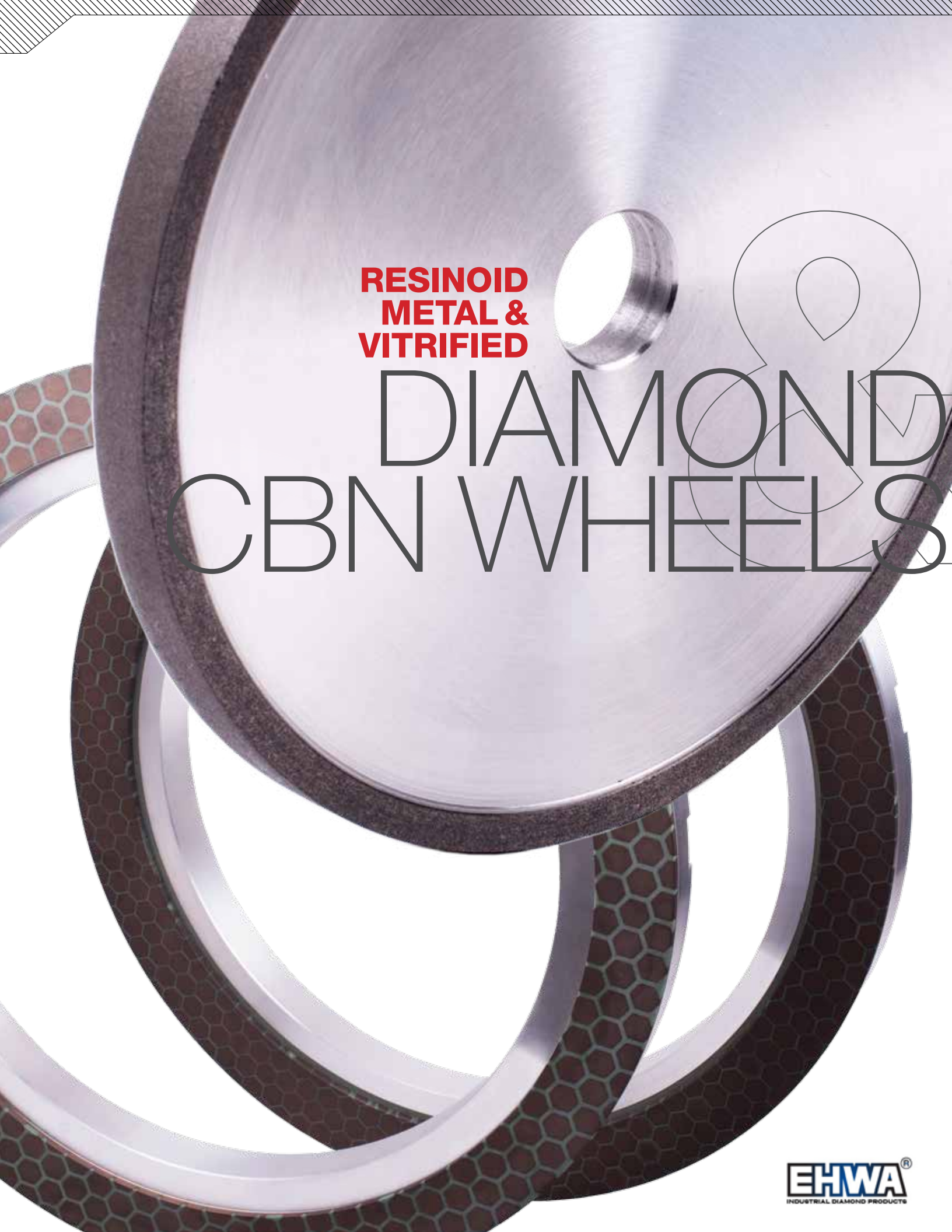


RESINOID METAL & VITRIFIED

DIAMOND & CBN WHEELS

EHWA®
INDUSTRIAL DIAMOND PRODUCTS

EHWA has become an international benchmark for success because of our ability to adapt quickly to the changing markets and diverse needs of customers, and by leading the way in applying the most advanced technology to the manufacturing of industrial tools.

