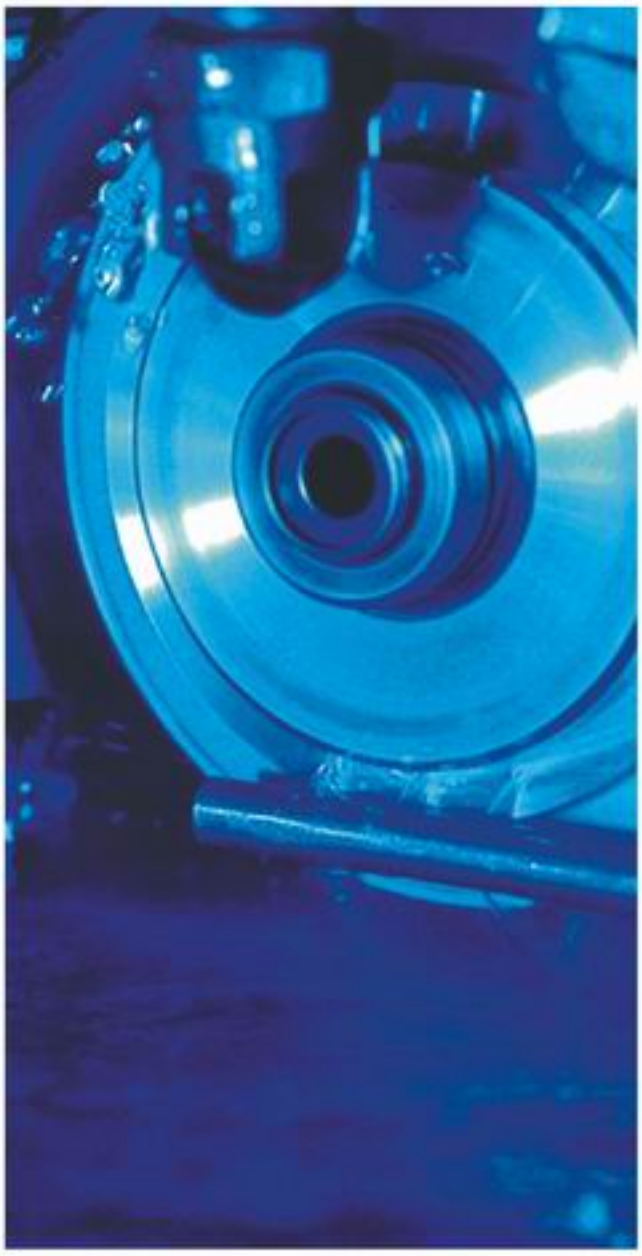
Diamond & CBN Wheels

TAIWAN DIAMOND INDUSTRIAL CO., LTD.

Grinding



Taiwan Diamond Industrial Co., Ltd. has been chasing this theme.
Grinding is an indispensable step of the manufacturing process. Taiwan Diamond manufactures a comprehensive array of "super abrasive wheels" using the highest quality diamond and CBN (Cubic Boron Nitride). Superabrasive wheels play a key role in the grinding process for electric, semiconductor, automotive, bearing, and mold making industries. Taiwan Diamond aims, through research and development, to manufacture wheels which have characteristics such as "faster cutting speeds," "extremely accurate," and are "safe and clean" in order to provide the highest quality products to satisfy our customer's needs.

Contents

1. Ordering Diamond and CBN Wheels 2

2. Wheel Markings 3

3. Abrasive Indication and Surface Roughness 4

4. Characteristic of Abrasive and Materials To Be Ground 5

5. Safety Instructions 6

6. Resin Bond Wheels 8

7. Polyx Wheels 9

8. Metal Bond Wheels 10

9. Vitrified Bond Wheels 11

10. Electroplated Wheels 12

11. Standard Shapes of Wheel Type 14

12. Basic Shape Code of Wheel(JIS) 18

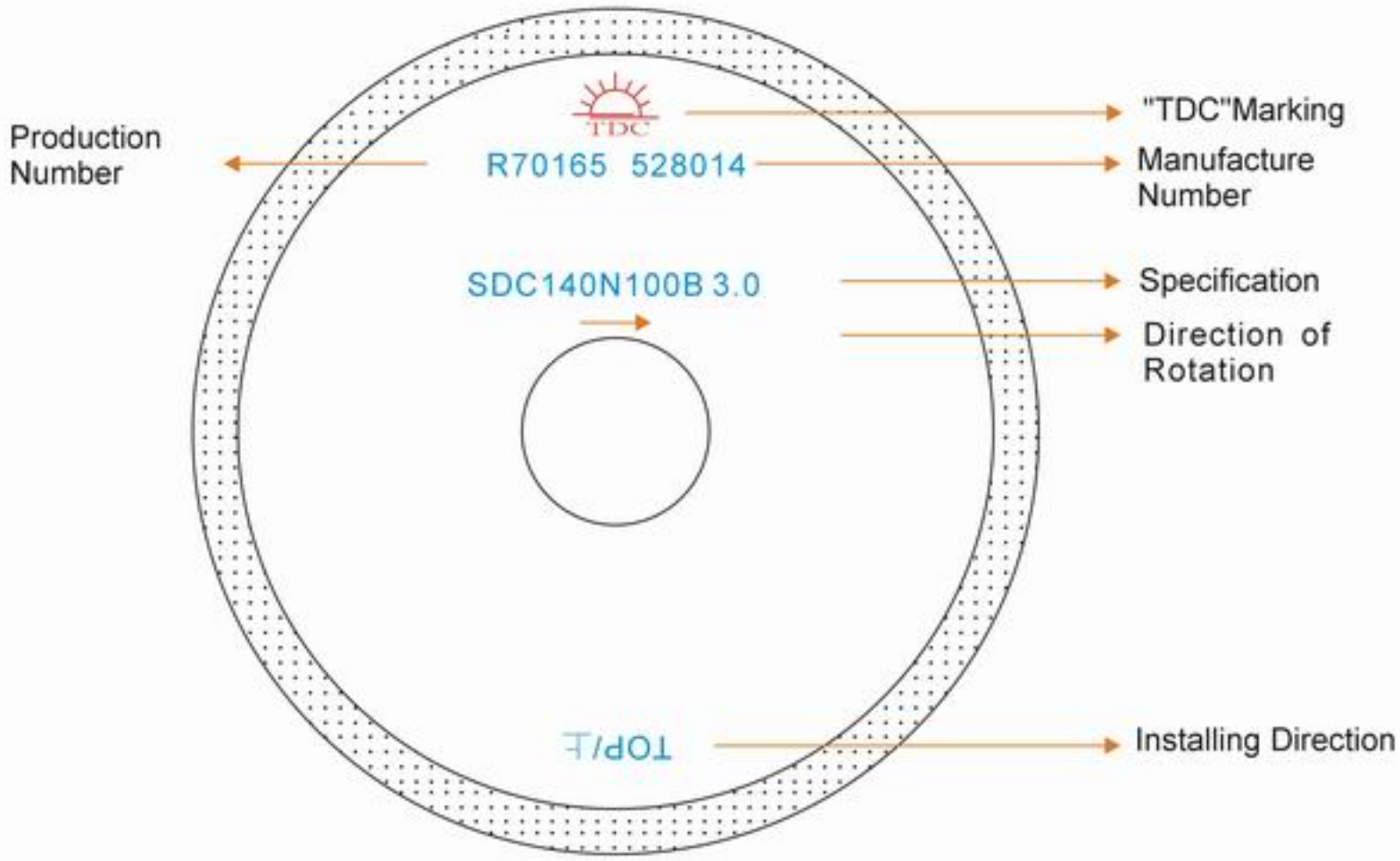
1. Ordering Diamond and CBN Wheels

Please indicate the following when placing a new order.

1.Materials to be ground (What type of product do you produce?)	
(1)Name:	
(2)Material:	
(3)Hardness:	
(4)Size:	
(5)Stock removal:	
(6)Required Surface Roughness:	
(7)Required Accuracy Tolerances:	
2.Machine Type(What kind of machine do you use?)	
(1)Type and Model:	
(2)Spindle Capacity:	
(3) Type of Grinding(Surface Grinding, Cylindrical Grinding etc.)	
(4)Wheel Revolution:	
(5)Peripheral Speed:	
(6)Feed Rate:	
(7)Depth of Cut:	
(8)Coolant Type:	
(9)Other Conditions:	
3.Wheel Being Used(What kind of wheel do you use?)	
(1)Shape and Size:	
(2)Manufacturer:	
(3)Specification:	
(4)Problems:	
4.Quantity and Time for Delivery	
(1)Quantity:	
(2)Required Time for Delivery:	
5.Other Requirements	
Company:	
Address/Telephone#:	
Your Ordering No.:	

We would appreciate if you could inform us of the previous production number (6digits), if any.

