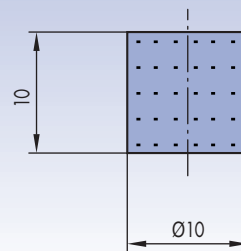
K405 Ø10x10

(Diamond grit size D 711)



K406 Ø10x10

(Diamond grit size D 350)



Types of multigrit dressing tools

HOLDER: MK0, MK1, ...



Standard types can also be used
(see single grit surface dressing tools)



Order printout sample:
K404 MK0 8x8 1 kt

MK0-G, MK1-G, ...



Order printout sample:
K406 MK1-G/10x10 1,5 kt

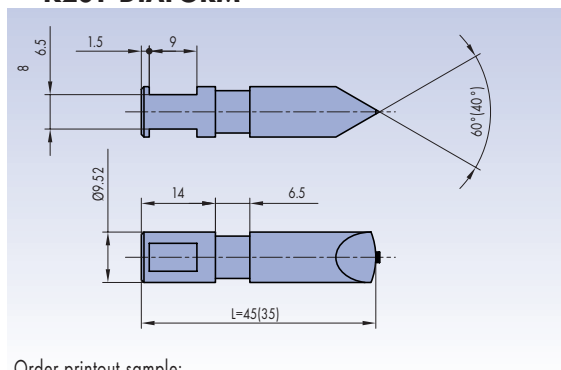
CYLINDRIC HOLDER



Order printout sample:
K401 8x80/6x8 0,75 kt

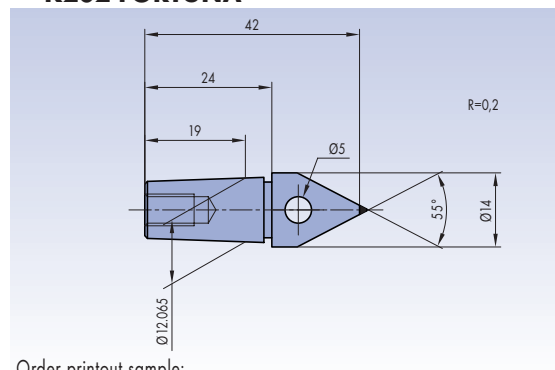
PROFILE DIAMOND SURFACE DRESSING TOOLS

K201 DIAFORM



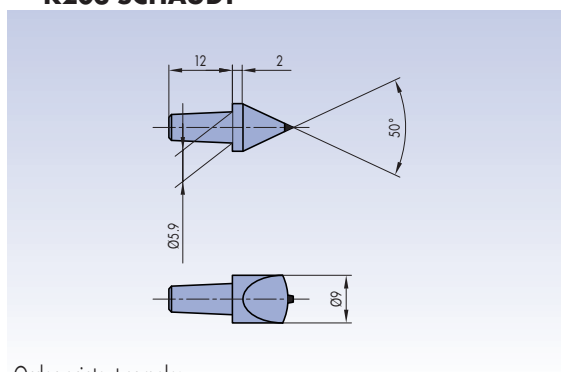
Order printout sample:
K201 DIAFORM - 1.0 kt

K202 FORTUNA



Order printout sample:
K202 FORTUNA (Ø6.5) - 1.5 kt

K203 SCHAUDT



Order printout sample:
K203 SCHAUDT 1.25 kt



COOLANTS

The purpose of a coolant is to cool the workpiece and grinding wheel during machining and to lubricate the ground surface. Cooling of the workpiece and tool is necessary to eliminate the unwanted effects of heat on both the workpiece and tool. Lubrication is needed to reduce friction between the tool and workpiece and protect the workpiece from corrosion.

Types of coolants

The following agents are used as coolants:

- oil for machining where very smooth surface is required,
- mineral, white emulsion - emulsion of oil in water with added emulsifiers and antibacterial additives; universally applicable,
- synthetic, clear emulsion - emulsion of synthetic oils in water; resistant to bacteria,
- synthetic coolants.

The coolant type and concentration depend on the machining method and type of material worked. It is recommended that the user consult the producer of coolant regarding the type of coolant and its concentration.

Most important properties of coolants:

- Good cooling and lubrication,
- prevention of corrosion,
- physical, chemical and technological stability during use,
- no harmful effects on human health,
- no excessive foaming.

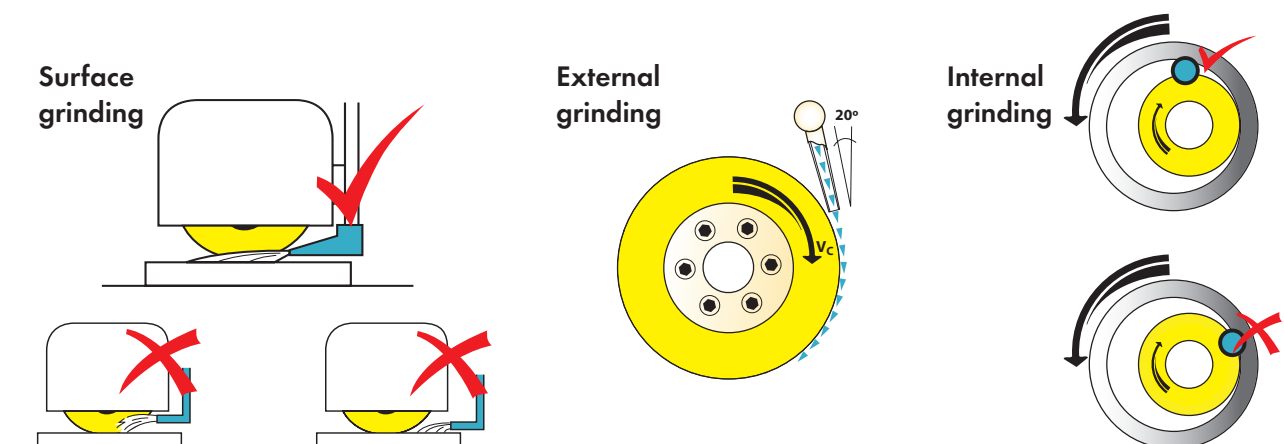
Cooling during machining

A sufficient amount of a coolant needs to be supplied at a certain pressure to the worked area during machining in order to perform this function. If the coolant is not supplied to the right place, its effects are suboptimal.

The figures show the points/places to which the coolant needs to be supplied for individual types of grinding.

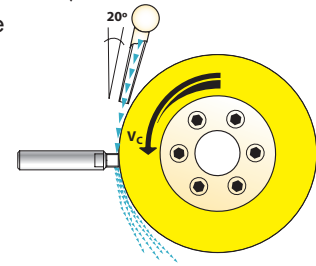
Reducing the amount of a coolant because it is sprayed around the work area may cause defects on the workpiece (cracks, thermal changes and similar problems).

During work and after it, the grinding wheel should not remain immersed in the coolant, because it might break during next use due to imbalance. When work is completed, the grinding wheel should be centrifuged to prevent damage upon reuse. Newer machines are constructed in such a way that the machining zone and thus also the cooling zone are enclosed and the coolant cannot be sprayed around.



Cooling during surface dressing

During surface dressing, cooling is necessary to lead heat away from the machining zone or to maintain the diamond's temperature stability. If the temperature in the dressing zone exceeds 620°C , a layer of graphite begins to be formed on the diamond surface, but if the temperature increases to 1200°C , all of the diamond grit will be transformed to graphite. If a coolant is not supplied during surface dressing or profiling in order to cool the surfaces and wash away the chips, some chips may be pressed into the grinding wheel surface, changing the grinding wheel shape.



Coolant maintenance

Coolants need to be cleaned before they are supplied to the cutting site, so that the chips would not cause damage to the ground surface. A coolant cleaning device is usually positioned between the work area and the coolant tank, so that the coolant can be purified prior to its repeat use. The most common used cleaning devices are:

- magnetic coolant cleaner,
- paper cleaner,
- centrifugal cleaner,
- magnetic-paper cleaner.

The concentration and the pH value of the coolant should also be monitored regularly, because they might change due to high temperatures (water evaporation).

SELECTION OF GRINDING WHEEL TYPE, DIMENSIONS AND QUALITY

Selection of the shape and dimensions of grinding wheels is limited by the machine (the machine manufacturer prescribes/recommends the shapes and maximum dimensions of grinding wheels which can be used on the machine). When one has a choice, the highest permissible peripheral speed of the grinding wheel should be used as a guidance as prescribed by the manufacturer, along with the machine rpm setting options and the grinding method. The grinding wheel quality required for individual grinding methods should be selected as shown below.

There are a few general principles which apply to the selection of grinding wheel quality:

Selection of abrasive grit type:

Both the workpiece material and its condition should be taken into account when selecting the grit type. In general, Al-oxide should be selected for grinding steel materials and silicon carbides for grinding non-steel materials (see page 16).

Selection of abrasive grit size:

The desired quality of the ground surface after grinding should be known to be able to select the abrasive grit size. Depending on the required ground surface roughness, the grit size should be selected from the table and diagram on pages 17.

Selection of grinding wheel hardness and structure:

In order to be able to select the correct grinding wheel hardness and structure, the condition of the ground material needs to be known (primarily its quality, hardness and any surface treatment/machining). When hardness is selected, it is important to select a softer grinding wheel for grinding harder materials and vice versa, i.e. a harder grinding wheel for grinding softer materials. There are certain principles which apply to grinding wheel hardness and structure, namely that it is impossible to manufacture low-hardness grinding wheels with a very closed structure and vice versa. When determining the grinding wheel hardness and structure, the use of a coolant is also relevant, i.e. with cooling, harder grinding wheels can be used than without it.

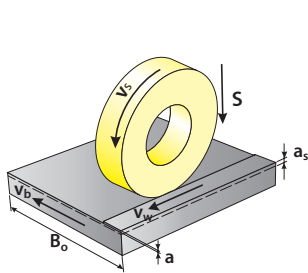
Bond selection:

Grinding wheels of various bonds are available for grinding. Recommendations for selecting vitrified bonded grinding wheels are given below.

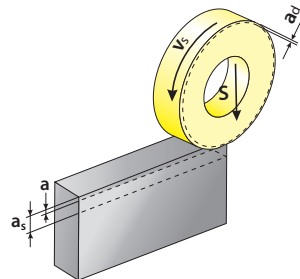
Ordering

When ordering grinding tools, please state all the necessary parameters in your order: tool type, dimensions and quality. For repeat orders, grinding tool identification number will suffice. The grinding wheel quality is determined as follows:

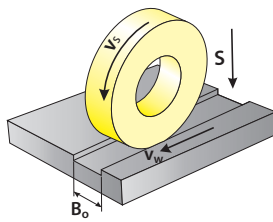
- If you are already using the grinding tool, order an identical one (all data required for the order can be found on the cardboard flange or adhesive label on the product). If your grinding tool is not manufactured by COMET, please add the manufacturer's name in your order (in addition to the prescribed data).
- If you have no information on the grinding tool quality or are just beginning to grind, state all data on the machine, grinding method, ground material and required ground surface quality in your order, or consult our technicians (fill out the TECHNICAL ORDER FORM).



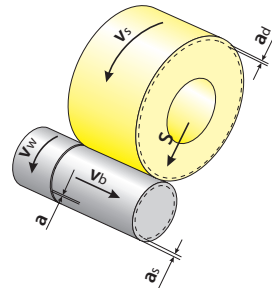
Surface grinding



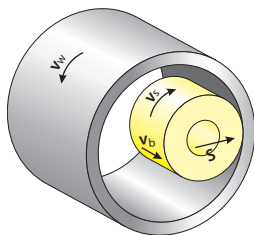
Surface grinding without transverse motion



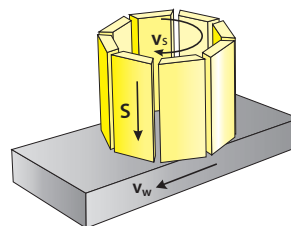
Profile grinding



External cylindrical grinding



Internal cylindrical grinding



Surface grinding with segments

Grinding parameters

v_s - peripheral speed
 v_w - speed of workpiece motion
 v_b - transverse workpiece speed
 s - tool transverse feed rate
 a - grinding depth per turn
 a_s - total grinding depth
 B_o - ground surface width

G - volume grinding factor
 V_w - volume of removed material
 V_s - amount of wear on wheel

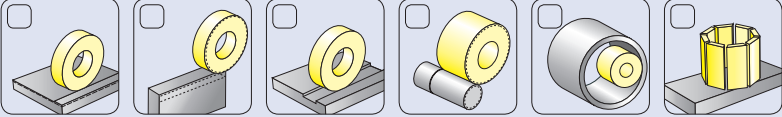
$$G = V_w / V_s$$

TECHNICAL ORDER FORM

Work order No.: _____
 Shape and quality of grinding wheel: _____
 Dimension of grinding wheel: _____

Customer: _____
 Address: _____
 Contact person: _____
 Phone: _____

DATA ON THE WORKPIECE:

Description: _____ Material: _____
 Hardness: _____ Surface finish: N, R_a, R_i, R_z : _____
 GRINDING METHOD:  Other method: _____
 Grinding machine: _____ Power of main spindle P_s : _____ W
 Grinding wheel peripheral speed v_s : _____ m/s or rpm _____ min^{-1}
 Workpiece speed _____ v_w : _____ m/min or rpm _____ min^{-1}
 Infeed _____ a : _____ mm
 Transverse speed _____ v_b : _____ mm
 Grinding allowance _____ a_s : _____ mm
 Other process parameters: _____
 Cooling: ☐ YES ☐ NO Coolant type (designation): _____ Flow rate (pressure): _____ l/min