Since 1975, EHWA has been able to expand its market share throughout the world because we have established a world renowned reputation of high quality products, service and expertise in the industry. EHWA is deeply committed to keeping customers up-to-date and equipped with the most competitive products and technical information. The key to our flexibility and strength in the global marketplace is due to our multiple alliances, reliable overseas partners and customers throughout the world. EHWA purchases only the highest quality raw materials, industrial diamonds and CBN from reputable sources. In addition to having strong supply lines with major suppliers, EHWA has successfully teamed up with high-tech manufacturers in Europe, Japan, and the U.S. under several joint-ventures for the research and development of high precision diamond tools, rotary dressers, and precision electroplated diamond tools.

EHWA is able to progress in the age of globalization because we are already globalized. EHWA diamond tools is your partner for success.

CONTENTS

HOW TO ORDER DIAMOND AND CBN WHEELS

When placing your orders, please provide us with the following information.

1. **SHAPE**
2. **DIMENSION** *Provide the shape and dimensions in detail. If possible, include a drawing.*
3. **ABRASIVE**
4. **GRIT SIZE**
5. **GRADE**
6. **CONCENTRATION**
7. **BOND**
8. **QUANTITY**

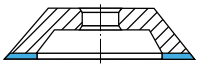
In order to handle your order properly, we also like to be informed of the following:

9. **WORK**
   - A) Material (type & quality)
   - B) Shape
   - C) Dimension and dimensional tolerance (precision)
   - D) Hardness
   - E) Grinding removal or depth of cut
   - F) Required surface roughness (Rmax, Ra, Rz)

10. **MACHINE USED**
    - A) Type
    - B) Horse power

11. **GRINDING CONDITION**
    - A) Wheel speed: r. p. m.
    - B) Infeed : u. mm
    - C) Table speed : m/min
    - D) Cross feed : mm
    - E) Coolant : (dry or wet, coolant type)

This catalog does not reflect all of the products that can be manufactured at EHWA. For information on wheel shapes not shown in this catalog, please contact the Sales Dept. of EHWA Diamond Ind. Co., Ltd., 1-844-EHWAUSA.



MARKINGS FOR DIAMOND AND CBN WHEELS
RESINOID AND VITRIFIED BOND

D	200	N	100	B	A	3
ABRASIVE	GRIT SIZE (MESH)	GRADE	CONCENTRATION	BOND	BOND MODIFICATION	DEPTH
DIAMOND	NORMAL				RESINOID	
D	60		25 = 1.1ct/cc		BA	1.5
ND	80		50 = 2.2ct/cc		BB	2
DM	100	J = SOFT	75 = 3.3ct/cc	B = RESINOID	BC	3
CSD	120		100 = 4.4ct/cc		BCT	4
	140		125 = 5.5ct/cc		BD	5
	170	N = MEDIUM	150 =6.6ct/cc	V = VITRIFIED	BE	6
	200		175= 7.7ct/cc		BG	7
	230		200 =8.8ct/cc		BH	8
	270	R = HARD			BN	10
	325				BP	
	400				BQ	
CBN	MICRON				BXC	
B	40/60				B34	
NB	40/50				B39	
BM	30/40				PAE	
NBM	22/36				PA8	
	20/30				BMX	
	15/25				VITRIFIED	
	8/16				VA	
	6/12				VB	
	4/8				VBT	
	3/6				VC	
	2/4				VD	
	0/2				VE	
					VH	
					VCL	