2. Wheel Markings



JIS B4130(DIA & CBN mesh size regulation)
B4131(DIA & CBN wheel regulation)

Interpretation of the markings

SDC 140 N 100 B 3.0

Abrasive Type	Mesh Size	Hardness of Bond	Concentration	Bond Type	Depth of Super Abrasive Section
D: Natural Diamond	16 100 400	J Softer	25 Lower	B:Resin	1.5mm
SD: Synthetic Diamond	18 120 600	L ⇧	50	V:Vitrified	2.0mm
SDC: Metal Coated Diamond	20 140 800		75 ⇧		
BN: Cubic Boron Nitride*	30 170 1000	N Medium	100	M:Metal	3.0mm
BNC: Metal Coated Cubic Boron Nitride*	40 200 1500		125		
(*Also can be described B.)	50 230 2000	P ⇩	150 ⇩		
	60 270 2500		175		
	80 325 3000	R Harder	200 Higher	P:Electr-oplated	5.0mm

3. Abrasive Indication and Surface Roughness

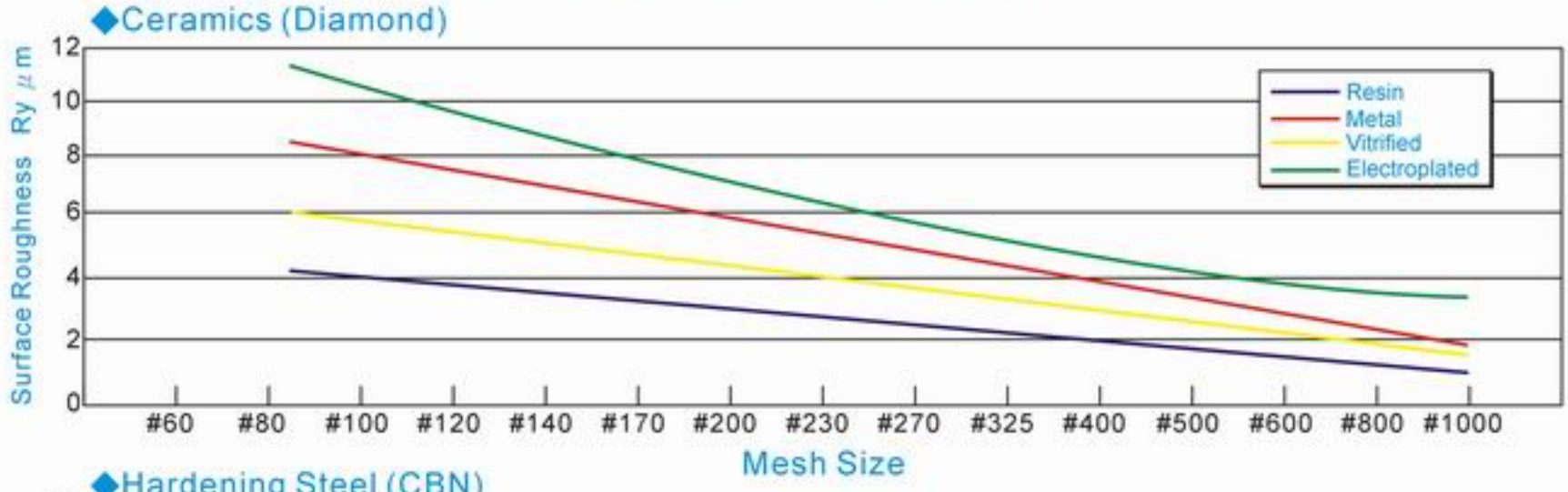
(1)Abrasive Indication

Mesh Size	Average Diameter(μm)	JIS	U.S.A.	B.S.S.	FEPA
50	297	50/60	50/60	50/60	D301
60	250	60/85	60/85	60/85	D252
80	177	85/100	85/100	85/100	D181
100	149	100/120	100/120	100/120	D151
120	125	120/140	120/140	120/150	D126
140	105	140/170	140/170	150/170	D107
170	88	170/200	170/200	170/200	D91
200	74	200/230	200/230	200/240	D76
230	62	230/270	230/270		D64
270	53	270/325	270/325	240/300	D54
325	44	325/400	325/400		D46
400	37		36-54μ		M40
600	28		22-36μ	27-40μ	M25
1000	15		12-22μ	12-18μ	M16
1500	10		8-12μ	8-12μ	M10
2000	8		5-12μ		
2500	6		4-8μ	4-8μ	M6.3
3000	5		2-6μ	2-6μ	

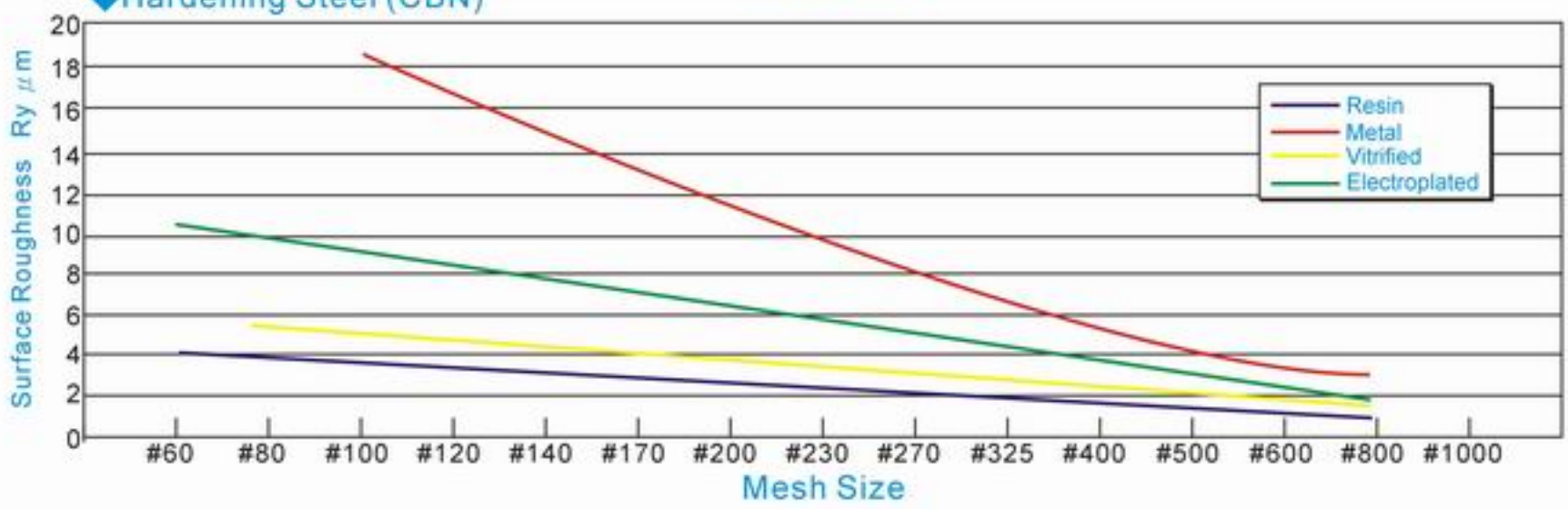
*Average diameter slightly vary due to each regulation.Also some grit sizes are not available.

(2)Mesh Size and Surface Roughness(Reference date)

◆Ceramics (Diamond)



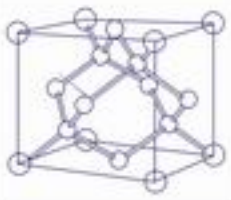
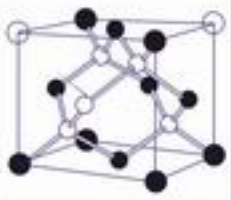
◆Hardening Steel (CBN)



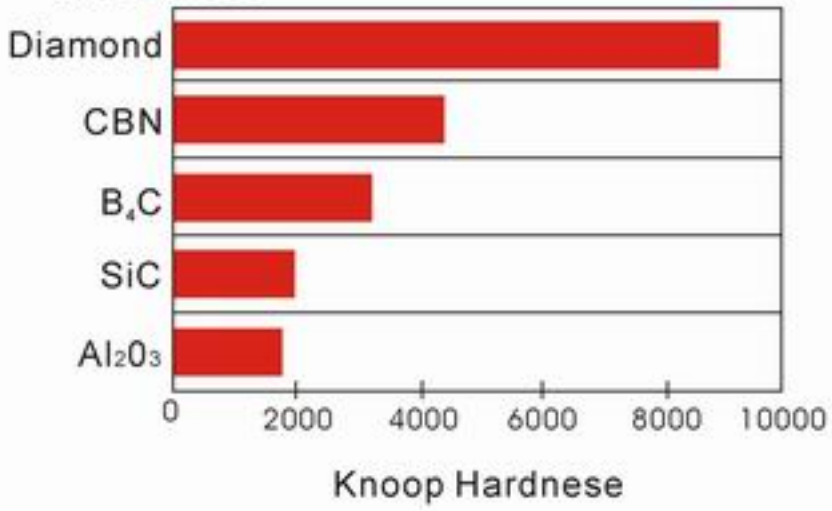
Characteristics of Abrasive and Materials To Be Ground

(1)Characteristics of Abrasive

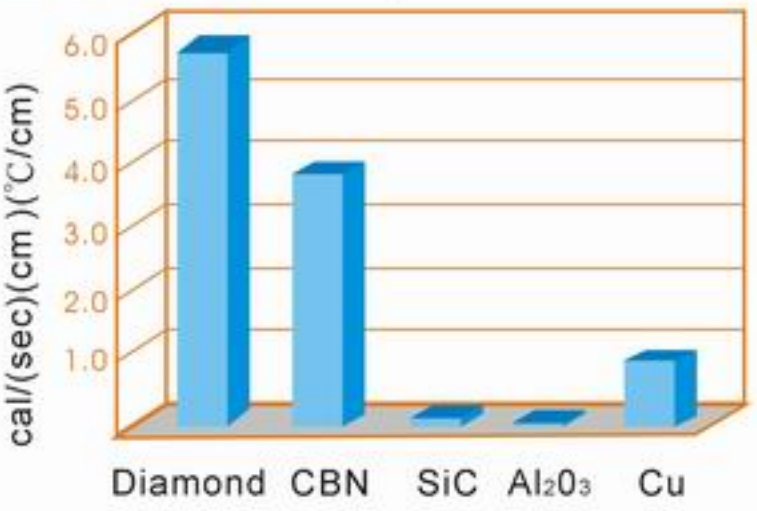
❶Comparison of Crystal Structures

	Diamond	CBN
Crystal Structure (Cubic Crystal)		
Molecular Formula	C	BN
Lattice Constant A	3.567	3.615
Density g/cm3	3.514	3.480