TEST GRINDING REPORT:

Surface finish: _____ Observations : _____
 Material removal volume V_w : _____
 Grinding wheel layer volume _____ V_s : _____
 Process (grinding) time _____ t_s : _____
 Dressing infeed _____ a_d : _____
 Frequency of dressing: _____
 G ratio _____ $G = V_w / V_s$: _____

COMPARISON WITH SIMILAR GRINDING WHEELS FROM OTHER MANUFACTURERS:

Manufacturer: _____ Wheel designation: _____
 Notes: _____
☐ Better ☐ Equal ☐ Worse

TESTED SAMPLE:













Tested sample: ☐ Appropriate ☐ Semi appropriate
☐ Inappropriate, why? _____

Signature, date: _____

Please copy the table or download it from
www.comet.si, INQUIRIES, Vitrified bondend grinding tools



REVIEW OF PRODUCTS BY TYPE

	01.....Surface grinding with grinding wheel face	44
	02..... Surface grinding with grinding segments, rings and cups	46
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	04.....Centerless external cylindrical grinding	52
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	06.....Crankshaft and camshaft grinding	56
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	Internal cylindrical grinding	60
	08.....Tool grinding and sharpening	62
	09.....Manual grinding on stationary grinding machines	66
	10.....Mounted points	68
	11.....Files	76
	12.....Honing tools	82

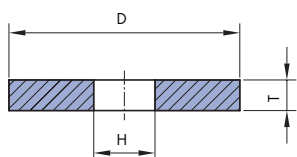


Surface grinding with grinding wheel face

Grinding wheel F1

D x T x H

Flat grinding wheel



Order printout sample:

F1 300x30x127

82A46/3G16/3SV12L

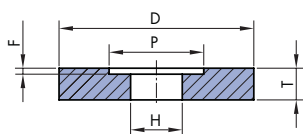


D	T	H
100	10 to 32	10, 13, 16, 20, 25, 32
125	10 to 32	13, 16, 20, 25, 32, 40
150	10 to 32	13, 16, 20, 25, 32, 40
200	10 to 32	13, 16, 20, 25, 32, 40, 51
225	10 to 32	16, 20, 25, 32, 40, 50, 60
250	10 to 32	20, 25, 32, 40, 51, 76
300	10 to 50	32, 40, 51, 76, 127
350	16 to 50	32, 40, 51, 76, 127, 151
400	20 to 80	40, 51, 76, 127, 152.4, 203
450	20 to 80	76, 127, 152.4, 203,
500	25 to 160	76, 127, 152.4, 203
600	32 to 160	127, 152.4, 203, 305

Grinding wheel F5

D x T x H - P x F

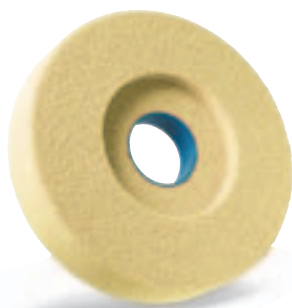
Flat, recessed on one side



Order printout sample:

F5 300x50x127-200x20

3LA60H16/2SV12L



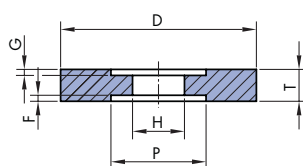
D	T	H	P	F
100	10 to 32	25, 32, 40	60	
125	10 to 32	25, 32, 40, 51	75	
150	25 to 32	25, 32, 40, 51	75	
200	25 to 32	25, 32, 40, 51	110	
225	20 to 40	25, 32, 40, 51	110	
250	20 to 40	40, 51, 76	130	
300	32 to 80	76, 127	190	
350	40 to 80	76, 127	215	
400	40 to 80	127, 152.4	230	
450	40 to 100	127, 152.4	290	
500	40 to 160	127, 152.4	290	
600	32 to 160	127, 152.4	290	

F = max. T/2

Grinding wheel F7

D x T x H - P x F / G

Flat, recessed on both sides



Order printout sample:

F7 300x50x127-100x15/10

23A46H18/4VV12L



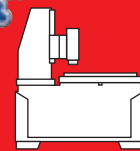
D	T	H	P	F,G
100	10 to 32	25, 32, 40	60	
125	10 to 32	25, 32, 40, 51	75	
150	10 to 32	25, 32, 40, 51	75	
200	10 to 40	25, 32, 40, 51	110	
225	20 to 40	25, 32, 40, 51	110	
250	10 to 40	40, 51, 76	130	
300	13 to 80	76, 127	190	
350	16 to 80	76, 127	215	
400	20 to 80	127, 152.4	230	
450	20 to 100	127, 152.4, 203	290	
500	25 to 160	152.4, 203, 305	290	
600	25 to 160	152.4, 203, 305	290	






F+G = max. T/2

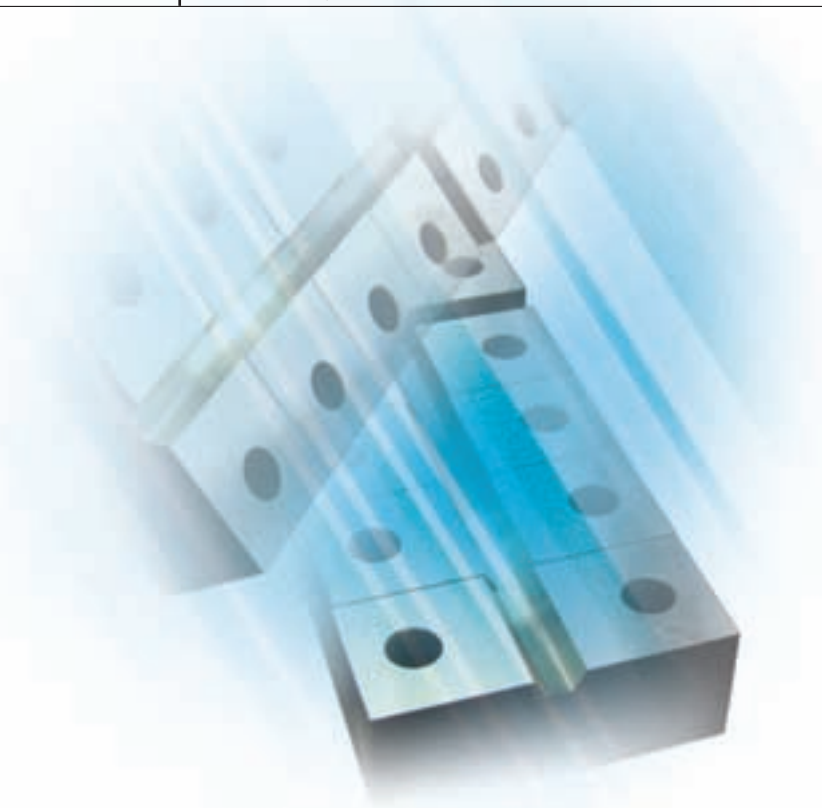
Quality of grinding wheels for surface grinding with wheel face



01



Ground material		Quality
Steels 	Universal Non-hardened steel Hardened up to 62 HRc Hardened over 62 HRc High-speed steels (HSS) Stainless Nitriding	3LA60H1V6/2SV12L 3LA60H16/2SV12L , 12A46I14/2SV12L 3LA60H16/2SV12L , 23A46H18/4VV12L 03B126N14/1SVC75, 3SA46H18/3VV12L, 82A46/3G16/3SV12L 62A46G16/2SV12L, 82A46/3G16/2SV12L 22A46H18/4VV12L 10C46H14/2SV12L, 82A46I14/2SV12L
Hard metals 	Tungsten carbides	01D126N6VC75, 10C60J6VL
Alloys 	Gray Nodular Steel	90C46J6VL 90C46J6VL 12A46J7VL
Non-ferrous metals 	Al and alloys Cu and alloys	90C46G10/3SV16WL 90C46G10/3SV16WL
Non-metals 	Plastic materials Rubber	90C46G16 /2SVWL 90C46G16/2SVWL

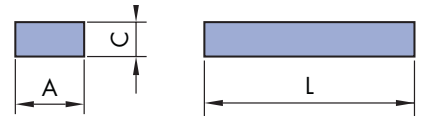




Surface grinding with grinding segments

Grinding segment A

A x C x L



A	C	L
80	25	150
90	30	200
102	25	199
102	25	250
120	30	200
154	25	150

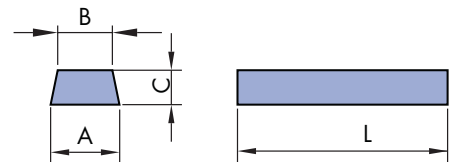
Order printout sample:

S-A 80x25x150

3SA36F16/4NVL

Grinding segment B

A / B x C x L



A	B	C	L
50	45	25	110
60	54	22	120
70	64	25	110
100	85	35	150
103	94	38	200
120	106	41	200
120	106	41	220

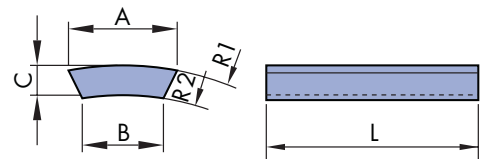
Order printout sample:

S-B 100/85x35x150

12A36F16/1V13L

Grinding segment C

A / R1 / R2 / B x C x L

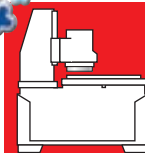


A	R1	R2	B	C	L
95	150	125	72	25	120
95	150	125	70	25	120
75	150	125	45	25	120
103	200	175	77	25	150
115	175	145	85	30	120
115	175	145	85	30	180
115	175	145	80	30	180

Order printout sample:

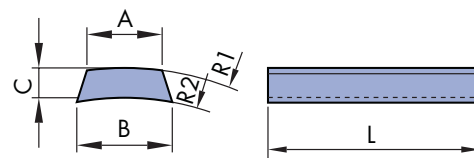
S-C 95/150/125/72x25x120

4LA36D20/2SVL



Grinding segment D

A / R1 / R2 / B x C x L



A	R1	R2	B	C	L
45	112	95	50	20	120
45	150	134	50	16	90
45	85	70	50	15	90

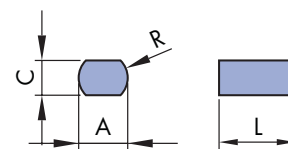
Order printout sample:

S-D 95/150/125/72x25x120

22A36F16/4NVL

Grinding segment ARR

A / R x C x L



A	R	C	L
85	40	55	63

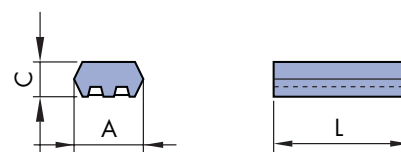
Order printout sample:

S-ARR 85/40x55x63

41A36F16/4NVL

Grinding segment BBU

A x C x L



A	C	L
160	60	200

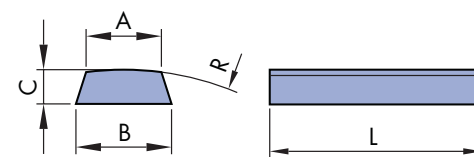
Order printout sample:

S-BBU 160x60x200

58A36F16/4NVL

Grinding segment DR

A / R / B x C x L



A	R	B	C	L
85	150	70	25	120
65	175	56	25	100

Order printout sample:

S-DR 160x60x200

22A36F16/4NVL



Surface grinding with grinding rings and cups

Grinding ring F2 and F2P

D x T - W

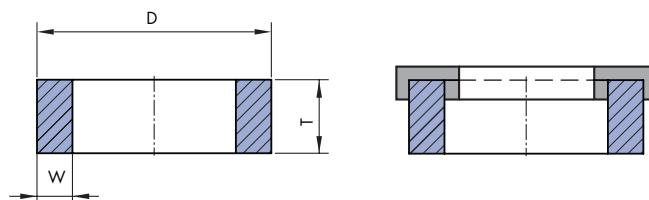
Grinding ring



Order printout sample:

F2 200x90-20

22A46H14/4NVL



D	T	W
100	90	10
125	80	32
150	90	15
175	90	20
200	90	20
250	100	25
300	120	32
350	125	40
400	125	40

Grinding cup F6

D x T x H - W x E

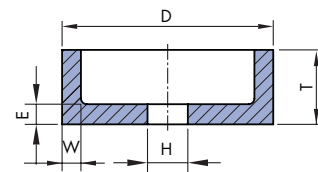
Cylindrical cup



Order printout sample:

F6 150x80x20-10x16

40A46H12/4NVL



D	T	H	W	E
50	32	13	5	8
80	40	20	6	10
100	50	20	8	10
125	63	20	8	13
150	80	20	10	16
175	100	32	15	20
200	100	32	20	25
250	100	76	20	25

Grinding cup F11

D / J x T x H - W x E x K

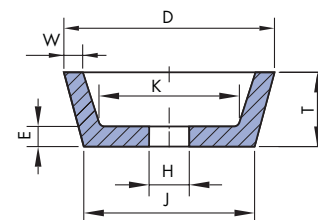
Flaring cup



Order printout sample:

F11 125/96x40x20-10x10x81

3SA46H12/4NVL



D	J	T	H	W	E	K
50	27	32	13	4	8	22
80	57	32	13	6	8	46
100	71	40	20	8	10	56
125	96	40	20	10	10	81
150	114	45	20	10	13	96
175	135	45	32	12.5	15	120
200	155	50	32	20	20	140
250	200	60	76	30	20	180




Products of other dimensions can be made to special order.