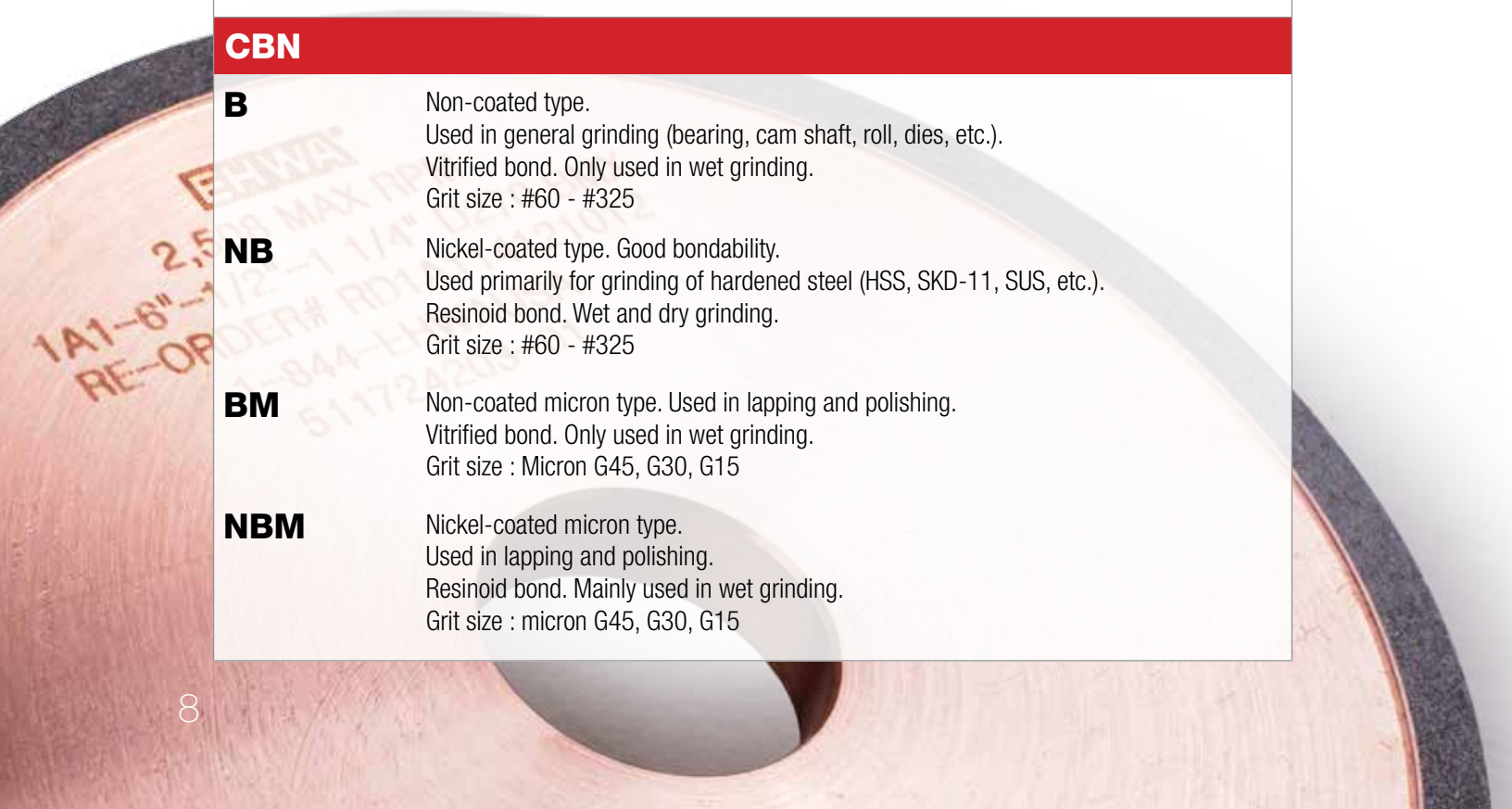
MARKINGS FOR DIAMOND AND CBN WHEELS
METAL BOND

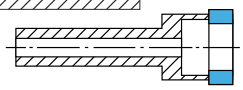
MVD	200	N	100	M	A	3
ABRASIVE	GRIT SIZE (MESH)	GRADE	CONCENTRATION	BOND	BOND MODIFICATION	DEPTH
DIAMOND	NORMAL					
MVD	20		25 = 1.1ct/cc		MB2	1.5
SDS	30		50 = 2.2ct/cc		MB2-1	2
HD	40	J = SOFT	75 = 3.3ct/cc	M = METAL	M6P5	3
MMD	50		100 = 4.4ct/cc		ME	4
	60		125 = 5.5ct/cc		MG6	5
	80	N = MEDIUM	150 =6.6ct/cc		MG8	6
	100				MAC	7
	120				MA	8
	140	R = HARD			MS	10
	170				MS1	
	200				MF	
	230				MH	
	270				MSC	
	325					
	400					
CBN	MICRON					
MB	40/60					
MBH	30/40					
	22/36					
	15/25					
	10/20					
	8/16					

DIAMOND AND CBN TYPES
RESINOID AND VITRIFIED BOND
MANUFACTURED ABRASIVES

DIAMOND	
D	Non-coated type. Friable, irregular shape. General grinding of cemented carbide. Resinoid and Vitrified bond. Mainly used in wet grinding. Grit size: #60 - #400
ND	Nickel-coated type. Good bondability. Used primarily for grinding of all kinds of workpieces (cemented carbide, ceramic, cermet, glass, ferrite, etc.). Resinoid bond. Wet and dry grinding. Grit size : #60 - #400
DM	Micron type. Friable, regular shape. Used in lapping and polishing (cemented carbide, ceramic, glass ,etc.). Resinoid and Vitrified bond. Only used in wet grinding. Grit size : micron D 40/60 - D 0/2
CSD	Nickel-coated type. High strength, excellent bondability. Used in cemented carbide and hardened steel combinations grinding. Grit size : #60 - #325 Grit size : micron D 40/60 - D 20/30