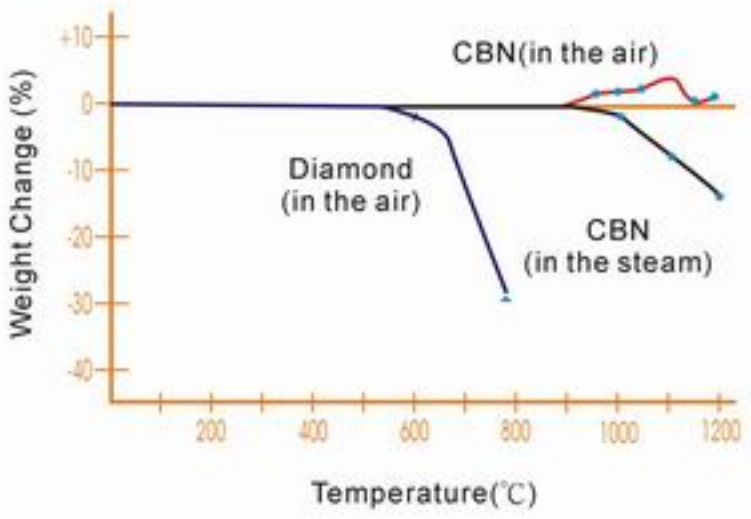
❷ Hardnese



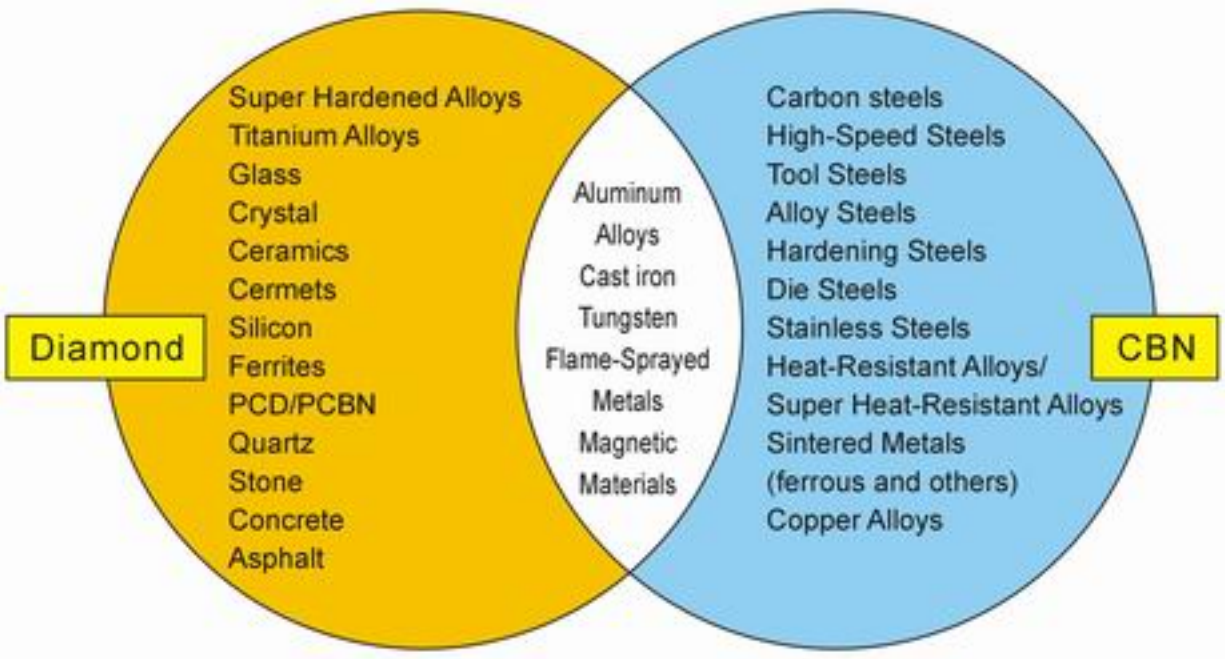
❸Thermal Conductivity



❹Thermal Stability



(2)Materials To Be Ground



5.Safety Instructions

For preventing accidents and safe operation, carefully read the Safety Instructions, the notes described in Inspection List and the Operators Manual before operating.

(1) Working Environment, Clothes, Protections

①Operators should put on protection such as goggles, dustproof mask, safety boots, protecting cap.

②Wheels can generate sparks during operation. Do not operate where subjected to ignition or explosion.

(2) Prior to Operation

①Make sure to apply grinding fluid continuesly when using in wet grinding.

②Do not reprofile the wheel, please return to us.

③Do not operate when wheel shape and size don't fit the designated size of grinder: diameter, thickness and arbor hole diameter.

④ When using a ferrous core, remove applied rustproof wax.

⑤ When using a ceramic core, inspect using sound by tapping wheel side with wooden hammer prior to installation.

⑥ Always use the wheel for it's intended use, do not attempt to use the side of an O.D. wheel.

(3) Installation

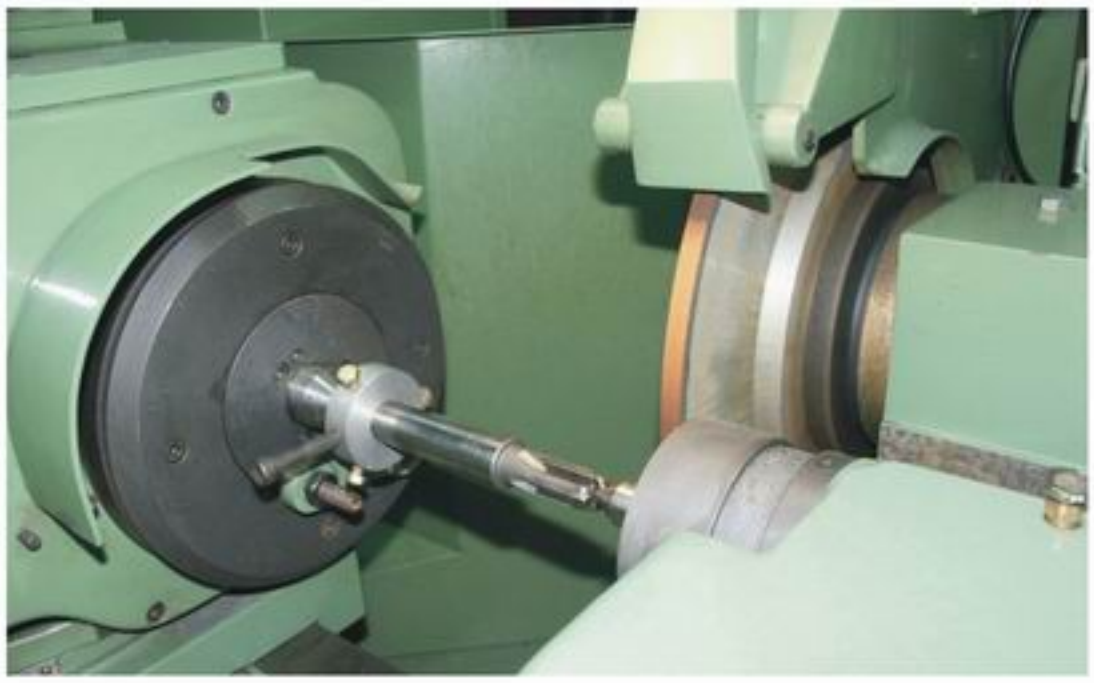
①Make sure the grinder is OFF when installing the wheel and when removing wheel from grinder.

②When using a ceramic core, place the paper rings between the core and the flange in order to prevent fracture, crack, etc..

③When putting a wheel on to the flange, do not push by force: e.g. striking with hammer.

④When using a ceramic core, make sure (TDC) label is on top and the wheel is fixed to spindle vertically.

⑤Secure bolts on flanges with equal torque at each diagonal position.



(4) Grinding Operation

①Do not touch spinning wheel. In case of dry grinding, do not touch wheel even after grinding because it might be hot.

②Never operate exceeding the maximum operating speed designated in Wheel Inspection List as well as tolerance operating speed of grinder spindle.

③When unusual sound or vibration occurs, stop the operation and switch off the machine immediately.

④Make a no-load trial run for 1 to 3 minutes prior to operation in order to make sure the operating direction is correct and there is no vibration.

⑤When processing wet, be sure to apply grinding fluid sufficiently at the point of grinding.

⑥When contacting wheel with workpiece, be sure not to cut excessively. Also do not continue to operate overload.

⑦When operating dry, be sure not to burn wheel.

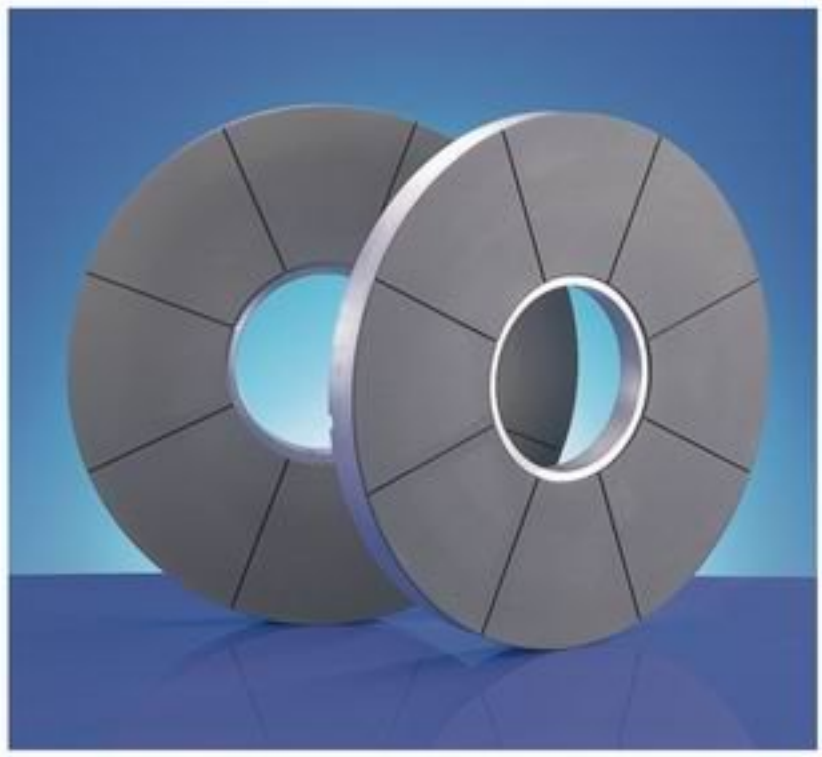
(5) Storage

① After operating, if wheel needs to be removed and stored, store it in a dry and safe area. Do not store wheel where subjected to falling objects or electrical shock.