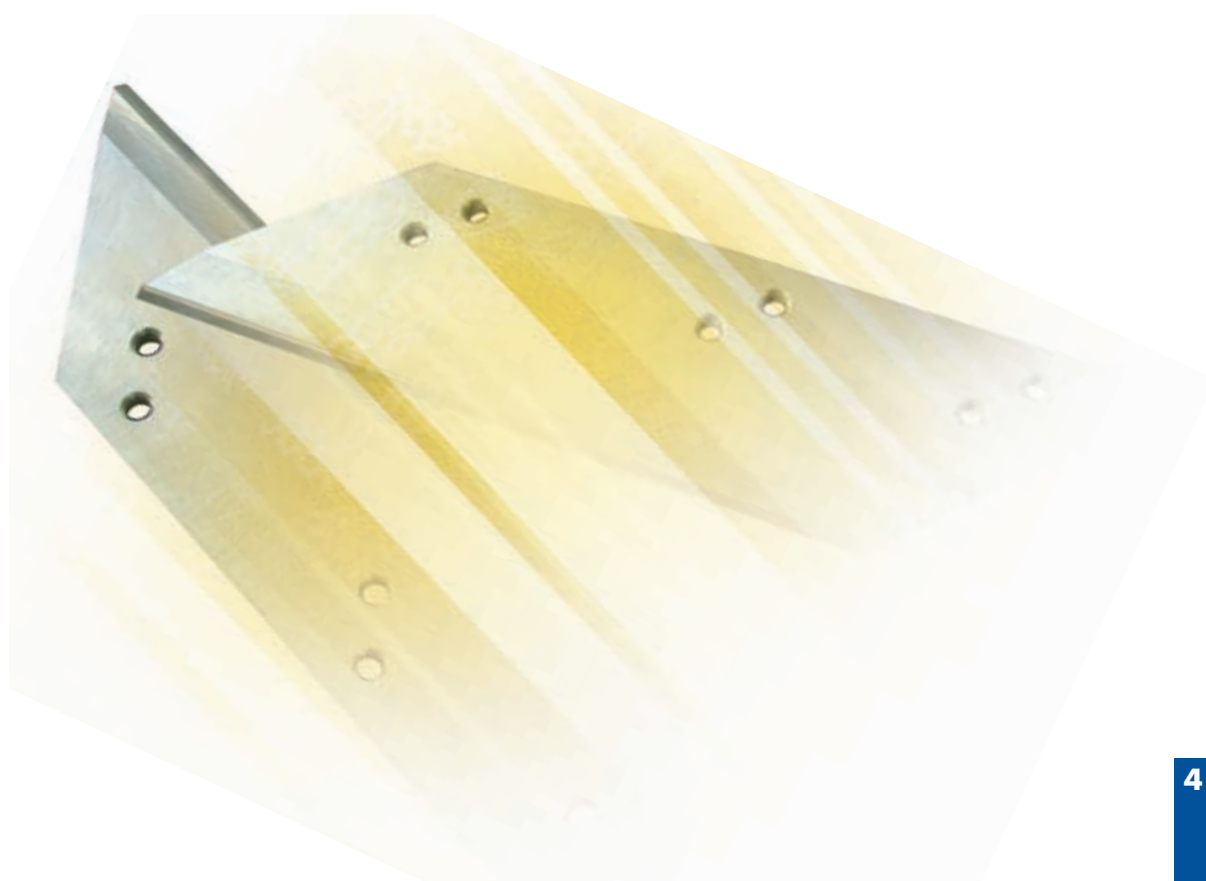
Quality of grinding wheels for surface grinding

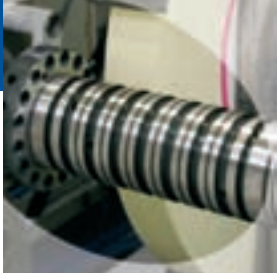


02



Ground material		Quality	
Steels 		Grinding rings and cups	Grinding segments
	Universal	22A46H12/3SV12L	22A36/5G18/2SV12L
	Non-hardened steel	22A36/1G10/0V11L	22A36H10/4NV11L
	Hardened up to 62 HRC	40A36F18/2SV12L	40A46F14/3SV12L
	Hardened over 62 HRC	3SA36F18/2SV12L, 42A46K5B	3SA36F14/4NV12L
	High-speed steels (HSS)	82A36F18/2SV12L, 42A46K5B	3SA36F14/4NV12L
	Stainless steel	22A36F18/2SV12L	22A46F18/2SV12L
	Composite materials		48A24/1I10/4NVL
Alloys 	Steel	3SA46H16/3SV12L	3SA46H16/3SV12L
Non-ferrous metals 	Al and alloys	54A36M5B	12A36G10/1V12L
	Magnetic tables		60A24/3G10/4NV12L



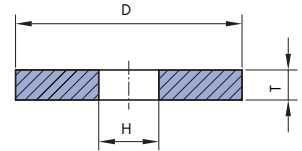


External cylindrical grinding

Grinding wheel F1

$D \times T \times H$

Flat grinding wheel



Order printout sample:

F1 300x30x127

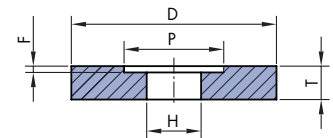
3LA70G5VL

D	T	H
200	10 to 32	13, 16, 20, 25, 32, 40, 51
225	10 to 32	16, 20, 25, 32, 40, 50, 60
250	10 to 32	20, 25, 32, 40, 51, 76
300	10 to 50	32, 40, 51, 76, 127
350	16 to 50	32, 40, 51, 76, 127, 151
400	20 to 80	40, 51, 76, 127, 152.4, 203
450	20 to 80	76, 127, 152.4, 203
500	25 to 100	76, 127, 152.4, 203
600	32 to 100	152.4, 203, 305

Grinding wheel F5

$D \times T \times H - P \times F$

Flat, recessed on one side



Order printout sample:

F5 300x50x127-190x20

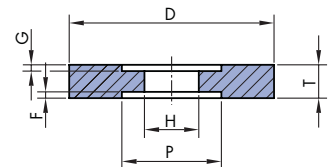
22A60I12/2SVL

D	T	H	P	F
200	20 to 40	25, 32, 40, 51	110	F = max. T/2
225	20 to 40	25, 32, 40, 51	110	
250	20 to 40	40, 51, 76	130	
300	32 to 80	76, 127	190	
350	40 to 80	76, 127	215	
400	40 to 80	127, 152.4	230	
450	40 to 100	127, 152.4	290	
500	40 to 160	127, 152.4	290	
600	32 to 160	127, 152.4	290	

Grinding wheel F7

$D \times T \times H - P \times F / G$

Flat, recessed on both sides



Order printout sample:

F7 300x50x127-190x15/10

23A46H14/2SVL






D	T	H	P	F, G
200	10 to 32	25, 32, 40, 51	110	F+G = max. T/2
225	20 to 40	25, 32, 40, 51	110	
250	10 to 40	40, 51, 76	130	
300	13 to 80	76, 127	190	
350	16 to 80	76, 127	215	
400	20 to 80	127, 152.4	230	
450	20 to 100	127, 152.4, 203	290	
500	25 to 160	152.4, 203, 305	290	
600	32 to 160	152.4, 203, 305	290	

Quality of grinding wheels for external cylindrical grinding



03



Ground material		Quality
Steels 	Universal Non-hardened steel Hardened up to 62 HRc Hardened over 62 HRc High-speed steels (HSS) Stainless steels	3LA70G5VL 22A60I12/2SVL, 114A46L/M8B 3LA70H16/2SVL , 23A60H16/2SVL 03B91N5VC100, 82A60F18/2SVL 03B91N5VC100, 82A60F18/2SVL, 47A46M8B 22A46G18/2SVL, 47A46J8B
Hard metals 	Tungsten carbides	01D126P4VC100, 10C60I6VL
Alloys 	Gray Nodular Steel	10C46I6VL, 41A46K6B 90C46I6VL, 41A46K6B 12A36J7VL
Non-ferrous metals 	Al and alloys Cu and alloys	90C46G10/3SVWL, 54A60L5B 90C46G10/3SVWL, 22A30N6B,50C100F10B
Non-metals 	Plastic materials Rubber	90C46H14/2SVWL 90C46G16/2SVWL, 22A40J8B

Centerless external cylindrical grinding

Grinding wheel F1

D x T x H

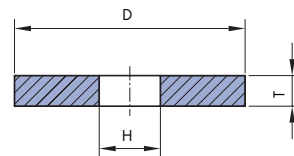
Flat grinding wheel



Order printout sample:

F1 300x50x127

11A54M5VL



D	T	H
250	to 150	51, 76, 100, 120
300	to 150	76, 127
350	to 150	76, 127, 151
400	to 150	127, 151, 203
450	to 150	127, 151, 203
500	to 150	203, 305
600	to 150	203, 305

Grinding wheel F5

D x T x H - P x F

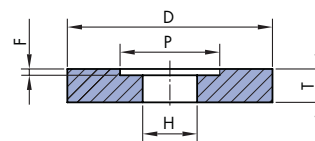
Flat, recessed on one side



Order printout sample:

F5 300x50x127-200x20

40A46K6VL



D	T	H	P	F
250	to 150	51, 76	130	F = max. T/2
300	to 150	76, 127	190	
350	to 150	76, 127	215	
400	to 150	127, 151, 203	230	
450	to 150	127, 151, 203	290	
500	to 150	203, 305	290	
600	to 150	203, 305	290	

Grinding wheel F7

D x T x H - P x F / G

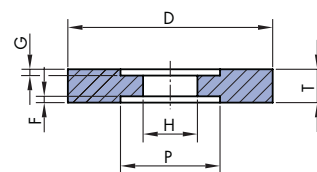
Flat, recessed on both sides



Order printout sample:

F7 300x50x127-100x15/10

22A46L6VL

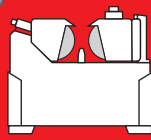


D	T	H	P	F, G
250	to 150	51, 76	130	F+G = max. T/2
300	to 150	76, 127	190	
350	to 150	76, 127, 151	215	
400	to 150	127, 151, 203	230	
450	to 150	127, 151, 203	290	
500	to 150	203, 305	290	

Quality of grinding wheels for centerless external cylindrical grinding



04



Ground material		Quality
Steels 	Non-hardened steel Hardened up to 62 HRc Hardened over 62 HRc High-speed steels (HSS) Stainless steel	15A60M6B, 11A54M5VL, 11A100L7VL 47A60N6B, 22A46L6VL, 47A60N6B, 40A46K6VL, 22A100L7VL 47A60N6B, 82A46K6VL, 82A100K7VL 22A46K8VL, 22A100K8VL
Alloys 	Gray Nodular Steel	417A46M6B, 12A46M6VL, 12C100K7VL 417A46M6B, 41A46L6VL, 41A120K7VL 22A46L6VL
Non-metals 	Plastic materials Ferrites	90C60K7B, 90C46K7VL, 90C100J8VL 90C60K7VL, 90C100J8VL
Control wheels		A80T35B, 15A100R5B



Grinding of gears and threads

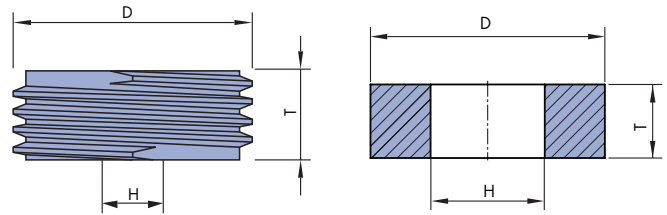
Grinding wheel REISHAUER and F1

$D \times T \times H - M$

Grinding wheel for
grinding gears and threads



Order printout sample:
REISH 350x80x160 - M3
82A100F16/1VV50L



D	T	H
250	3.2 to 8	155
350	8 to 30	160, 230
400	8 to 80	160, 203
500	8 to 30	203, 254
350	62 to 104	160
400	84 to 104	160
450	62 to 104	203

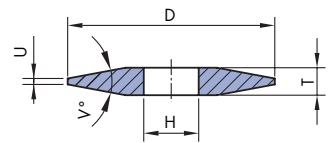
Grinding wheel NILES

$D \times T / U \times H \times V^\circ$

NILES grinding wheel for
grinding of threads



Order printout sample:
NILES 350x32/5x90x20°
21A100/3H16/1SV14L



D	T	U	H	V°
250	13	3	51	30,40
250	16	4	51	30,40
250	20	4	51	30,40
300	25	4	90, 127	30,40
350	32	5	90, 127	30,40

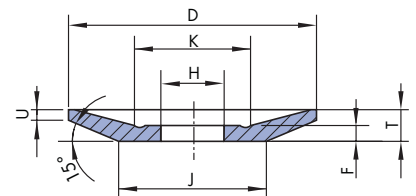
Grinding wheel MAAG

$D \times T / U \times H - W \times E \times K$

MAAG grinding wheel for
grinding gears

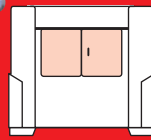


Order printout sample:
MAAG 220/120x18/2x40-6x16x140
23A54K6VL



D	J	T	U	H	W	E	K
220	120	18	2	40	6	16	140
220	120	18	3	40	6	16	140
220	120	18	4	40	6	16	140
220	120	18	6	40	6	16	140
280	120	25	4	40	8	18	140
280	120	25	8	40	10	18	140
340	120	25	4	40	8	18	140
340	120	25	8	40	10	18	140

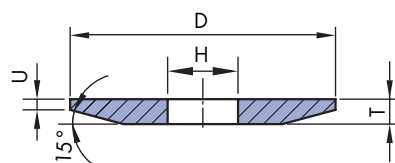
Products of other dimensions can be made to special order.