CBN	
B	Non-coated type. Used in general grinding (bearing, cam shaft, roll, dies, etc.). Vitrified bond. Only used in wet grinding. Grit size : #60 - #325
NB	Nickel-coated type. Good bondability. Used primarily for grinding of hardened steel (HSS, SKD-11, SUS, etc.). Resinoid bond. Wet and dry grinding. Grit size : #60 - #325
BM	Non-coated micron type. Used in lapping and polishing. Vitrified bond. Only used in wet grinding. Grit size : Micron G45, G30, G15
NBM	Nickel-coated micron type. Used in lapping and polishing. Resinoid bond. Mainly used in wet grinding. Grit size : micron G45, G30, G15





DIAMOND AND CBN TYPES
METAL BOND
MANUFACTURED ABRASIVES

DIAMOND

MVD
Metal Versatile Diamond.
Widely used in wet grinding of glass, ceramic and non-metallic materials.
Grit size :#60 - #400

SDS
Synthetic Diamond Special.
Blocky, special diamond with higher toughness than MVD.
Grit size : #80 - #325

HD
Hardened Diamond.
Blocky, extremely tough crystal with a smooth surface.
Used in grinding of stone.
Grit size : #20 - #50

MMD
Metal Micron Diamond.
Blocky, regular shape.
Used in polishing application and precision grinding.
Grit size : micron D 40/60 - D 8/16

CBN

MB
Used in grinding of ferrous alloy and cast steel.
Grit size : #60 - #325

MBH
Blocky, high-toughness monocrystalline CBN abrasive.
Used in precision grinding of cemented carbide, dies, and HSS.
Grit size : #60 - #325

BOND MODIFICATIONS

RESINOID	
BA	Good elasticity. Depth of grinding is about 10 μm Mainly used in micron size abrasive and grinding of cemented carbide, hardened steel and PCD (Polycrystalline Diamond).
BB	Heat transfer is excellent for dry grinding. Especially effective for CBN wheels. Mainly used in cup type wheel.
BC	Heat transfer and shape maintenance are very good. Applied to flute grinding of endmill, reamer and drill (HSS).
BD	Very soft. Low noise and good finished shape. Used in general grinding of cemented carbide.
BE	Used in heavy duty dry grinding with diamond cup type wheel.
BG	Standard bond for all kinds of workpieces. Applied to profile, face and centerless grinding.
BH	Shape maintenance and heat transfer are very good. Applied to profile and face grinding.
BN	Same applications as BB, but harder.
BP	Lubricant bond. Same applications as BG, but softer.
BX	Good cutting ability. Applied to flute grinding of endmill, reamer and cemented carbide by down feed method.
BXT	Used in grinding of cermet, ceramic and cemented carbide.
BQ	Used in finish grinding of glass and quartz.
PA	High temp polyimide for small carbide tool grind.
BMX	Hybrid bond for heavy stock removal in carbide tool grinding.