② Using a ferrous core, apply rustproof wax and store.

6.Resin Bond Wheels

Resin bond is usually made with heat-cured resin mainly composed of phenolic resin.Resin bond wheel has excellent grinding ability, surface finish and minimal chipping. It is widely applied for difficult-to-machine materials such as tungsten carbide, ceramics, glass, and silicon as well as ferrous materials such as high-speed steels and sintered ferrous metals.



(1) Characteristics of Resin Bond Wheels

①Resin bond usually has some added filler such as organic and inorganic materials, metals, etc. into the phenolic resin in order to control its wear resistance, heat resistance, grit retention and lubrication.

②Resin wheels are low in Young's modulus ;therefore they have excellent characteristics in: processing efficiency, free cutting, surface finish, and minimal chipping.

③Resin bond wheels have shorter wheel life because the adhesion between the grit and the bond is not as strong as that of metal bond wheels. However, resin bond has much better cutting ability when processing hard-to-grind materials such as cermets, ceramics, etc.

④The diamond and CBN abrasives used for resin bond wheels are different from those used for metal bond. They are irregular-shaped and easy to microfracture. By doing so, they also create new cutting edges constantly while grinding. In order to improve grit retention, the diamond is metal-coated and the surface is more uneven shaped.

⑤Resin wheels are typically used for wet grinding, but they can be used for dry grinding by adding some filler to reduce heat generated by grinding and improving their cutting ability.

(2) Applications of Diamond Wheels

①Resin Bond diamond wheels are mostly used for precision grinding of tungsten carbide, cermets and ceramics.

②Because of the bond elasticity, they are used for finish grinding of silicon, glass, ceramic-made electrical parts, etc. which require excellent surface finish.

(3) Application of CBN Wheels

①Resin bond wheels are suitable for grinding ferrous metals such as cast iron, high speed steels, and sintered iron.

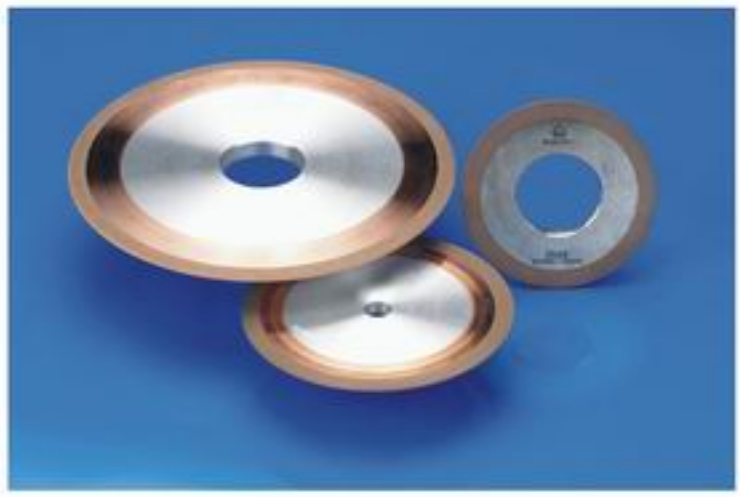
②They are suitable for processing hard to machine materials because CBN grains are much stronger than conventional abrasives.

③They can perform precision grinding because they wear much less than conventional abrasives.

7 .POLYX Wheels

Polyimide resin is used in polyx wheels instead of the standard phenolic resin known as resin bond. Among other high-function resins, polyimide resin is best in heat and wear resistance.

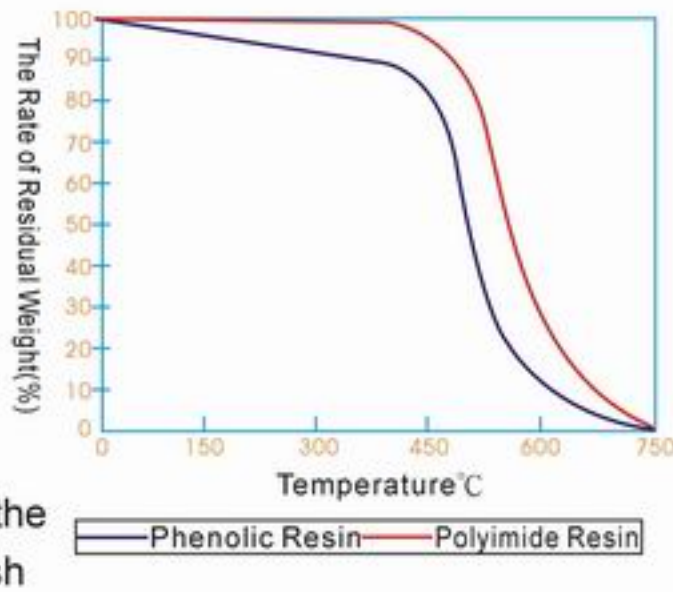
(1) Characteristics of Polyx Wheels



①Excellent Heat Resistance

According to thermogravimetry, the rate of residual weight reaches 90% at a temperature of 388℃ for phenolic resin and 516℃ for polyimide resin, which makes a difference of 128℃, and a difference of 150℃ at the point of thermal decomposition. This heat resistance brings superiority in superabrasive grit retention when generating grinding heat.

Thermogravimetry of Polyimide Resin and Phenolic Resin



②Excellent machine strength

Tensile strength of polyimide resin goes down by only 15% when it is kept between 250 and 1000 degrees ceicius. Therefore, polyx wheels perform well under conditions of high temperature, particularly when compared against phenolic resin.

③Excellent grinding performance

◇**With finer mesh size, longer wheel life can be achieved.**／Contrary to conventional resin wheel, the wheel life of polyx wheel tends to be longer as mesh size becomes finer within a range of #100 to #200. Therefore the process of rough and finish can be done with only one wheel.

◇**Wheel life is unchanged even though the depth of cut increases.**／When the depth of cut increases from 0.01mm to 0.05mm in surface grinding applications, the wheel life of resin wheel is shortened to less than 1/3, but polyx wheel life is rarely changed.

◇**Excellent surface finish can be expected.**／Polyx bond has elasticity like rubber, and efficient cutting edges are increased when grinding. Consequently excellent surface finish can be expected.

(2) Applications of Diamond Wheels

Polyx bond has excellent characteristics such as heat resistance, mechanical strength, etc. therefore it is suitable for heavy grinding compared to resin bond.

Polyx bond provides superior performance in heavy grinding of tungsten carbide and difficult-to machine materials like ceramics and glass.

(3) Applications of CBN Wheels

The grinding ability of this wheel is extensively advanced by improving the element of polyx bond and making CBN abrasive grit retention stronger. As a result, it achieves outstanding performance in heavy grinding for all kinds of steel materials.

8.Metal Bond Wheels

Metal bond is a binding material made of metallic powders of copper, tin, iron, cobalt, etc. It has excellent grit retention and wear resistance compared to other wheels.

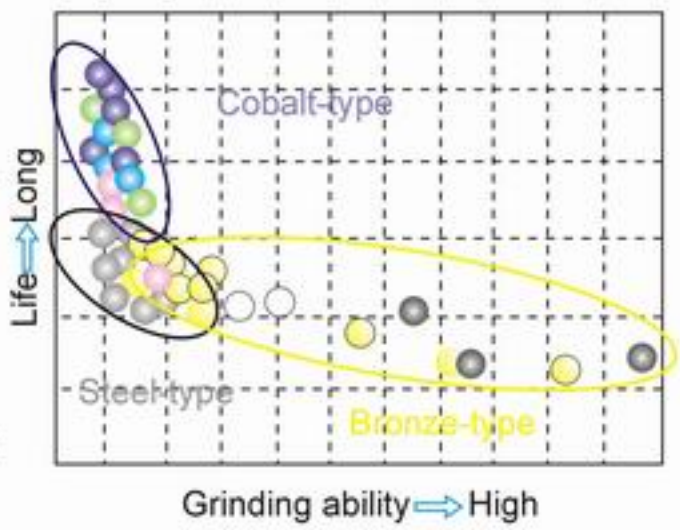
(1)Characteristics of Metal Bond Wheels

①Metal bond wheels are divided into three major types bronze-type which is superior in grinding ability cobalt-type which is superior in wheel life and steel-type which stands in the middle in grinding capability.

②Metal bond wheels have excellent grit retention and wear resistance compared to resin bond wheels and vitrified bond wheels, it has long wheel life in processing difficult to machine materials such as glass, ceramics, semiconductor electron materials, etc.

③ Metal bond wheels also can be used for electrolytic grinding and electrical discharge grinding (EDM), using its electric conductivity.

Metal Bond System



(2)Applications of Diamond Wheels

① With excellent grit retention and wear resistance, it is used for rough / semi-finish processing of difficult-to-machine materials such as glass, ceramics, ferrite, semiconductor electronic materials, fireproof materials, stones, etc. It is exceptionally efficient for chamfering processes.

②It is also widely used for form / profile grinding in which Diamond Wheels are required to keep profile.

(3)Applications of CBN Wheels

①The excellent wear resistance of the bond gives perfect efficiency in rough grinding of unhardened steel materials.