Grinding wheel KLINGELNBERG 1

$D / J \times T / U \times H$

KLINGELNBERG 1 grinding wheel
for grinding gears



Order printout sample:

KLI.-1 250/110x14/3x32

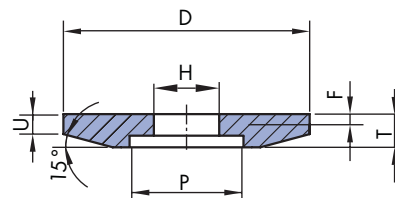
3LA60M7V13L

D	J	T	U	H
250	110	14	3	32

Grinding wheel KLINGELNBERG 2

$D / J \times T / U \times H - P \times F$

KLINGELNBERG 2 grinding wheel
for grinding of threads



Order printout sample:

KLI.-1 250/110x17/5x32-100x3

3LA60M7V13L

D	J	T	U	H	P	F
250	110	17	5	32	100	3
250	110	22	8	32	100	8



Crankshaft and camshaft grinding

Grinding wheel F1

D x T x H

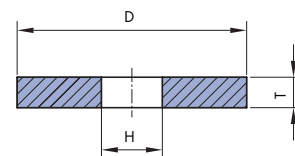
Flat grinding wheel



Order printout sample:

F1 300x30x127

12A46K7VL

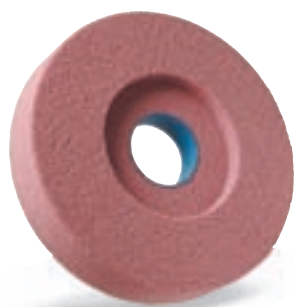


D	T	H
250	10 to 32	20, 25, 32, 40, 51, 76
300	13 to 50	32, 40, 51, 76, 127
350	16 to 50	32, 40, 51, 76, 127, 151
400	20 to 80	40, 51, 76, 127, 152.4, 203
450	20 to 80	76, 127, 152.4, 203
500	25 to 100	76, 127, 152.4, 203
600	32 to 100	152.4, 203, 305

Grinding wheel F5

D x T x H - P x F

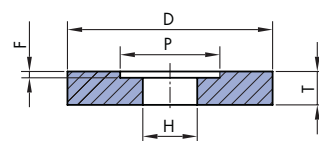
Flat, recessed on one side



Order printout sample:

F5 300x50x127-200x20

48A80I18VL



D	T	H	P	F
250	10 to 32	51, 76	130	F = max. T/2
300	13 to 50	76, 127	190	
350	16 to 50	76, 127	215	
400	20 to 80	127, 152.4	230	
450	20 to 80	127, 152.4	290	
500	25 to 100	127, 152.4	290	
600	32 to 100	127, 152.4, 305	290	

Grinding wheel F7

D x T x H - P x F / G

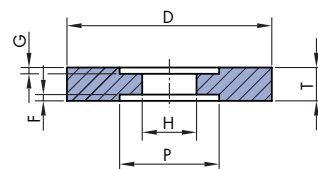
Flat, recessed on both sides



Order printout sample:

F7 300x50x127-100x15/10

3SA46K7VL







D	T	H	P	F, G
250	10 to 32	51, 76	130	F+G = max. T/2
300	13 to 50	76, 127	190	
350	16 to 50	76, 127	215	
400	20 to 80	127, 152.4	230	
450	20 to 80	127, 152.4	290	
500	25 to 100	127, 152.4	290	
600	32 to 100	127, 152.4, 305	290	

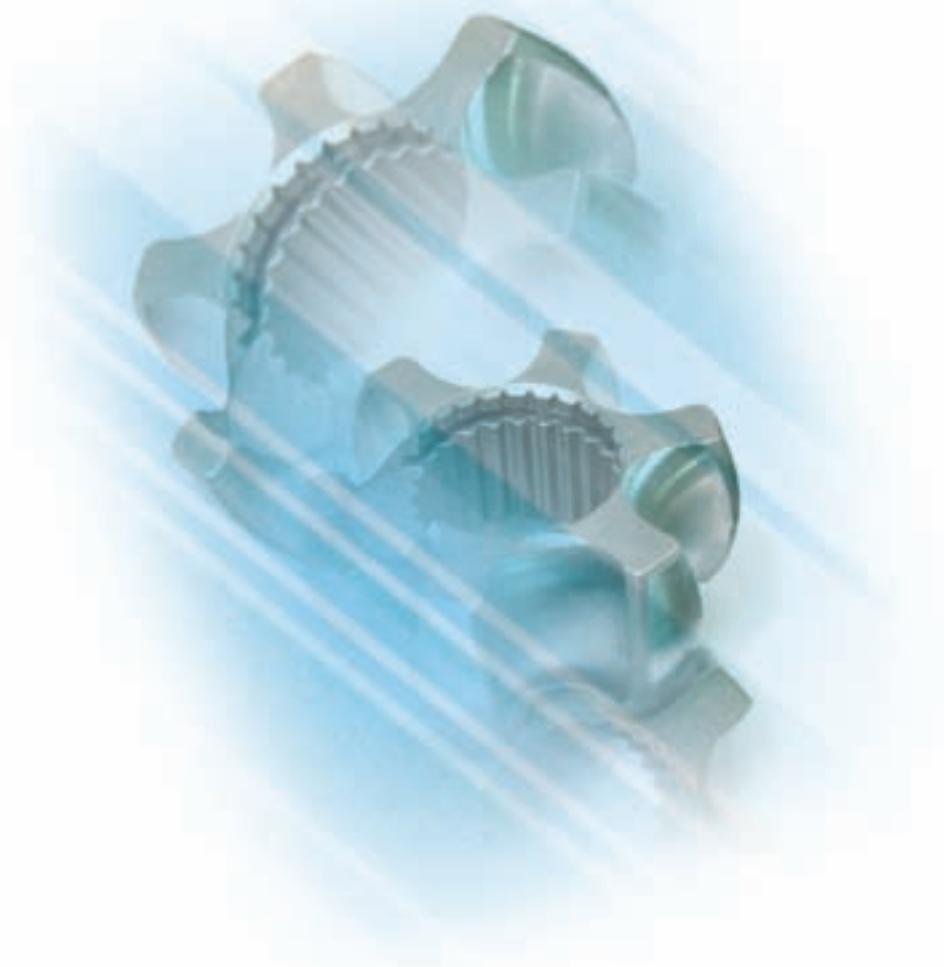
Quality of grinding wheels for crankshaft and camshaft grinding



06



Ground material		Quality
Camshafts - Cam grinding		
Steel alloy 	Rough grinding Finishing	22A46/3K7VL, 12A46K7VL, 4L8A80I6VW50L, 48A80H12/2SVL
Steel 	Rough grinding Finishing	22A46/3K7VL, 12A46K7VL, 4L8A80I6VW50L, 48A80I8VL
Camshafts - Bearing grinding		
Steel alloy 	Rough grinding Finishing	22A46/3K7VL, 12A46J7VL 3LA70G5VL, 48A80H12/2SVL
Steel 	Rough grinding Finishing	22A46K7VL, 12A46J7VL 3LA70G5VL, 48A80H12/2SVL
Crankshafts	Rough grinding Finishing	3SA46K7VL, 22A46K7VL 3SA80J8VL, 48A80J8VL



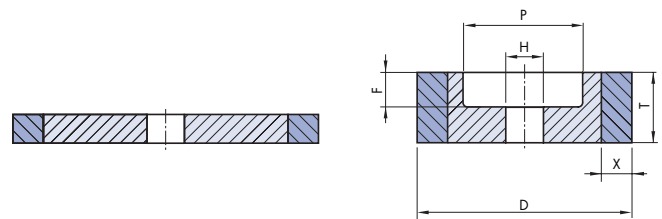
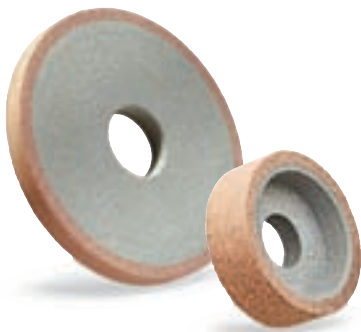


Internal cylindrical grinding with superabrasives

1A1

D x T x X x H

Flat grinding wheel*



Order printout sample:

1A1 100x15x3x20

02B126P4VC100

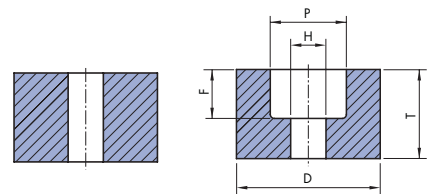
D	T	H	X	P	F
25	6-20		3		F = max. T/2
32	6-20		3		
40	6-20	by	3.5	by	
100	6-20	agreement	3.5	agreement	

*abrasive ceramic core

1A8

D x T x H - P x F

Grinding roll



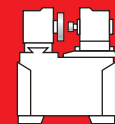
D	T	H	P	F
6	4-15	3		F = max. T/2
8	2-15	3 (4)		
10	4-16	3 (4)	by	
13	4-16	4 (6)	agreement	
16	4-16	4 (6,8)		
18	4-16	4 (6)		
20	4-20	6 (8,10)		

Order printout sample:

1A8 16x16x4 - 6x8

01D107P4VC125

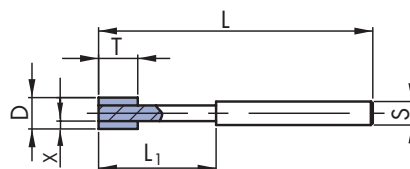
Products of other dimensions can be made to special order.



1A8W

D x T x X x S x L

Grinding tool - mounted point

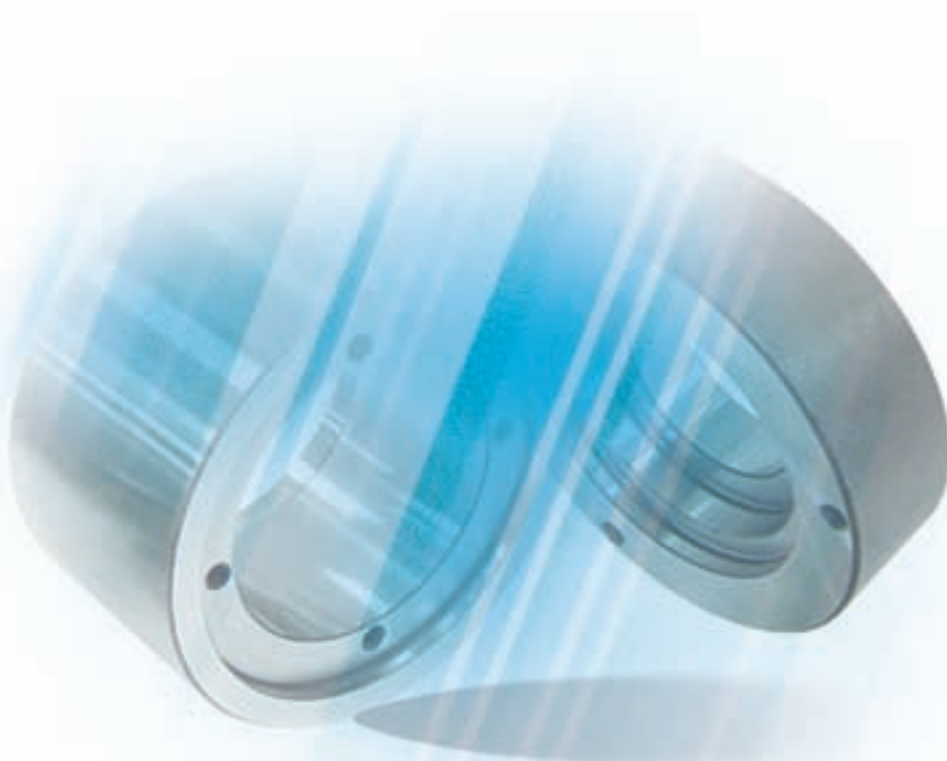


Order printout sample:

1A8 16x10x4x8x70

01D107P4VC125

D	T	X	S	L	L1
6	6	3	6	70	20
8	8-10	3(4)	6	70	20
10	8-10	3(4)	6	70	
13	8-10	4(6)	6	70	
16	8-15	4(6)	(6) 8	70	
18	8-15	4(6)	(6) 8	70	
20	8-15	6(8)	(6) 8	70	



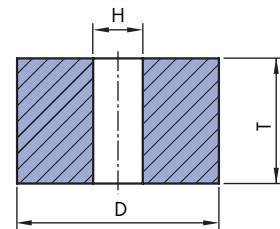


Internal cylindrical grinding

Grinding tool NB F1

D x T x H

Flat grinding tools
for internal grinding



Order printout sample:

NB F1 20x20x8

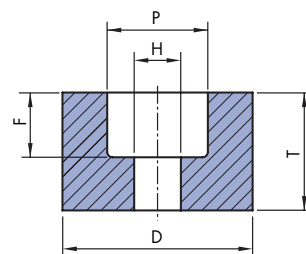
3LA80I8VL

D	T	H
6	6, 10, 13	2, 5, 3
8	8, 10, 16	2, 5, 3
10	6, 10, 13, 20	3, 4
13	6, 13, 20	3, 6
16	6, 10, 16	6
20	13, 20, 25, 32	6, 8
25	13, 20, 25, 32, 40	6, 8, 10
32	13, 20, 25, 32, 40	6, 8, 10, 13
40	13, 20, 25, 32, 40	6, 10, 13, 16
50	13, 20, 25, 32, 40	10, 13, 16, 20
63	13, 20, 25, 32, 40	13, 16, 20
80	13, 20, 25, 32, 40	16, 20, 25
100	16, 25, 32, 40, 50	16, 20, 25

Grinding tool NB F5

D x T x H - P x F

Grinding tools for internal grinding,
recessed on one side



Order printout sample:

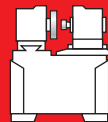
NB F5 40x25x10-25x12





3SA60J7VL

D	T	H	P	F, G
16	10, 16	6	10	F+G = max. T/2
20	13, 20	6, 8	13	
25	10, 16, 25	6, 8, 10	16	
32	16, 20, 25, 32	8, 10, 13	20	
40	20, 25, 32, 40	10, 13	25	
50	20, 25, 32, 40	16, 20	32	
63	25, 32, 40, 50	16, 20	32	
80	40, 50, 63	20, 25	40	
100	32, 40, 50	20, 25, 32	52	

Quality of grinding tools for internal cylindrical grinding

07



Ground material		Quality
Steel 	Universal	3LA80I8VL
	Non-hardened steel	22A60K7VL
	Hardened up to 62 HRc	40A60I8VL
	Hardened over 62 HRc	03B91P4VC125, 3LA80I8VL, 3SA60J7VL
	High-speed steels (HSS)	03B91P4VC125, 62A60I8VL, 10C80H7VL
	Stainless steel	22A60I8VL
	For bearings	82A80K6V80L, 82A120K6V80L, 5LA150/5L6V63WL, 5LA180/5L6V63WL
Hard metals 	Tungsten carbides	01D91P4VC100, 10C80H7VL
Non-ferrous metals 	Al and alloys	90C60H7VWL, 90C80H7VWL
	Cu and alloys	90C60H7VWL, 90C80H7VWL
Non-metals 	Plastic materials	90C60H8VWL





Grinding and tool sharpening

Grinding wheel F1

D x T x H

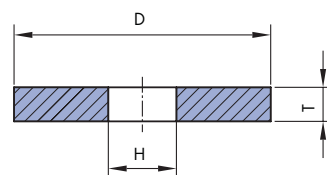
Flat grinding wheel



Order printout sample:

F1 250x13x32

22A60K7VL

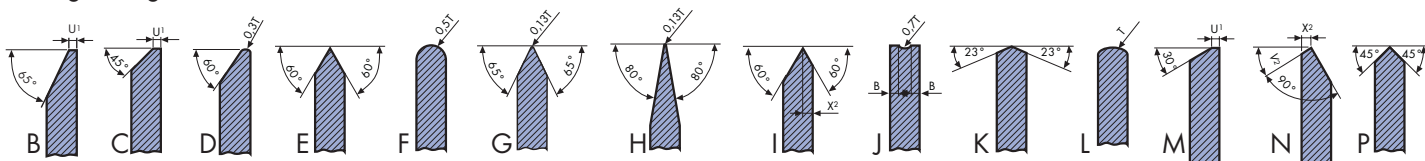


D	T	H
80	0.8 to 13	10, 13
100	1 to 20	13, 20
125	1 to 20	20
150	1 to 20	20, 32
175	1.5 to 20	20, 32
200	1.5 to 20	20, 32
250	2 to 20	20, 32

Grinding wheel F1_

D x T x H

Saw grinding wheel



Order printout sample:

F1B 200x8x20

40A60M/22A60K5VL

D	T	H
100	1 to 4	10, 13, 20
125	1 to 5	16, 20
150	2 to 13	20
175	2 to 13	20
200	2 to 16	20, 32
225	2.5 to 16	20, 32
250	4 to 20	20, 32
300	6 to 25	32, 40

Grinding wheel F3

D / J x T / U x H

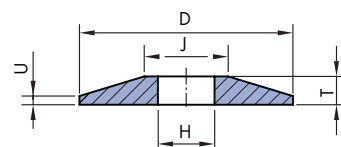
Grinding wheel tapered on one side



Order printout sample:

F3 100/50x6/1.5x20

3SA60/3M6VL



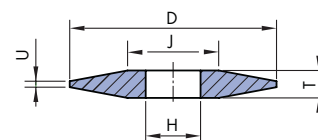
D	J	T	U	H
80	40	5	1	13
100	50	6	1.5	20
125	63	8	2	20, 32
150	75	8	2	20, 32
175	85	10	3	20, 32
200	100	13	3	20, 32
250	125	14	3	32



Grinding wheel F4

$D / J \times T / U \times H$

Grinding wheel tapered on both sides



Order printout sample:

F4 100/50x10/2x20

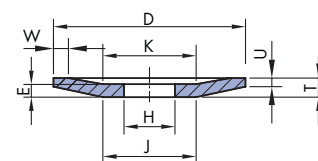
40A60M7VL

D	J	T	U	H
80	40	8	2	13
100	50	10	2	20
125	63	10	2	20, 32
150	75	13	2	20, 32
175	85	13	3	20, 32
200	100	16	3	20, 32
250	125	20	4	32

Grinding wheel F12

$D / J \times T / U \times H - W \times E \times K$

Dish-shaped grinding wheel



Order printout sample:

F12 80/31x10/2,5x13-4x6x31

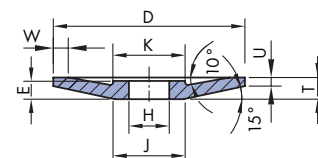
22A46/3M7VL

D	J	T	U	H	W	E	K
50	25	10	2	13	4	6	25
80	31	10	2.5	13	4	6	31
100	36	13	3.2	20	5	7	36
125	61	13	3.2	20	6	7	61
150	66	16	3.2	20	8	9	66
175	78	18	3.2	20	9	10	78
200	90	20	3.2	20, 32	10	10	90
250	140	22	4	32	12	12	140

Grinding wheel FB

$D \times T \times H - U \times J \times E$

Dish-shaped grinding wheel



Order printout sample:

FB 100x6x20-3x35x8

40A60M7VL

D	T	H	U	J=K	E
80	8	20	2	30	6
100	12	20	3	35	8
125	14	20	3	40	9
150	15	20	3	50	10
175	18	20	3	60	11
200	19	20, 32	3	70	12
250	21	32	3	100	13

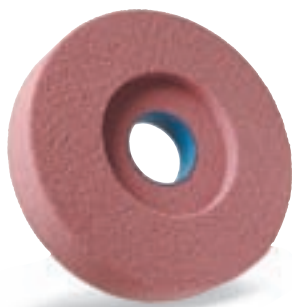


Grinding and tool sharpening

Grinding wheel F5

D x T x H - P x F

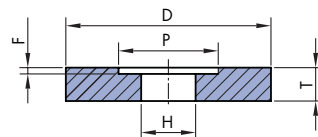
Flat, recessed on one side



Order printout sample:

F5 300x50x127-200x20

40A60M7VL



D	T	H	P	F, G
250	10 to 32	51, 76	130	F+G = max. T/2
300	13 to 50	76, 127	190	
350	16 to 50	76, 127	215	
400	20 to 80	127, 152.4	230	
450	20 to 80	127, 152.4	290	
500	25 to 100	127, 152.4	290	
600	32 to 100	127, 152.4	290	

Grinding cup F6

D x T x H - W x E

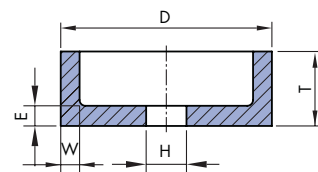
Cylindrical flat cup



Order printout sample:

F6 150x80x20-10x16

22A60K7VRL



D	T	H	W	E
50	32	13	5	8
80	40	20	6	10
100	50	20	8	10
125	63	20	8	13
150	80	20	10	16
175	100	32	15	20
200	100	32	20	25
250	100	76	20	25

Grinding cup F11

D / J x T x H - W x E x K

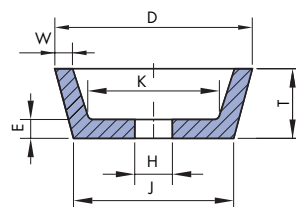
Cylindrical flaring cup



Order printout sample:

F11 150/114x45x20-10x13x96

3SA46K5VL



D	J	T	H	W	E	K
50	27	32	13	4	8	22
80	57	32	13	6	8	46
100	71	40	20	8	10	56
125	96	40	20	10	10	81
150	114	45	20	10	13	96
175	135	45	32	12.5	15	120
200	155	50	32	20	20	140
250	200	60	76	30	20	180



Quality of grinding wheels for grinding and tool sharpening

	Ground material	Manual grinding	Mechanical grinding	
Turning cutters 				
	Tool steel	22A60K7VL	22A60J8VL, 3SA60J8VL	
	High-speed steel (HSS)	40A60K7VL	62A60J8VL, 3SA60J8VL	
	Tungsten carbides	10C60K6VL	10C60K6VL	
Spiral drills 		Profiling	Sharpening	
	Tool steel	22A60M8VL,	22A100L8VL, 3LA120I6VL	
	High-speed steel (HSS)	82A60J6VL	22A100L8VL, 3LA120I6VL	
	Tungsten carbides	10C60J6VL	10C80J7VL,	
Cutters, drills 		Profiling	Sharpening	
	Tool steel	82A46/3J6VL, 82A100I8VL	22A46/1H9/0VL, 22A46H10/0VL	
	High-speed steel (HSS)	82A46/3J6VL, 82A100I8VL	22A46/1H9/0VL, 22A46H10/0VL	
	Tungsten carbides	10C60K6VL	10C60J7VL	
Pull and push broaches	High-speed steel (HSS)	02B64P4VC150, 03B46P3VC125, 3SA70/3K5VL		
Planing knives		Profiling	Sharpening	
	Wood working	22A30/1J7VL, 42A46G8B	22A80I12/2SVL, 42A60G8B	
	Printing works	22A30/1J7VL, 42A46G8B	22A80I12/2SVL, 42A60G8B	
Saw sharpening   		Profiling	Sharpening	Grinding of tooth flank
	Circular saws (HSS) - tool steel	11A60/3L7VL, 22A46/3M6VL, 3SA46/2K5V12R2L, 40A60N/22A60L5VL	3SA60/3M6VL 40A46/3M6VL	40A60M7VRL 22A60K7VRL
	Circular saws (Stellite)	11A60/3M7VL	22A60/3L7V13L	40A60M7VRL, 22A60K7VRL
	Band saws (HSS)	3SA60/3N5VL , 22A46/3M5VL,	3SA60/3N5VL , 22A46/3M5VL,	
	Band saws (Stellite)	40A46M/22A46K5VL	22A60/3K7V13RL	40A60M7VRL , 22A60K7VRL
	Chain saws (HSS)	40A60M6VL		
	Band-block saw (HSS)	3SA46/3O5VL , 22A46/3N5VRL	3SA60/3O5VRL , 22A46/3N5VRL	40A60M7VRL , 22A60K7VRL

Note:

Use finer and harder grinding wheels for sharpening narrow band saws and fine-toothed circular saws!



Manual grinding on stationary grinding machines

Grinding wheel F1

D x T x H

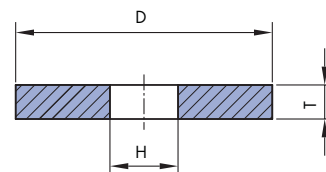
Flat grinding wheel



Order printout sample:

F1 300x30x127

10C60K6VL



D	T	H
125	10 to 25	22.7, 16, 20
150	10 to 25	16, 20, 25, 32
175	10 to 25	20, 25, 32
200	10 to 25	20, 25, 32, 40
250	10 to 32	20, 25, 32, 40, 51, 76
300	13 to 50	32, 40, 51, 76, 127
350	16 to 50	32, 40, 51, 76, 127, 151
400	20 to 80	40, 51, 76, 127, 152.4, 203
450	20 to 80	76, 127, 152.4, 203
500	25 to 100	76, 127, 152.4, 203
600	32 to 100	127, 152.4, 203, 305

Grinding wheel F5

D x T x H - P x F

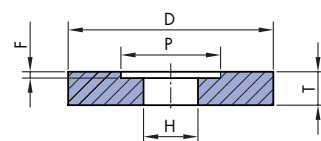
Flat, recessed on one side



Order printout sample:

F5 300x50x127-190x20

23A60M7VL



D	T	H	P	F
200	10 to 25	20, 25, 32	110	F = max. T/2
250	10 to 32	51, 76	130	
300	13 to 50	76, 127	190	
350	16 to 50	76, 127	215	
400	20 to 80	127, 152.4	230	
450	20 to 80	127, 152.4	290	
500	25 to 100	127, 152.4	290	
600	32 to 100	127, 152.4	290	

Grinding wheel F7

D x T x H - P x F / G

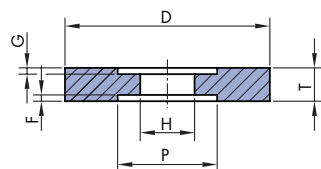
Flat, recessed on both sides



Order printout sample:

F7 300x50x127-190x15/10

10C60K6VL

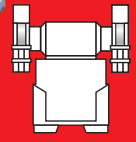








D	T	H	P	F, G
200	20 to 40	20, 25, 32	110	F+G = max. T/2
250	10 to 32	51, 76	130	
300	13 to 50	76, 127	190	
350	16 to 50	76, 127	215	
400	20 to 80	127, 152.4	230	
450	20 to 80	127, 152.4	290	
500	25 to 100	127, 152.4	290	
600	32 to 100	127, 152.4	290	

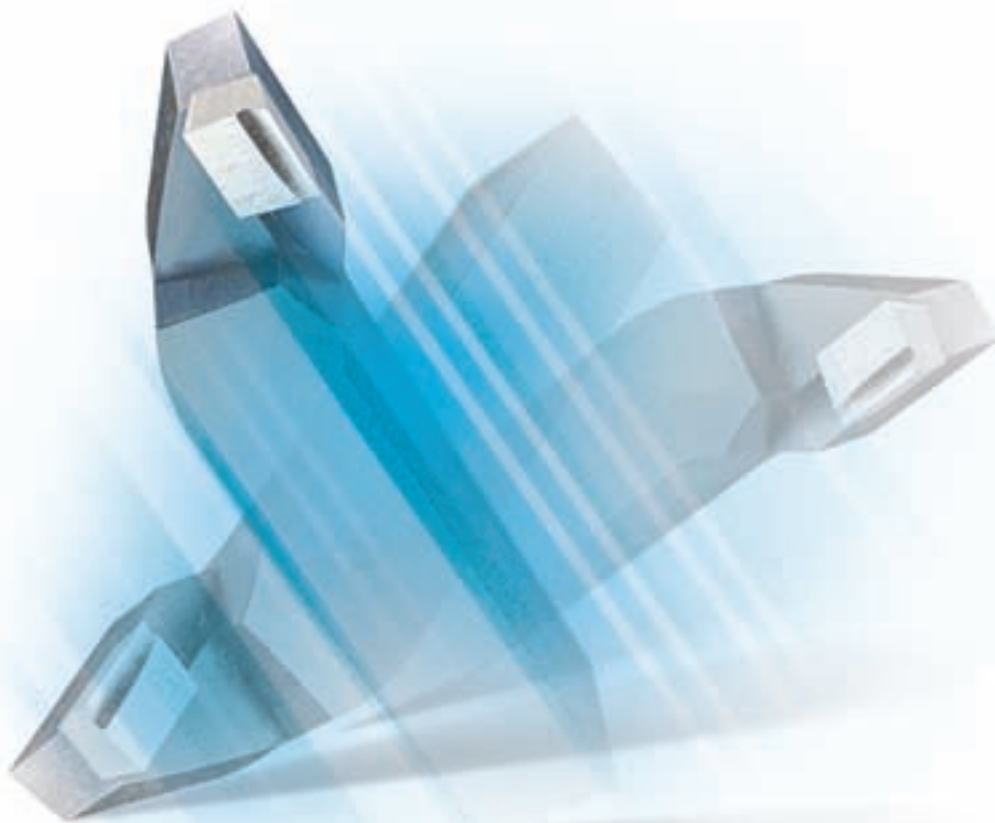
Quality of grinding wheels for manual grinding



09

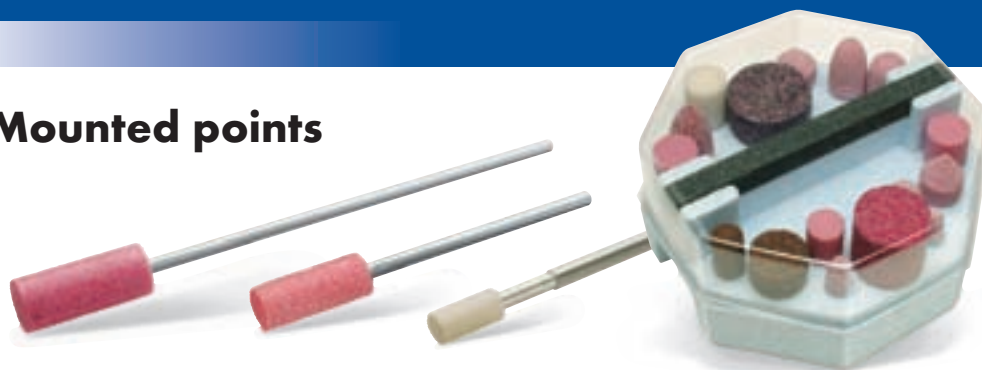


Ground material		Quality	
Steels 		Coarse grinding	Finishing
	Non-alloyed	11A36P5VL	11A60M6VL
	Alloyed	22A46M5VL	22A60K6VL
	High-alloyed	40A60M7VL	40A60K6VL
Hard metals 	Tungsten carbides	10C60K6VL, 11A30P7VL	10C80K6VL
Alloys 	Gray Steel Nodular	90C46M6VL, 12A24P4VL 12A36M5VL 41A36L5VL	
Non-ferrous metals 	Al and alloys Cu and alloys	90C46K7VL 90C46K7VL	
Non-metals  	Plastic materials Ceramics	90C46J8VL 90C46J8VL	





Mounted points



ORDER PRINTOUT
SAMPLE:

OA







Point type

40A46P4VWL

Quality

25 x 12 x 6

Diameter Height Pin
 diameter

Ground material		40A			22A				3LA			41A				64A	10C	90C
		K	O	P	K	M-W	N-W	P	M	N	O	L	M	N	P	K	F-W	P
Steels 	Universal			••	••						•••							
	Non-alloyed			••						•••					•••			
	Tool	••	••						•••									
	HSS				••				•••									
	Stainless				•••				••			••						
Hard metals 	Carbides																••	
	Stellite												•••					
Alloys 	Steel												•••					
	Alloyed											••			••	•••		
	Gray								••					•••		••		•••
	Nodular											•••						•••
Non-ferrous 	Aluminium					•••	••	••									•••	
	Copper																••	
	Bronze																••	
Other  	Plastic				••												•••	••
	Rubber				••												•••	••

••• Most suitable •• Satisfactory

SELECTION OF GRIT SIZE
DEPENDING ON POINT DIAMETER:

Dimensions D (mm)	Grit size	
	Coarse	Fine
up to 3,9	/	100
from 4 to 7.9	60	100
from 8 to 13.9	46	80
from 14 to 29.9	36	60
over 30	24	36

Mounted points

10



Mounted points OA and W

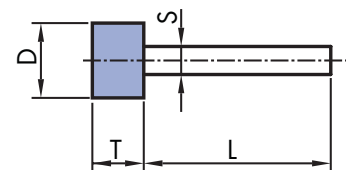
D x T x S x L

Mounted point cylindrical

Order printout sample:

OA 13x13x6

40A46P4VL



Designation	DIN EN 68	D	T	S	L
OA 3x3x3	W 143	3	3	3	35
OA 4x2x3	W 148	4	3	3	35
OA 5x3x3	W 151	5	3	3	35
OA 6x3x3	W 158	6	3	3	35
OA 6x5x3	W 159	6	5	3	35
OA 6x6x3	W 160	6	6	3	35
OA 8x3x3	W 166	8	3	3	35
OA 8x6x3	W 167	8	6	3	35
OA 8x8x3	W 168	8	8	3	35
OA 10x3x3	W 173	10	3	3	35
OA 10x6x3	W 174	10	6	3	35
OA 10x10x3	W 175	10	10	3	35
OA 13x3x3	W 182	13	3	3	35
OA 13x6x3	W 183	13	6	3	35
OA 13x10x3	W 184	13	10	3	35
OA 13x13x3	W 185	13	13	3	35
OA 16x3x3	W 191	16	3	3	35
OA 16x4x3		16	4	3	35
OA 16x6x3	W 192	16	6	3	35
OA 16x8x3		16	8	3	35
OA 16x10x3	W 193	16	10	3	35
OA 16x13x6	W 194	16	13	3	35
OA 16x16x6		16	16	3	35
OA 19x3x3	W 200	19	3	3	35
OA 19x6x3	W 201	19	6	3	35
OA 19x10x3	W 202	19	10	3	35
OA 20x4x3		20	4	3	35
OA 20x6x3		20	6	3	35
OA 20x10x3		20	10	3	35
OA 20x13x3		20	13	3	35
OA 20x20x3		20	20	3	35
OA 10x2x6		10	2	6	40
OA 10x2x6		10	2	6	40
OA 10x5x6		10	5	6	40
OA 10x10x6		10	10	6	40
OA 13x3x6	W 182	13	3	6	40
OA 13x6x6	W 183	13	6	6	40
OA 13x10x6	W 184	13	10	6	40
OA 13x13x6	W 185	13	13	6	40
OA 16x3x6	W 191	16	3	6	40
OA 16x4x6		16	4	6	40
OA 16x6x6	W 192	16	6	6	40
OA 16x8x6		16	8	6	40
OA 16x10x6	W 193	16	10	6	40
OA 16x13x6	W 194	16	13	6	40
OA 16x16x6		16	16	6	40
OA 19x3x6	W 200	19	3	6	40
OA 19x6x6	W 201	19	6	6	40
OA 19x10x6	W 202	19	10	6	40
OA 19x13x6	W 203	19	13	6	40
OA 19x19x6	W 204	19	19	6	40
OA 20x6x6		20	6	6	40
OA 20x8x6		20	8	6	40
OA 20x10x6		20	10	6	40
OA 20x13x6		20	13	6	40
OA 20x16x6		20	16	6	40
OA 20x20x6		20	20	6	40
OA 22x3x6	W 211	22	3	6	40

Designation	DIN EN 68	D	T	S	L
OA 22x6x6	W 212	22	6	6	40
OA 22x10x6	W 213	22	10	6	40
OA 24x6x6	W 214	24	6	6	40
OA 25x3x6	W 215	25	3	6	40
OA 25x4x6		25	4	6	40
OA 25x6x6	W 216	25	6	6	40
OA 25x10x6	W 217	25	10	6	40
OA 25x13x6	W 218	25	13	6	40
OA 25x16x6		25	16	6	40
OA 25x19x6	W 219	25	19	6	40
OA 25x25x6	W 220	25	25	6	40
OA 32x6x6	W 225	32	6	6	40
OA 32x8x6		32	8	6	40
OA 32x10x6	W 226	32	10	6	40
OA 32x13x6	W 227	32	13	6	40
OA 32x16x6		32	16	6	40
OA 32x20x6		32	20	6	40
OA 32x25x6	W 229	32	25	6	40
OA 32x32x6	W 230	32	32	6	40
OA 38x6x6	W 235	38	6	6	40
OA 38x13x6	W 236	38	13	6	40
OA 38x25x6	W 237	38	25	6	40
OA 38x38x6	W 238	38	38	6	40
OA 40x6x6		40	6	6	40
OA 40x10x6		40	10	6	40
OA 40x13x6		40	13	6	40
OA 40x16x6		40	16	6	40
OA 40x20x6		40	20	6	40
OA 40x25x6		40	25	6	40
OA 40x40x6		40	40	6	40
OA 50x8x6		50	8	6	40
OA 50x10x6		50	10	6	40
OA 50x13x6		50	13	6	40
OA 50x16x6		50	16	6	40
OA 50x20x6		50	20	6	40
OA 50x25x6		50	25	6	40
OA 50x40x6		50	40	6	40
OA 50x50x6		50	50	6	40
OA 20x20x8		20	20	8	40
OA 25x25x8		25	25	8	40
OA 32x25x8		32	25	8	40
OA 32x32x8		32	32	8	40
OA 40x20x8		40	20	8	40
OA 40x32x8		40	32	8	40
OA 40x40x8		40	40	8	40
OA 50x25x8		50	25	8	40
OA 50x40x8		50	40	8	40
OA 20x20x9		20	20	9	40
OA 25x25x9		25	20	9	40
OA 32x25x9		32	25	9	40
OA 32x32x9		32	32	9	40
OA 40x20x9		40	20	9	40
OA 40x32x9		40	32	9	40
OA 40x40x9		40	40	9	40
OA 50x25x9	W 242	50	25	9	40
OA 50x38x9	W 243	50	38	9	40
OA 51x51x9	W 244	51	51	9	40
OA 50x40x9		50	40	9	40

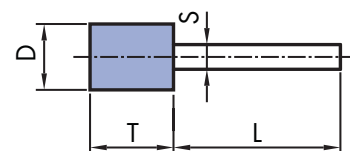


Mounted points

Mounted points OB and W

D x T x S x L

Mounted point cylindrical



Order printout sample:

OB 16x40x6

40A46P4VL

Designation	DIN EN 68	D	T	S	L
OB 3x6x3	W 144	3	6	3	35
OB 3x10x3	W 145	3	10	3	35
OB 3x13x3	W 146	3	13	3	35
OB 4x6x3	W 149	4	6	3	35
OB 4x8x3		4	8	3	35
OB 4x10x3		4	10	3	35
OB 5x6x3	W 150	5	6	3	35
OB 5x10x3	W 153	5	10	3	35
OB 5x13x3	W 154	5	13	3	35
OB 6x8x3	W 161	6	8	3	35
OB 6x10x3	W 162	6	10	3	35
OB 6x13x3	W 163	6	13	3	35
OB 6x16x3		6	16	3	35
OB 6x19x3	W 164	6	19	3	35
OB 8x10x3	W 169	8	10	3	35
OB 8x13x3	W 170	8	13	3	35
OB 8x16x3		8	16	3	35
OB 10x13x3	W 176	10	13	3	35
OB 10x16x3		10	16	3	35
OB 10x20x3	W 177	10	20	3	
OB 10x25x3	W 178	10	25	3	
OB 12x20x3		12	20	3	
OB 3x6x6		3	6	6	40
OB 4x8x6		4	8	6	40
OB 5x10x6		5	10	6	40
OB 6x10x6		6	10	6	40
OB 6x13x6		6	13	6	40
OB 6x20x6	W 164	6	20	6	40
OB 8x10x6		8	10	6	40
OB 8x13x6		8	13	6	40
OB 8x16x6		8	16	6	40
OB 8x19x6	W 171	8	19	6	40
OB 10x13x6		10	13	6	40
OB 10x19x6	W 177	10	19	6	40
OB 10x25x6	W 178	10	25	6	40
OB 10x32x6	W 179	10	32	6	40
OB 13x16x6		13	16	6	40
OB 13x19x6	W 186	13	19	6	40