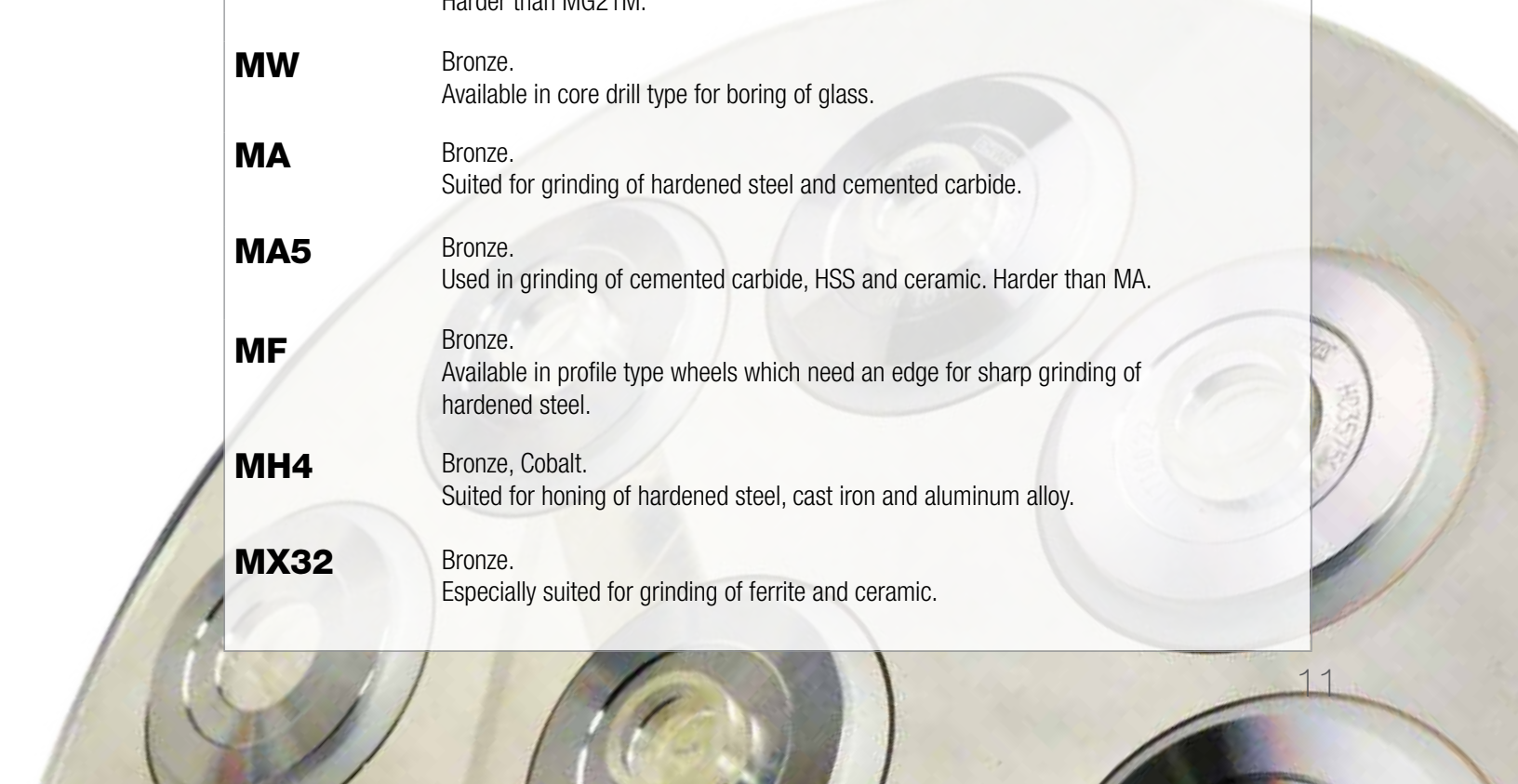
** NOTE: The bond application according to hardness is as follows.*

WHEEL TYPE	SOFT ---------------------------------- HARD
D11V9	BP ----- BE ----- BH
B11V9	BB ----- BN ----- BE ----- BH
1A1	BA ----- BP ----- BG ----- BH ----- BX
1A1R	BD ----- BG ----- BH
4A2/6A2/2A2T	BA ---- BB ---- BG ---- BE ---- BH ---- BC ---- BX ---- BXT

BOND MODIFICATIONS

VITRIFIED	
VC	Used in CBN Wheel. Available for grinding of bearing, cam shaft, roll, velocity ball joint and dies.
VD	Used in Diamond Wheel. Available for grinding of cemented carbide, PCD and PCBN.

METAL	
MB21C	Bronze. Widely used as metal bond suited for grinding of glass and lens.
MP5	Bronze. Especially suited for finishing work in lens grinding.
MS3	Bronze. Used in grinding of lens. Harder than MP5.
MF	Cobalt. Used primarily for grinding of architecture glass on a manual working machine.
MG21M	Iron. Used primarily for grinding of vehicle glass on an automatic operating machine.
MG21N	Iron. Used primarily for grinding of vehicle glass on an automatic operating machine. Harder than MG21M.
MW	Bronze. Available in core drill type for boring of glass.
MA	Bronze. Suited for grinding of hardened steel and cemented carbide.
MA5	Bronze. Used in grinding of cemented carbide, HSS and ceramic. Harder than MA.
MF	Bronze. Available in profile type wheels which need an edge for sharp grinding of hardened steel.
MH4	Bronze, Cobalt. Suited for honing of hardened steel, cast iron and aluminum alloy.
MX32	Bronze. Especially suited for grinding of ferrite and ceramic.