②It is highly recommended for grooving of hardened steel and grinding which requires high efficiency and accuracy.

9. Vitrified Bond Wheels

Vitrified bond is a vitreous binding material and generally contains pores inside while other materials contain no pores. Therefore vitrified bond wheels have excellent grinding ability and are superior in forming.

(1)Characteristics of Vitrified Bond Wheels

①Wheel grinding ability and wheel life depend on the combination of binding material, super abrasive mesh size, concentration, and porosity. The harder the bond, the longer wheel life is achieved.
On the contrary, the softer the bond, better grinding ability is achieved because porosity becomes higher.
Also higher concentration of abrasive, equates to longer wheel life.

②Automated processing is available because simultaneous operation of truing and dressing using rotary dresser on the grinding machine is possible.

③Cutting edges can be manipulated in such a manner that the surface finish of the part can be controlled.

④Diamond wheels have difficulty in truing and dressing with rotary dressers. Therefore surface finish depends on the mesh size of super abrasive in the diamond wheel.

(2)Applications of Diamond Wheels

①They are efficiently used for grinding difficult-to-machine materials such as PCD, PCBN, ceramics, etc.

②They are generally superior in grinding ability to metal bond wheels. Because the vitrified bond has no elasticity, it is better suited for tight tolerance applications than resin bond wheels.

(3)Applications of CBN Wheels

①They are used for grinding ferrous materials such as automotive parts (camshafts, crankshafts, gears, CVJ, etc.), bearing parts, household appliance parts (compressors, motor shafts, etc.), and cutting tools.

②CBN abrasive has superior heat stability thus providing excellent performance in super high-speed grinding to process camshafts, crankshafts, etc.

10. Electroplated Wheels

Electroplated wheels, bring stable performance in grinding accuracy, grinding ability, and wheel life. They have an excellent reputation in a variety of applications.

(1)Characteristics of Electroplated Wheels

①They are constant in grinding ability, and can be suited for many materials because of the amount of the abrasive protruding from the bond.

②They are capable of holding form at low cost and can be made in short period of time.

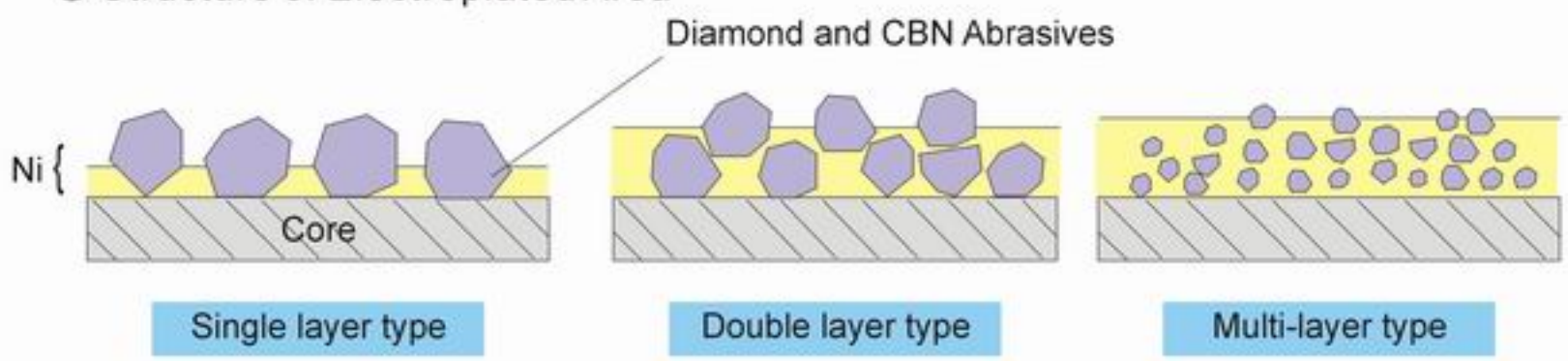
③They are best suited to produce small volume in wide range of categories. Wheel life is shorter than other bonds because electroplated wheels are typically a single layer of abrasive material.

④If the core is metallic, the super abrasive can be electroplated to various forms. Therefore it is used not only as a grinding wheel but as wear-resistant tools.

⑤The consumed abrasive can be stripped and replated using the existing core, providing it is not damaged.

(2)Applications of Electroplated Wheels

① Structure of Electroplated Area



②Structure of Electroplated Wheel and Aim / Application

Structure of Electroplate	Mesh Size	Aim	Application
Single layer type	General	Shape accuracy	General
Double layer type	Mid / Fine	GIA	General
Multi-layer type	Fine	GIA / Wheel life	Glass / Silicon / Others

(3) Others

①Mesh Size and Undercut Volume

Typical Application	Mesh Size	Undercut Volume
Rough	#25/30	0.800mm
	#30/40	0.650mm
	#40/50	0.500mm
	#50/60	0.400mm
	#60/80	0.300mm
	#80/100	0.250mm
	#100/120	0.200mm
	#120/140	0.180mm
Semi-Finish	#140/170	0.150mm
	#170/200	0.125mm
	#200/230	0.100mm

Typical Application	Mesh Size	Undercut Volume
Finish	#230/270	0.090mm
	#270/325	0.080mm
	#325/400	0.070mm
	40-60(#400/500)	0.060mm
	30-40(#500/600)	0.040mm
	20-30(#600/800)	0.030mm
	12-25(#800/1000)	0.025mm
	10-20(#1000/1200)	0.020mm
	5-12(#1500-2000)	0.010mm

※Mesh sizes above designate those of Diamond abrasives, and those of CBN abrasives differ slightly.

②Wheel Accuracy and Installation

◇Wheel Accuracy (JIS B0405 Middle Class)

Peripheral run-out should be within 20 μm to mandrel when assembled.

(Normally diamond section runs true to the indicating band on the core.)

◇Installation

Indicate the run out on the indicating band within 1/5" of the undercut. (Set)

Mesh Size	Undercut Volume(mm)	Run-out(Max.)
#80/100	0.250	50
#170/200	0.125	25
#600/800	0.030	6

③Dressing

Dressing typically means to expose super-abrasive cutting edges from the supporting bond. In the case of electroplated wheels, dressing is performed to adjust the surface finish. However, frequent dressing causes the deterioration of grinding ability and wheel life.

※Please consult us when dressing.

④When a core is provided

If you provide us a core, please indicate its material type since pre-treatment varies depending on each material-ferrous (carbon steel, high-speed steel, die steel, and others) and non-ferrous (aluminum alloy, copper alloy, and others).

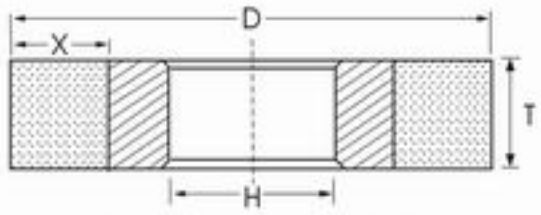
11. Standard Shapes of Wheel Type

Marks of Applied Wheel	
Mark	Wheel
B	Resin Bond Wheel
M	Metal Bond Wheel
V	Vitrified Bond Wheel
P	Electroplated Wheel

Internal Wheel

AD-1A

1A8
1A1

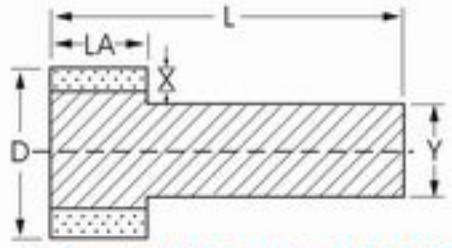


Applied Wheels: B/M/V/P

Stemmed Internal Wheel

AD-1B

DW

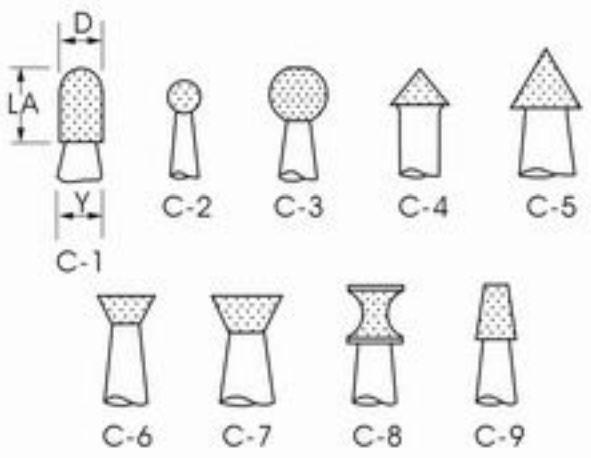


Applied Wheels: B/M/V/P

Mold Grinding Special Wheel

AD-1C

DW

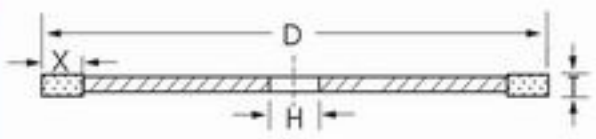


Applied Wheel: P

Cutting Wheel

AD-2A

1A1R
1U1R

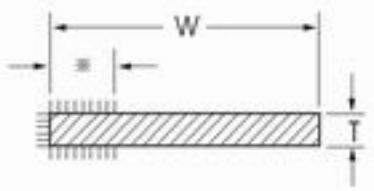


Applied Wheels: B/M/P

Band Saw

AD-2B

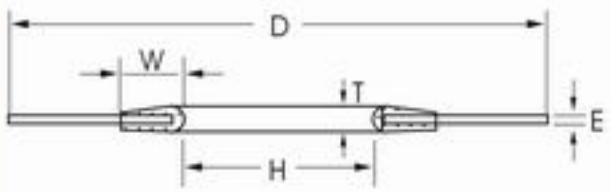
L:Length
Edge Shapes
- Continuous rim Type
- Segmented Type
- Cutting Teeth Type