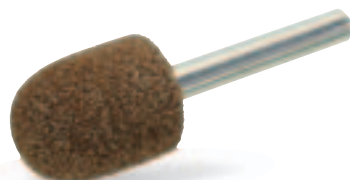
Designation	DIN EN 68	D	T	S	L
OB 13x25x6	W 181	13	25	6	40
OB 13x32x6		13	32	6	40
OB 13x40x6	W 188	13	40	6	40
OB 13x51x6	W 189	13	51	6	40
OB 16x19x6	W 195	16	19	6	40
OB 16x25x6	W 196	16	25	6	40
OB 16x32x6		16	32	6	40
OB 16x40x6		16	40	6	40
OB 16x50x6	W 197	16	50	6	40
OB 16x63x6	W 198	16	63	6	40
OB 19x19x6	W 205	19	25	6	40
OB 19x19x6	W 207	19	38	6	40
OB 19x19x6	W 208	19	51	6	40
OB 19x19x6	W 209	19	64	6	40
OB 20x25x6		20	25	6	40
OB 20x32x6		20	32	6	40
OB 20x40x6		20	40	6	40
OB 20x50x6		20	50	6	40
OB 22x50x6		22	50	6	40
OB 25x32x6		25	32	6	40
OB 25x38x6	W 221	25	38	6	40
OB 25x40x6		25	40	6	40
OB 25x50x6	W 222	25	50	6	40
OB 25x63x6	W 223	25	63	6	40
OB 32x40x6		32	40	6	40
OB 32x50x6		32	50	6	40
OB 20x25x 8		20	25	8	40
OB 25x32x8		25	32	8	40
OB 32x40x8	W 231	32	40	8	40
OB 32x50x8	W 232	32	50	8	40
OB 40x45x8		40	45	8	40
OB 20x25x6		20	25	9	40
OB 25x32x6		25	32	9	40
OB 32x40x6		32	40	9	40
OB 32x63x6	W 233	32	63	9	40
OB 32x50x6		32	50	9	40
OB 38x51x6	W 239	38	51	9	40
OB 40x45x6		40	45	9	40



Mounted points OC

D x T x S x L

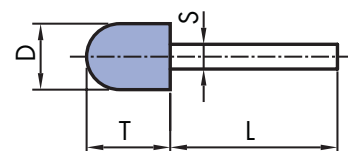
Mounted point cylindrical - circular



Order printout sample:

OC 16x20x6

11A60P4VL

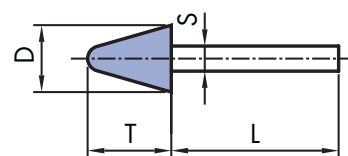


Designation	D	T	S	L
OC 3x6x3	3	6	3	35
OC 6x10x3	6	10	3	35
OC 8x16x3	8	16	3	35
OC 13x16x3	13	16	3	35
OC 3x6x6	3	6	6	40
OC 6x10x6	6	10	6	40
OC 8x16x6	8	16	6	40
OC 13x9x6	13	19	6	40
OC 16x20x6	16	20	6	40
OC 20x25x6	20	25	6	40

Mounted points OD

D x T x S x L

Mounted point conical - circular



Designation	D	T	S	L
OD 6x10x3	6	10	3	35
OD 10x10x3	10	10	3	35
OD 10x12x3	10	12	3	35
OD 6x10x6	6	10	6	40
OD 10x10x6	10	10	6	40
OD 10x12x6	10	12	6	40
OD 10x25x6	10	25	6	40
OD 12x16x6	12	16	6	40
OD 16x16x6	16	16	6	40
OD 16x32x6	16	32	6	40
OD 16x40x6	16	40	6	40
OD 20x20x6	20	20	6	40
OD 20x25x6	20	25	6	40
OD 20x32x6	20	32	6	40
OD 20x40x6	20	40	6	40
OD 25x25x6	25	25	6	40
OD 25x32x6	25	32	6	40
OD 25x70x6	25	70	6	40
OD 32x32x6	32	32	6	40
OD 32x50x6	32	50	6	40

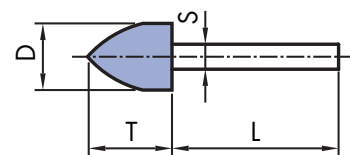
Order printout sample:

OD 16x32x6

3LA80MPVL



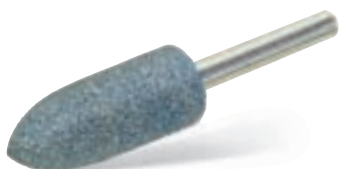
Mounted points



Mounted points OE

D x T x S x L

Mounted point rounded - pointed



Order printout sample:

OE 12x20x6

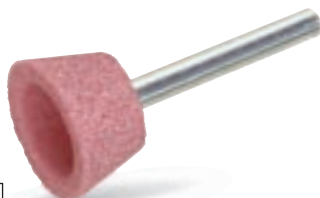
13A46P4VL

Designation	D	T	S	L
OE 3x6x3	3	6	3	35
OE 5x10x3	5	10	3	35
OE 6x10x3	6	10	3	35
OE 8x16x3	8	16	3	35
OE 10x20x3	10	20	3	35
OE 12x16x3	12	16	3	35
OE 12x20x3	12	20	3	35
OE 3x6x6	3	6	6	40
OE 6x10x6	6	10	6	40
OE 8x16x6	8	16	6	40
OE 10x20x6	10	20	6	40
OE 12x20x6	12	20	6	40
OE 16x32x6	16	32	6	40
OE 16x40x6	16	40	6	40
OE 20x32x6	20	32	6	40
OE 20x40x6	20	40	6	40
OE 20x50x6	20	50	6	40
OE 25x40x6	25	40	6	40

Mounted points OF

D x T x S x L

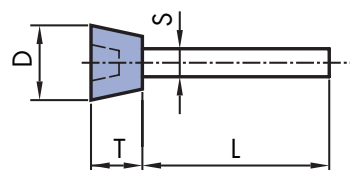
Mounted point cup shaped - flaring



Order printout sample:

OF 32x25x6

40A46P4VL



Designation	D	T	S	L
OF 20x16x6	20	16	6	40
OF 25x16x6	25	16	6	40
OF 25x20x6	25	20	6	40
OF 32x25x6	32	25	6	40
OF 40x32x6	40	32	6	40

Mounted points OG

D x T x S x L

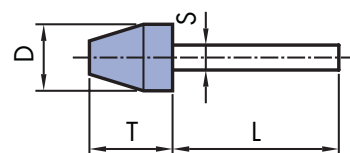
Mounted point conical



Order printout sample:

OG 16x40x6

40A46P4VL



Designation	D	T	S	L
OG 08x25x6	8	25	6	40
OG 10x20x6	10	20	6	40
OG 13x20x6	13	20	6	40
OG 13x32x6	13	32	6	40
OG 16x40x6	16	40	6	40
OG 20x25x6	20	25	6	40
OG 20x32x6	20	32	6	40
OG 25x32x6	25	32	6	40
OG 25x70x6	25	70	6	40
OG 32x40x6	32	40	6	40

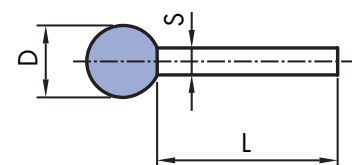
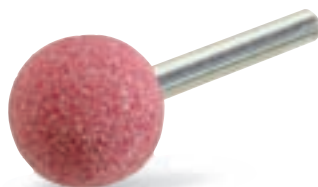
Products of other dimensions can be made to special order.



Mounted points OH

D x S x L

Mounted point ball



Designation	D	S	L
OH 3x3	3	3	35
OH 6x3	6	3	35
OH 8x3	8	3	35
OH 10x3	10	3	35
OH 12x3	12	3	35
OH 3x6	3	6	40
OH 6x6	6	6	40
OH 8x6	8	6	40
OH 10x6	10	6	40
OH 13x6	13	6	40
OH 16x6	16	6	40
OH 20x6	20	6	40
OH 25x6	25	6	40
OH 32x6	32	6	40
OH 40x6	40	6	40
OH 32x9	32	9	40
OH 40x9	40	9	40
OH 50x9	50	9	40

Order printout sample:

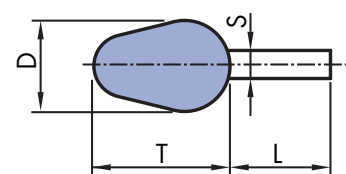
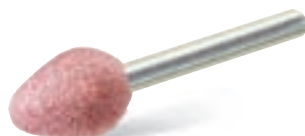
OH 13x6

40A60P4VL

Mounted points OI

D x T x S x L

Mounted point drop



Order printout sample:

OI 20x25x6

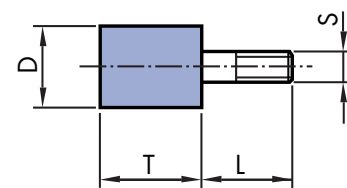
40A46P4VL

Designation	D	T	S	L
OI 20x25x6	20	25	6	40

Mounted points OJ

D x T x S x L

Mounted point with threaded pin



Order printout sample:

OJ 20x25xM6x10

41A46P4VL

Designation	D	T	S	L
OJ 9.5x10xM5x12	9.5	10	M5	12
OJ 10.5x13xM4x12	10.5	13	M4	12
OJ 13x13xM4	13	13	M4	14

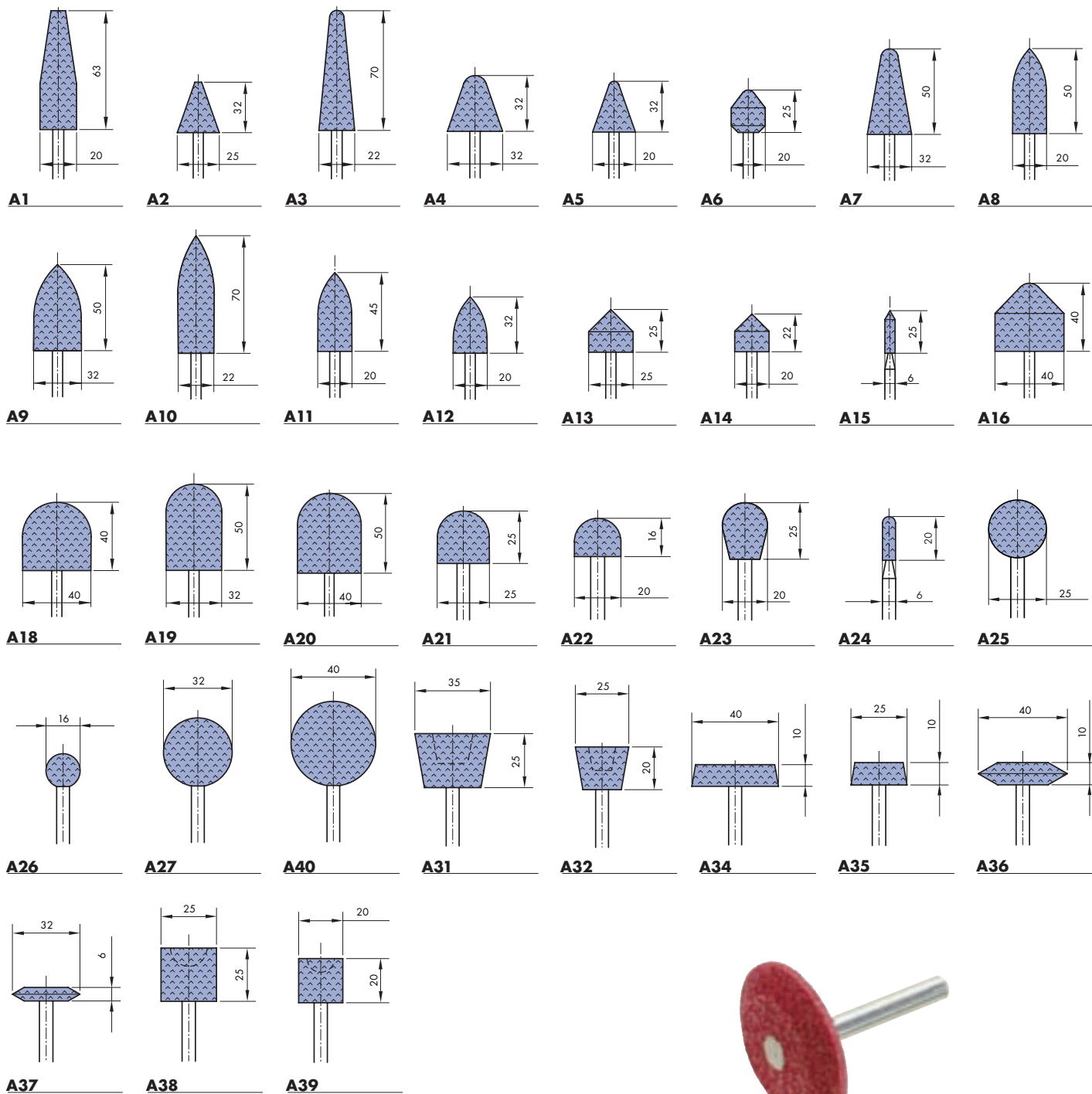


Mounted points



GROUP A ISO 2933

pin diameter 6 mm



Order printout sample:

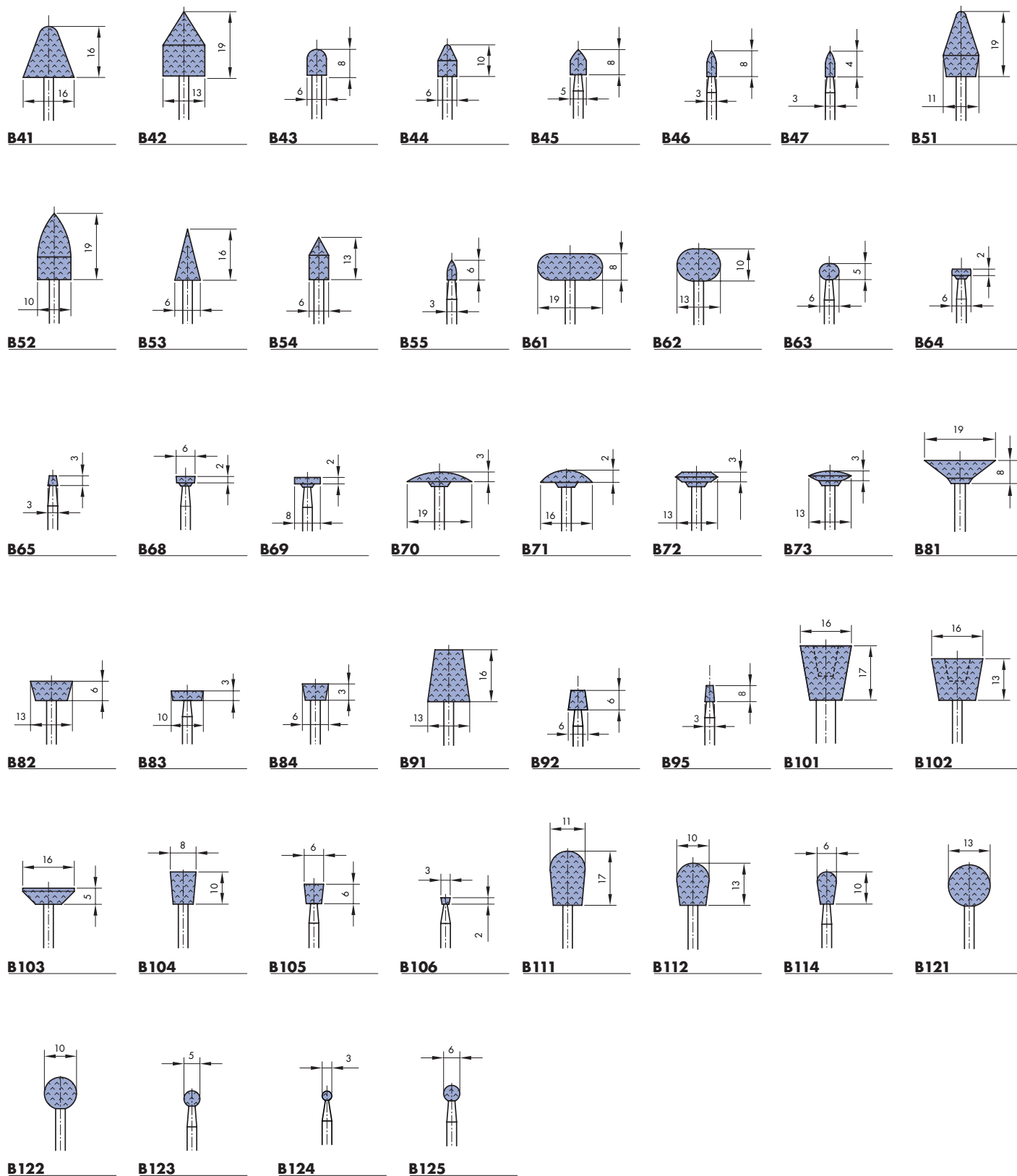
A20

40A46P4VL



Group B ISO 2933

pin diameter 3 mm





Files

PPR

A x C x L

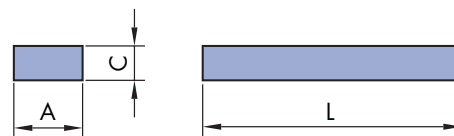
Rectangular file



Order printout sample:

PPR 20x10x200

22A150P4V11L



A	C	L
6	3	100
10	5	100
12	6	150
15	7.5	150
20	10	200
40	20	125
50	25	150
50	25	175
50	25	200
50	25	250

PKB

A x C x L

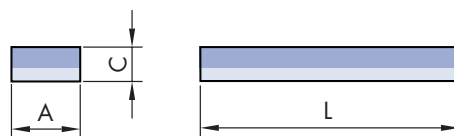
Combined file (bi-layered)



Order printout sample:

PKB 50x25x200

40A120/22A320-L



A	C	L
25	20	100
40	20	125
50	25	150
50	25	175
50	25	200
50	25	250

PKV

A x L

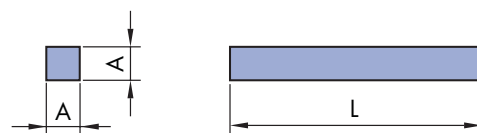
Rectangular file



Order printout sample:

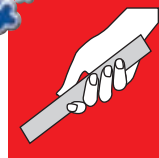
PKV 13x150

10C180N5V16L



A	L
6	100
8	100
10	100
10	150
15	100
15	150
20	200
25	200

Products of other dimensions can be made to special order.



PTR

A x L

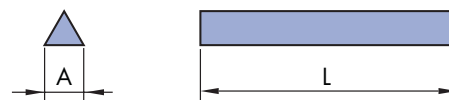
Triangular file



Order printout sample:

PTR 10x150

40A120P4V11L



A	L
6	100
8	100
10	100
10	150
15	100
15	150
20	200

POK

D x L

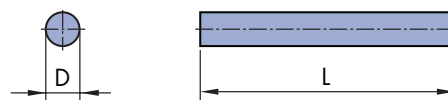
Circular file



Order printout sample:

POK 15x150

40A180P4V11L



D	L
6	100
8	100
10	100
10	150
15	100
15	150
20	200

PPO

D x L

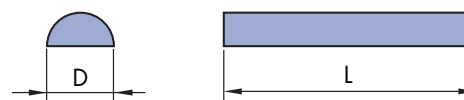
Semi-circular file



Order printout sample:

PPO 15x150

10C180P4V11L



D	L
6	100
8	100
10	100
10	150
15	100
15	150
20	200



Files

PDL

A x C / D x L

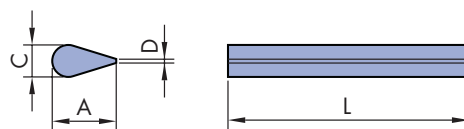
Chisel-shaped file



Order printout sample:

PDL 45x10/2x120

10C180P4V11L



A	C	D	L
25	6	1	100
25	6	1	150
45	10	0	100
45	10	3	100
45	10	2	120

PNO

A x C x L

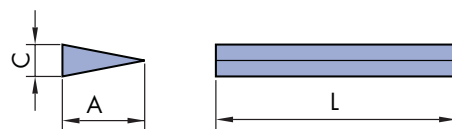
Blade shaped file



Order printout sample:

PNO 45x10x100

10C180P4V11L

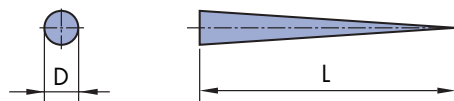


A	C	L
25	3	100
25	6	100
45	10	100

PŠI

D x L

Pointed file



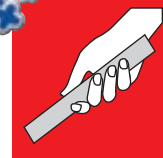
Order printout sample:

PŠI 10x75

10C120P4VL

D	L
8	60
10	75
12	75

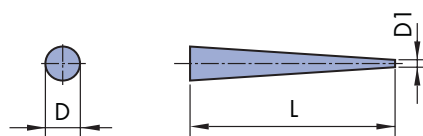
Products of other dimensions can be made to special order.



PKO

D x D1 x L

Conical file



Order printout sample:

PKO 12/4x75

10C240P4V11L

D	D1	L
10	4	75
12	5	75

PRO

B x C x L

Rhomboidal file



Order printout sample:

PRO 20x10x150

10C240N5VL

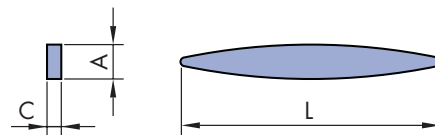
B	C	L
20	10	150
15	6	150
14	5	150



Files

PBK

A x C x L
Scythe file



Order printout sample:

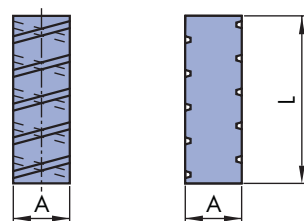
PBK 35x13x230

10C180-L

A	C	L
35	13	230

PKV-F

A x L
Quadratic grooved file



Order printout sample:

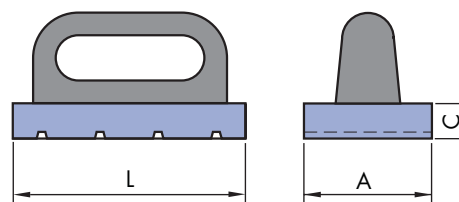
PKV-F 50x150

90C20P4VL

A	L
50	150

PPR-G

A x C x L
Square grooved file with handle



Order printout sample:

PPR-G 80x25x150



90C20P4VL

A	C	L
80	25	150

Filetype	Quality
PBK Scythe file	10C180-L, 90C180-L, 11A180-L, 21A180-L, 22A180-L
PKV-F	90C20P4VL
PPR-G	90C30P4VL

Products of other dimensions can be made to special order.



Applications	Quality		
	Coarse	Medium	Fine
For Steel 	22A120P4VL 40A120P4VL 10C120P4VL	22A240P4VL 40A240P4VL 10C240P4VL	22A400P4VL 40A400P4VL 10C400P4VL
Dressing of grinding wheels 	90C16P4VL, 90C24P4VL 90C30P4VL 90C36P4VL	90C60P4VL 90C80P4VL	90C120N5VL
For opening diamond tool PKB structure - Bilayered files	22A100H8V11L	22A180G9/0VL 22A220H8V11L	22A320H8V16L
	90C120/10C320-L W* 10C120/10C320-L	10C150/10C320-L W* 90C150/10C320-L	10C240/10C500-L W*
	21A120/22A320-L 40A120/22A320-L	22A150/40A320-L	40A240/22A400-L

W* Optional additional impregnation



Honing tools

Type A

A x L

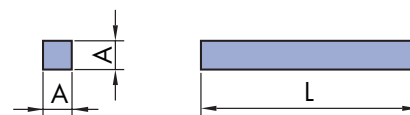
Quadratic honing tool



Order printout sample:

HON A 10x125

10C6017VL



A	L
4	50
5	63
6	80
8	100
10	125
13	150
15	150
20	200
25	200

Type B

A x B x L

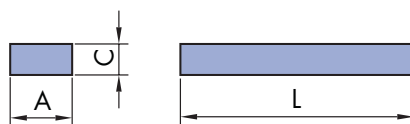
Square honing tool



Order printout sample:







HON B 10x8x100

10C6017VL



A	C	L
4	3	40
6	4	50
6	5	63
8	6	80
10	8	100
13	10	125
15	13	150



Ground material		Quality
Cylinders in automotive industry		
	Pre-grinding	90C24M4VW16L , 90C60I7VL, 10C60I7VL
	Finishing	90C320I7VL, 10C320I7VL
Pneumatic cylinders: pre-grinding		
	Non-hardened steel	12A80J7VL
	Hardened steel	22A80J7VL, 40A80J7VL
	Gray alloy	90C60J7VL, 10C60J7VL
Pneumatic cylinders: finishing		
	Non-hardened steel	12A320H8VL, 22A320H8VL
	Hardened steel	22A320H8VL, 40A320H8VL
	Gray alloy	90C320H8VL, 10C320H8VL



PRODUCT RANGE

RESIN BONDED WHEELS
with SiC and Al-oxide



FLEXIBLE ABRASIVES
from paper, cloth and
non woven materials



METAL BONDED
diamond cutting-off
tools



VITRIFIED BONDED GRINDING
TOOLS with silicon carbide,
Al-oxide and superabrasives



INDUSTRIAL CLOTH



MAGNESITE AND SYNTETIC
BONDED GRINDING WHEELS
with SiC and Al-oxide



DIAMOND DRESSING TOOLS



RESIN BONDED
diamond and CBN
grinding tools



REFRACTORY PRODUCTS





C O M E T
 Umetni brusi in nekovine, d.d.
 Tovarniška 5, 3214 Zreče, Slovenia
<http://www.comet.si> E-mail: comet@comet.si
 Tel.: +386 (0)3 7575 000
 Fax: +386 (0)3 7575 100

www.comet.si