BOND LISTS

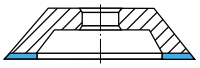
RESINOID				
WORKPIECE	GRADE	APPLICATION	WORK CONDITION	BOND
CEMENTED CARBIDE	J	GENERAL GRINDING	WET	BA
	N		WET OR DRY	BP
	R			BG, BH
	R	CENTERLESS	WET	BG
	R	PROFILE	WET OR DRY	BG, BH
	R	CREEP FEED	WET	BC
	J	LAPPING POLISHING	WET	BA, BD
HARDENED STEEL	N	TOOL GRINDING	WET OR DRY	BB, BP
	R			BN, BE
	R	CUTTING	WET OR DRY	BG, BH
CERAMIC	R	GENERAL GRINDING	WET	BG, BXT
		CENTERLESS	WET	BG
CERMET	R	GENERAL GRINDING	WET	BX, BXT
FERRITE	R	GENERAL GRINDING	WET	BG
GLASS	R	FINISH GRINDING	WET	BQ
	R			B32
PCD PCBN	J	FINISH GRINDING	WET	BA
HARDENED STEEL	NONE	HONING	WET	BA, BG
	NONE	HAND STONE	WET OR DRY	

** NOTE : Not all grades/bonds listed above are available in all wheel shapes.*

BOND LISTS

VITRIFIED		
WORKPIECE	APPLICATION	BOND
CEMENTED CARBIDE	DRILL, ENDMILL, HOB, CUTTING TOOL GRINDING	VC, VD
HARDENED STEEL	THREAD DIE GRINDING	VC
PCD, PCBN	CUTTING TOOL GRINDING	VAW, VAWN, VHGN
CAST STEEL	CAM SHAFT, COMPRESSOR GRINDING	VC VEN
CAST IRON	CYLINDER GRINDING	
BEARING STEEL	VARIOUS BEARING GRINDING	
ALLOY STEEL	CAM SHAFT, GEAR, SEWING MACHINE PART, FUEL INJECTOR PUMP GRINDING	

** NOTE : Not all grades/bonds listed above are available in all wheel shapes.*



BOND LISTS

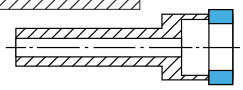
METAL				
WORKPIECE	GRADE	APPLICATION		BOND
CEMENTED CARBIDE	J	GENERAL GRINDING		MA
	N			MA5
HARDENED STEEL	R	EDGE PROFILE GRINDING		MF
GLASS	J	PENCIL EDGE WHEEL	MANUAL WORKING ARCHITECTURE GLASS	ME, MB2
LENS	N		AUTOMATIC OPERATING AUTOMOBILE GLASS	MP5
	R			MS3
QUARTZ	N	LENS FINISH GRINDING		MB21C
	R			MP5
HARDENED CARBIDE CAST STEEL	J	HONING		MH1
	N			MH2
	R			MH3, 4
FERRITE	N	GENERAL GRINDING		MS
	R			MSC
CERAMIC	R	CENTERLESS WHEEL FOR SCREW GRINDING		MF