Applied Wheel: P

ID Blade

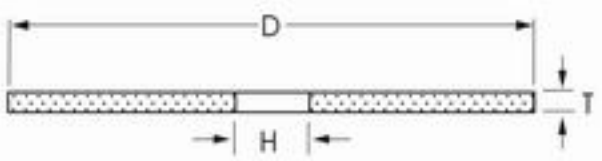
AD-21



Applied Wheel: P

Precision Cutting Wheel (All Blade Type)

AD-2U

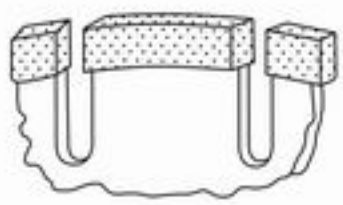


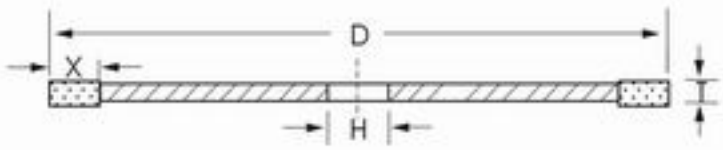
Applied Wheels: B/M/P

Saw Blade

AD-2S

1A1RSS

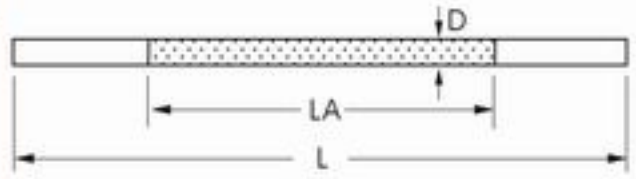




Applied Wheel: M

Wire Saw

AD-2Y

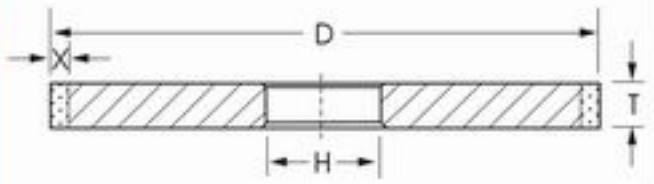


Applied Wheel: P

Straight Wheel

AD-3A

1A1

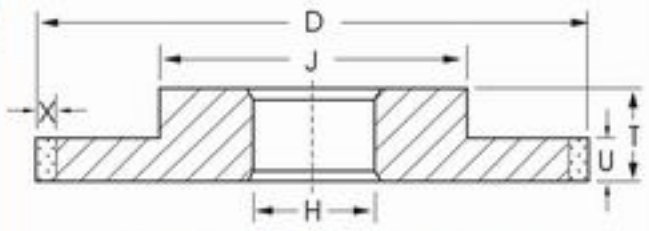


Applied Wheels: B/M/V/P

Sraighe Wheel (Boss Attached on A Side)

AD-3B

3A1

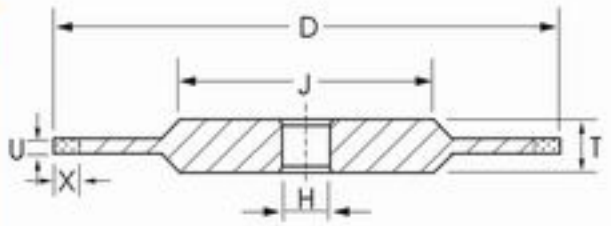


Applied Wheels: B/M/V/P

Straight Wheel (Boss Attached on Both Sides)

AD-3C

14A1

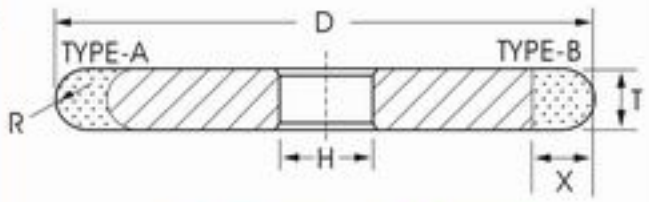


Applied Wheels: B/M/V/P

Straight Wheel (with radius)

AD-3D

1F1

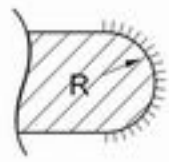


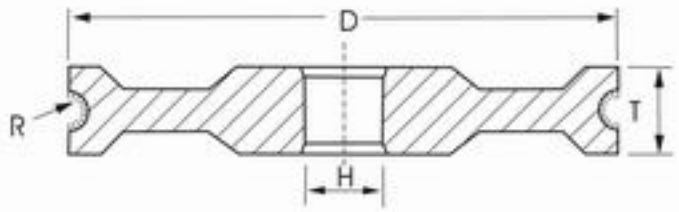
Applied Wheels: B/M/V

Formed Wheel

AD-3E

14JI



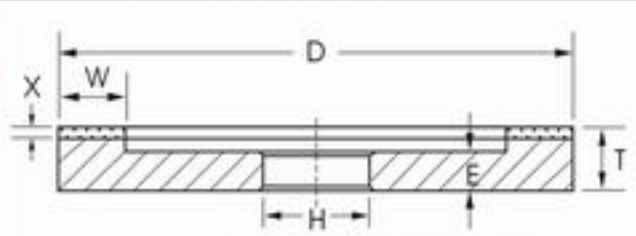


Applied Wheel: P

Plain Cup Wheel

AD-4N

6A2

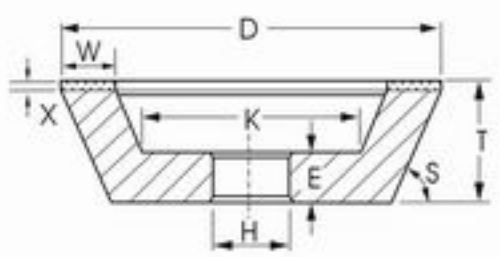


Applied Wheel: B/M/V/P

Fullering Cup Wheel (Right Angled)

AD-5A

11A2

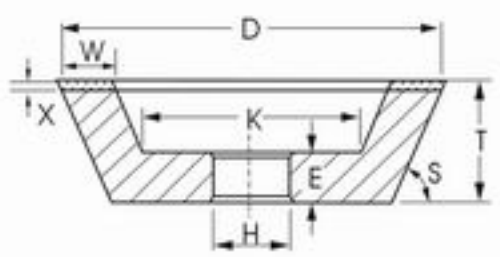


Applied Wheels: B/M/V/P

Fullering Cup Wheel (Acute-Angled)

AD-5B

11B2

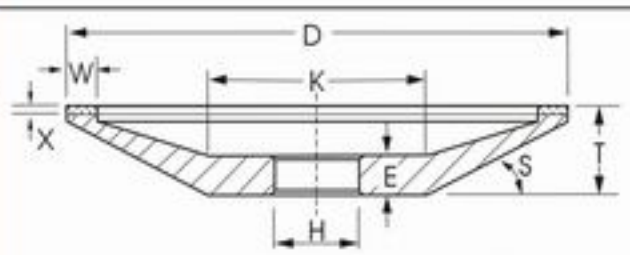


Applied Wheel: B/M/V/P

Dish Wheel

AD-5C

12A2

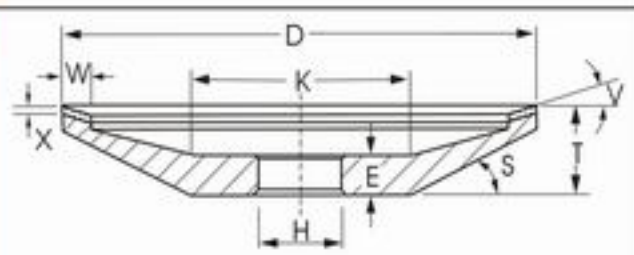


Applied Wheels: B/M/V/P

Dish Wheel (Internal Bevel)

AD-5D

12V4

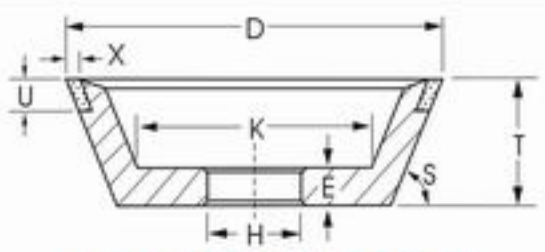


Applied Wheel: B/M/V/P

Fullering Cup Wheel (Periphery)

AD-6A

11V9

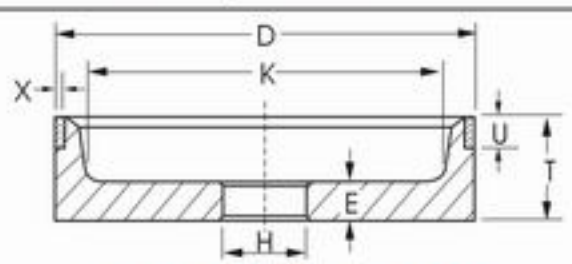


Applied Wheels: B/M/V/P

Plain Cup Wheel

AD-6B

6A9

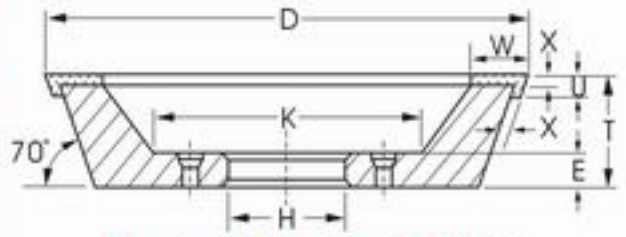


Applied Wheels: B/M/V/P

Fullering Cup Wheel(L-Angled)

AD-7A

11EE9

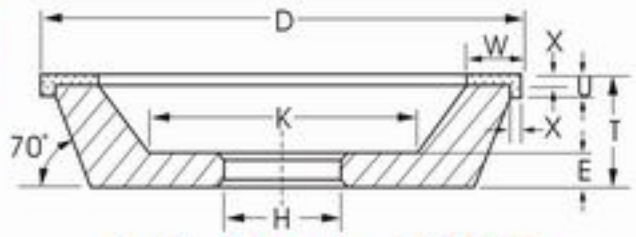


Applied Wheels: B/M/V/P

Fullering Cup Wheel(L-Shaped)

AD-7B

11C9

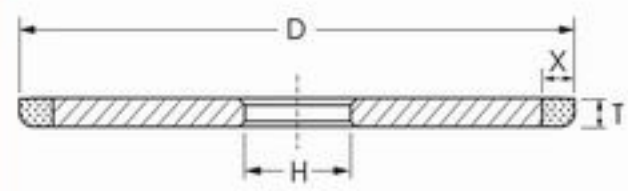


Applied Wheels: B/M/V/P

Chip Breaker Wheel(with radius on a side)

AD-8A

1Q1

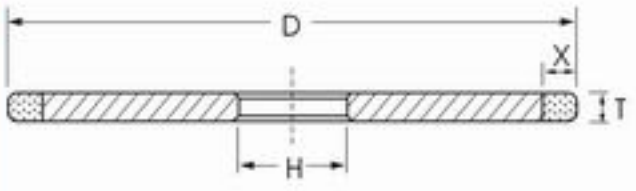


Applied Wheels: B/M/V/P

Chip Breaker Wheel(with radius)

AD-8B

1L1

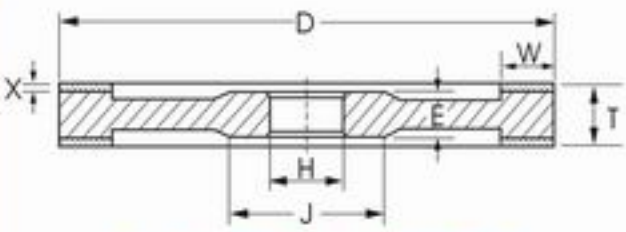


Applied Wheels: B/M/V/P

Double Sides Cup Wheel

AD-9

9A3

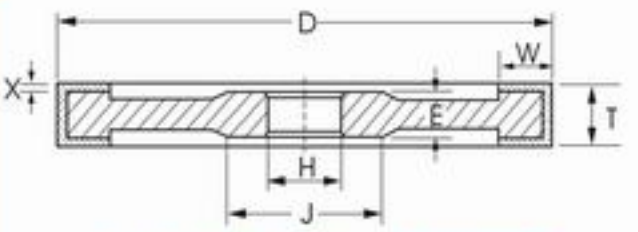


Applied Wheels: B/M/V/P

Straight Wheel(▭-Shaped)

AD-10

9U1

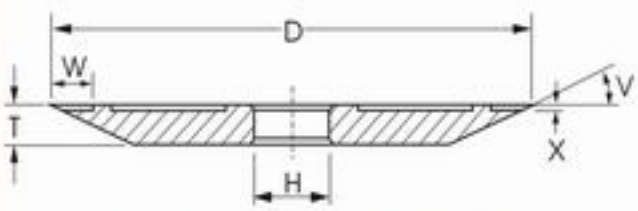


Applied Wheels: B/M/V/P

V-Face Wheel(Right-Angle on Side)

AD-11A

4B2

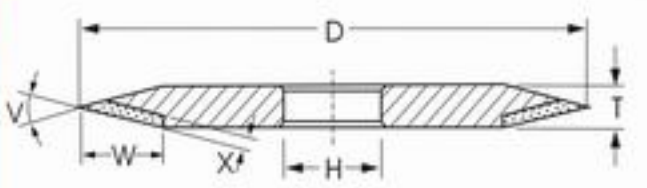


Applied Wheels: B/M/V/P

V-Face Wheel(Angled on Side)

AD-11B

1B5

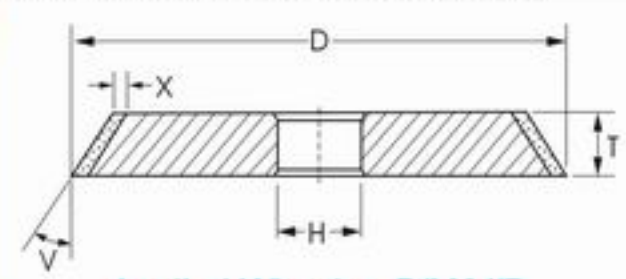


Applied Wheels: B/M/V/P

V-Face Wheel(Peripheral-Angled)

AD-11C

1V1

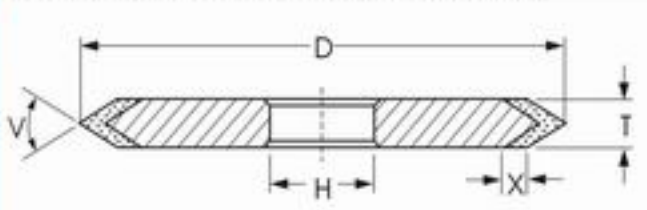


Applied Wheels: B/M/V/P

V-Face Wheel(Angled on Sides)

AD-11D

1EE1



Applied Wheels: B/M/V/P

Hand Stone

AD-12

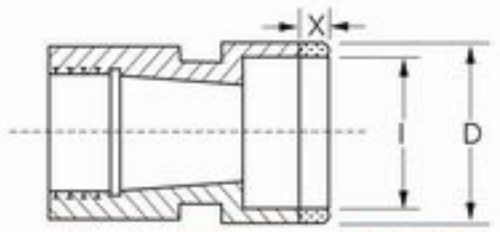
HH1

Applied Wheels: B/M/V/P

Lens Polishing Wheel

AD-13

2FF2

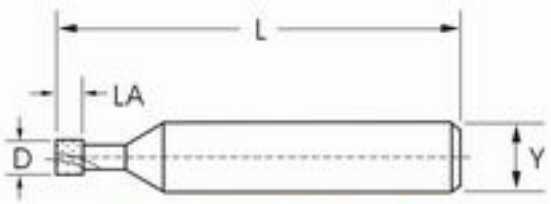


Applied Wheels: B/M/V/P

Stemmed Drill

AD-14A

UW

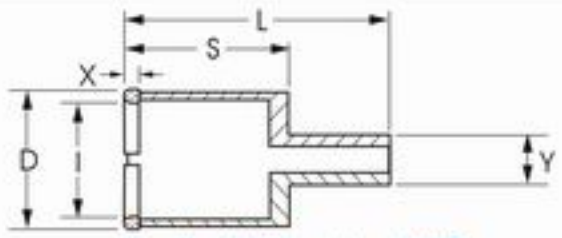


Applied Wheel: P

Core Drill

AD-14

6F2

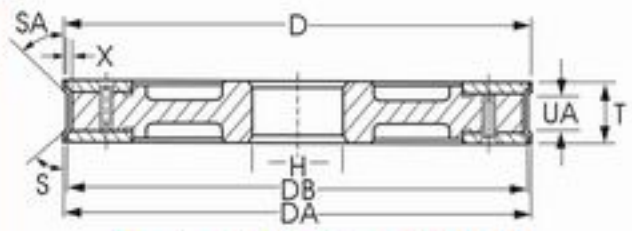


Applied Wheels: M/P

Edge Grinding Wheel

AD-15

1DD6Y

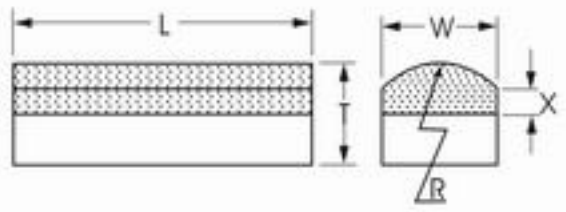


Applied Wheels: B/M/V/P

Honing Stone

AD-17

HMF

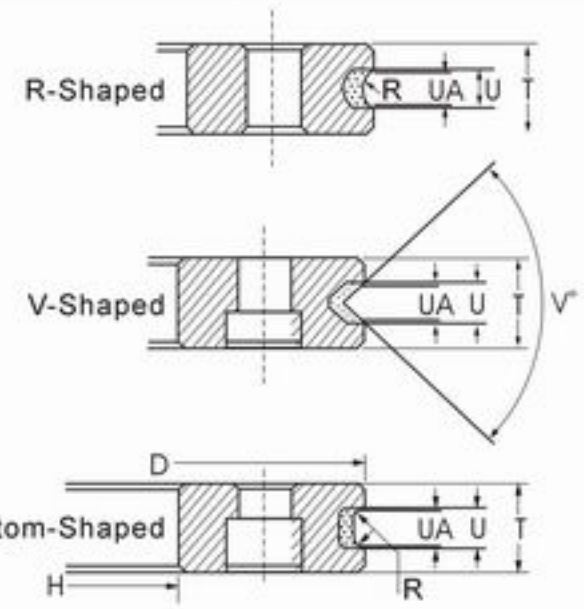


Applied Wheels: B/M/V/P

Pencil-Edging Wheel

AD-16

1FF6Y
1EE6Y
1LL6Y

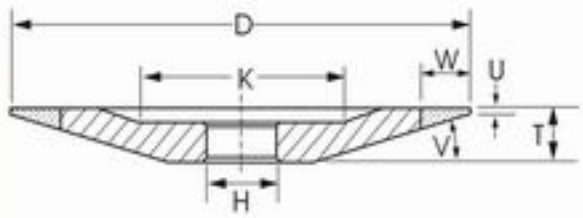


Applied Wheels: B/M/V/P

Plate Wheel

AD-18

4M1

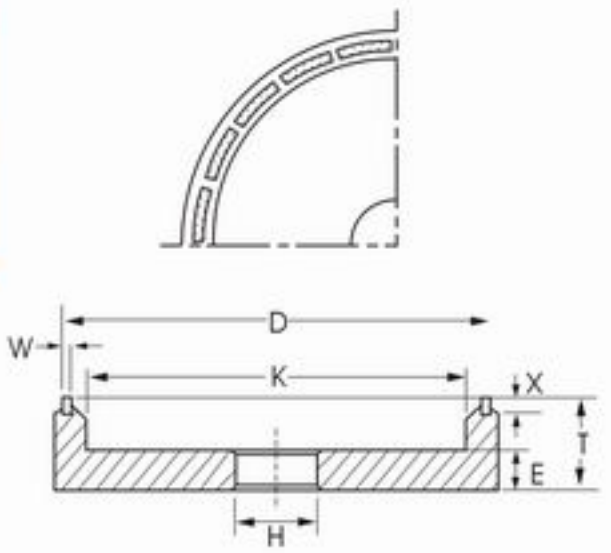


Applied Wheels: B/M/V/P

Segment Cup Wheel

AD-19

6A2S

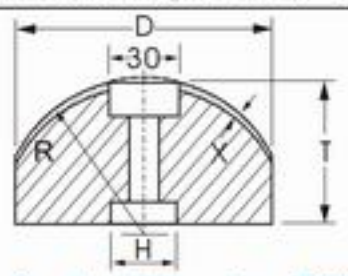


Applied Wheels: B/M/V

Grinding Dish for Polishing Lens(凸-Shaped)