** NOTE : Not all grades/bonds listed above are available in all wheel shapes.*

WHEEL SHAPES & AVAILABILITY

Carbide Cut Off	Wheel Shape	Size D x T x H (in)	Abrasive Width T (in)	Abrasive Depth X (in)	Grit Size (mesh)
	1A1R	6 X .030 X 1-1/4	0.030	1/4	120
	1A1R	6 X .035 X 1-1/4	0.035	1/4	100
	1A1R	6 X .040 X 1-1/4	0.040	1/4	120
	1A1R	6 X .045 X 1-1/4	0.045	1/4	120
	1A1R	6 X .060 X 1-1/4	0.060	1/4	120
	1A1R	6 X .0625 X 1-1/4	0.0625	1/4	100
	1A1R	8 X .045 X 1-1/4	0.045	1/4	120
	1A1R	8 X .060 X 1-1/4	0.060	1/4	80
	1A1R	10 X .0625 X 1-1/4	0.0625	1/4	80
	1A1R	10 X .070 X 1	0.070	1/4	150
	1A1R	14 X .070 X 1	0.070	1/4	150
Flute Grinding	**Wheel Shape**	**Size D x T x H (in)**	**Abrasive Width T (in)**	**Abrasive Depth X (in)**	**Grit Size (mesh)**
Small Tool Priority >	1A1	4 X 1/2 X 1-1/4	1/2	1/4	230
	1A1	4 X 1/4 X 1-1/4	1/4	1/4	270
	1A1	4 X 3/8 X 1-1/4	3/8	1/4	270
	1A1	4 X 1/2 X 1-1/4	1/2	1/4	270
Small Tool Priority >	1A1	5 X 1/2 X 1-1/4	1/2	1/4	230
	1A1	5 X 1/4 X 1-1/4	1/4	1/4	270
	1A1	5 X 3/8 X 1-1/4	3/8	1/4	270
	1A1	5 X 1/2 X 1-1/4	1/2	1/4	270
Small Tool Priority >	1A1	6 X 1/2 X 1-1/4	1/2	1/4	230
	1A1	6 X 1/4 X 1-1/4	1/4	1/4	270
	1A1	6 X 3/8 X 1-1/4	3/8	1/4	270
	1A1	6 X 1/2 X 1-1/4	1/2	1/4	270
Maximum Versatility & Economy	1A1	4 X 1/2 X 1-1/4	1/2	1/4	180
	1A1	4 X 1/2 X 1-1/4	1/2	1/4	220
	1A1	6 X 1/2 X 1-1/4	1/2	1/4	180
	1A1	6 X 1/2 X 1-1/4	1/2	1/4	220
	1A1	8 X 1/2 X 1-1/4	1/2	1/4	180
	1A1	8 X 1/2 X 1-1/4	1/2	1/4	220
Small Tool Priority >	1V1	4 X 1/2 X 1-1/4	1/2	1/4	230
	1V1	4 X 1/2 X 1-1/4	1/2	1/4	270
	1V1	100mm X 13mm X 31.75mm	13mm	6mm	270/325
Small Tool Priority >	1V1	5 X 1/2 X 1-1/4	1/2	1/4	230
	1V1	5 X 1/2 X 1-1/4	1/2	1/4	270
Small Tool Priority >	1V1	6 X 1/2 X 1-1/4	1/2	1/4	230
	1V1	6 X 1/2 X 1-1/4	1/2	1/4	270
	1V1	150mm X 13mm X 31.75mm	13mm	6mm	270/325

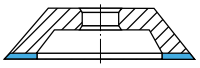
* All prices and specifications are subject to change without notice - please call 1-844-EHWAUSA for latest information



STOCK STANDARD DIAMOND GRINDING WHEELS

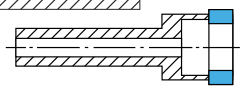
Face Angle (V)	Hardness	Con	Bond Type	Core Material	GT Cust P / N	Wet or Dry	CNC or Manual
-		100			RD1A1R-15021903	Dry	both
-		100			RD1A1R54241-7	Dry	both
-		100			RD1A1R14121004	Dry	both
-		100			RD1A1R14121005	Dry	both
-		100			RD1A1R15050814	Dry	both
-		100			RD1A1R10062103	Dry	both
-	R	100	BG	Steel	RD1A1R14121006	Dry	both
-		100			RD1A1R9052704	Dry	both
-		100			RD1A1R10062102	Dry	both
-		100			RD1A1R10112301	Dry	both
-		100			RD1A1R10112303	Dry	both
Face Angle (V)	**Hardness**	**Con**	**Bond Type**	**Core Material**	**GT Cust P / N**	**Wet or Dry**	**CNC or Manual**
-	R	125	PA8	Al	RD1A114121007	Wet	CNC
-	R	100	BMX	Cu	RD1A114121008-1	Wet	CNC
-	R	100	BMX	Cu	RD1A114121008-2	Wet	CNC
-	R	100	BMX	Cu	RD1A114121008	Wet	CNC
-	R	125	PA8	Al	RD1A114121009	Wet	CNC
-	R	100	BMX	Cu	RD1A114121010-1	Wet	CNC
-	R	100	BMX	Cu	RD1A114121010-2	Wet	CNC
-	R	100	BMX	Cu	RD1A114121010	Wet	CNC
-	R	125	PA8	Al	RD1A114121011	Wet	CNC
-	R	100	BMX	Cu	RD1A114121012-1	Wet	CNC
-	R	100	BMX	Cu	RD1A114121012-2	Wet	CNC
-	R	100	BMX	Cu	RD1A114121012	Wet	CNC
-	R	100	BG	Al	RD1A115050809	Wet/Dry	Both
-	R	100	BG	Al	RD1A115050810	Wet/Dry	Both
-	R	100	BG	Al	RD1A1-15021901	Wet/Dry	Both
-	R	100	BG	Al	RD1A1-15021902	Wet/Dry	Both
-	R	100	BG	Al	RD1A115050811	Wet/Dry	Both
-	R	100	BG	Al	RD1A115050812	Wet/Dry	Both
10°	R	125	PA8	Al	RD1V114121013	Wet	CNC
30°	R	100	BMX	Cu	RD1V114121014	Wet	CNC
25°	R	125	BXT	Al	RD1V115071702	Wet	CNC
10°	R	125	PA8	Al	RD1V114121015	Wet	CNC
30°	R	100	BMX	Cu	RD1V114121016	Wet	CNC
10°	R	125	PA8	Al	RD1V114121017	Wet	CNC
30°	R	100	BMX	Cu	RD1V114121018	Wet	CNC
25°	R	125	BXT	Al	RD1V115071701	Wet	CNC