AD-20A

6P5

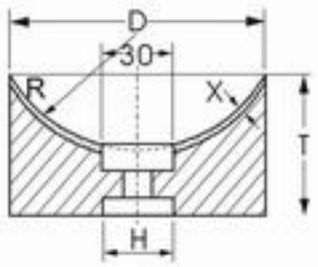


Applied Wheels: B/M

Grinding Dish for Polishing Lens(凹-Shaped)

AD-20B

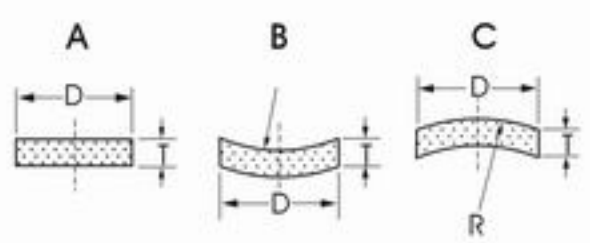
6P4



Applied Wheels: B/M

Pellet

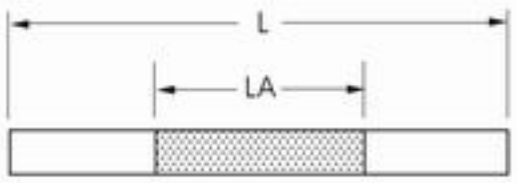
AD-21



Applied Wheels: B/M/V

Machine File

AD-24K



Applied Wheels: P

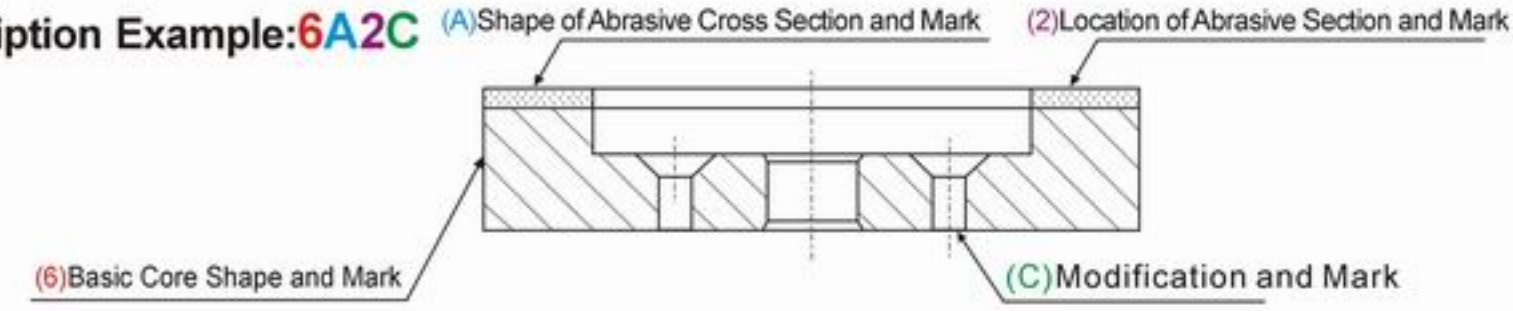
Hand File

AD-25

Applied Wheel: P

12. Basic Shape Code of Wheel(JIS)

Description Example:6A2C



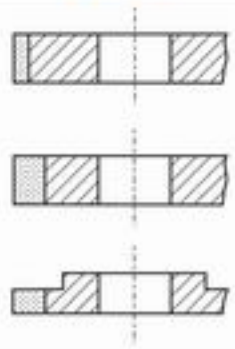
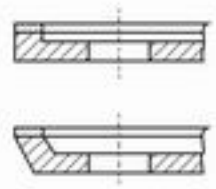
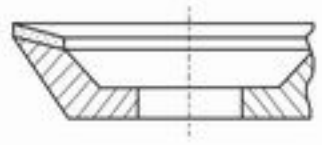
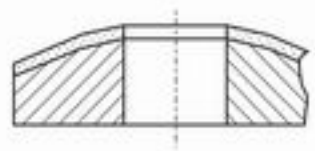
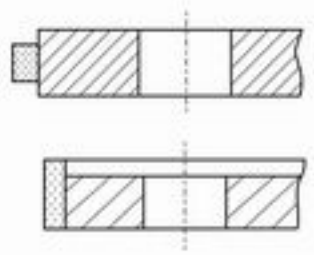
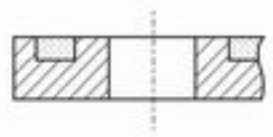
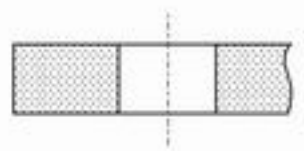
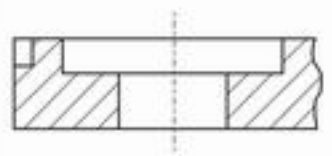
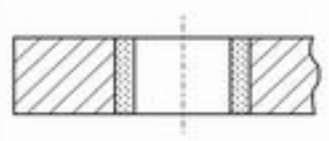
Basic Core Shapes and Marks

Mark	Basic Core Shape
1	
2	
3	
4	
6	
9	
11	Less Than90° and Over 45°
12	45° or Less
14	
15	

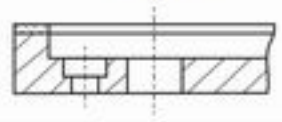
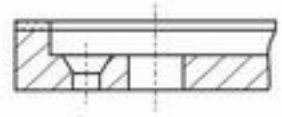
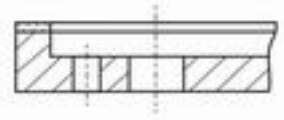
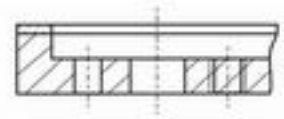
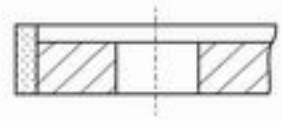
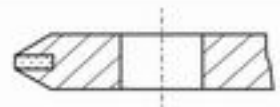
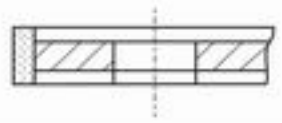
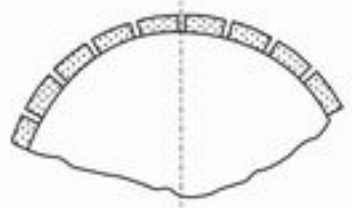
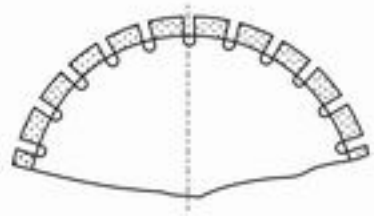
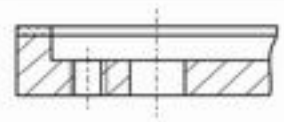
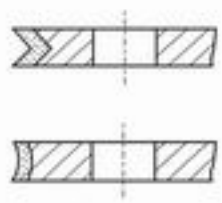
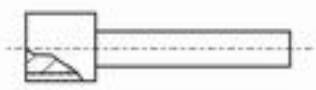
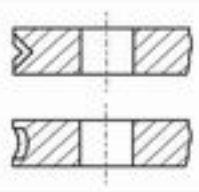
Shapes of Abrasive Cross Section

Mark	Shape of Abrasive Cross Section	Mark	Shape of Abrasive Cross Section
A		J	
AH		K	
B		L	
C		LL	
CH		M	
D		P	
DD		Q	
E		QQ	
EE		S	
F		U	
FF		V	
G		Y	
H			

Location of Abrasive Section and Marks

Mark	Location	Figure
1	Periphery	
2	Side	
3	Sides	
4	Inside Bevel or Ark	
5	Outside Bevel or Ark	
6	Part of Periphery	
7	Part of Side	
8	Throughout	
9	Corner	
10	Internal	

Modifications and Marks

Mark	Modificaton	Figure
B	Drill and Couterbore	
C	Drill and Countersink	
H	Plain Hole	
M	Holes Plain and Threaded	
P	Relieved One Side	
Q	Abrasive Section Inserted	
R	Relieved Two Sides	
S	Abrasive Section Segmented	
SS	Abrasive Section Segmented and Slotted	
T	Threaded Holes	
V	Abrasive Section Reversed	
W	Stemmed	
Y	Abrasive Section Reversed Inserted	

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2004.03(2000)