See our website www.Ehwa Diamond USA.com for the latest offer.



Gash Grinding	Wheel Shape	Size D x T x H (in)	Abrasive Width T (in)	Abrasive Depth X (in)	Grit Size (mesh)
Small Tool Priority >	1V1	5 X 1/2 X 1-1/4	1/2	1/4	270
	1V1	5 X 1/2 X 1 1/4	1/2	1/4	270
Relief Grinding	**Wheel Shape**	**Size D x T x H (in)**	**Abrasive Width U, W (in)**	**Abrasive Depth X (in)**	**Grit Size (mesh)**
Small Tool Priority >	11V9	3-3/4 X 1-1/2 X 1-1/4	3/8	1/8	230
	11V9	3-3/4 X 1-1/2 X 1-1/4	3/8	1/8	270
Small Tool Priority >	11V9	5 X 1-3/4 X 1-1/4	3/8	1/8	230
	11V9	5 X 1-3/4 X 1-1/4	3/8	1/8	270
Maximum Versatility & Economy	11V9	3-3/4 X 1-1/2 X 1-1/4	3/8	1/8	180
	11V9	3-3/4 X 1-1/2 X 1-1/4	3/8	1/8	220
	11V9	5 X 1-3/4 X 1-1/4	7/16	1/8	180
	11V9	5 X 1-3/4 X 1-1/4	7/16	1/8	220
	12V9	6 X 1 X 1-1/4	3/8	1/8	180
Burr Grinding	**Wheel Shape**	**Size D x T x H (in)**	**Abrasive Width T (in)**	**Abrasive Depth X (in)**	**Grit Size (mesh)**
CNC Priority	1V1	6" X 2.6mm X 1-1/4	2.6mm	1/4	325
	1V1	6" X 2.6mm X 1-1/4	2.6mm	1/4	270
	1V1	6" X 2.6mm X 1-1/4	2.6mm	1/4	270
EDG (Erosion)	**Wheel Shape**	**Size D x T x H (in)**	**Erosion Width**	**Electrode Depth**	
Anca	1A1	127mm X 12.7mm X 32mm	12.7mm	40mm	
Anca	1V1	127mm X 12.7mm X 32mm	12.7mm	40mm	
Walters	12A2	125mm X 23.8mm X 20mm	23.8mm	40mm	
H.S.S. Grinding	**Wheel Shape**	**Size D x T x H (in)**	**Abrasive Width U, W (in)**	**Abrasive Depth X (in)**	**Grit Size (mesh)**
CBN	11V9	3-3/4 X 1-1/2 X 1-1/4	3/8	1/8	60/80
CBN	11V9	3-3/4 X 1-1/2 X 1-1/4	3/8	1/16	100/120
CBN	1A1	5 X 1/2 X 1-1/4	1/2	1/4	180/200
CBN	1V1	5 X 1/2 X 1-1/4	1/2	1/4	180/200

*** All prices and specifications are subject to change without notice - please call 1-844-EHWAUSA for latest information**



STOCK STANDARD DIAMOND/CBN GRINDING WHEELS

Face Angle (V)	Hardness	Con	Bond Type	Core Material	GT Cust P / N	Wet or Dry	CNC or Manual
30°	R	125	PA6	Al	RD1V114121019	Wet	CNC
45°	R	100	BMX	Cu	RD1V114121020	Wet	CNC
Face Angle (V)	**Hardness**	**Con**	**Bond Type**	**Core Material**	**GT Cust P / N**	**Wet or Dry**	**CNC or Manual**
-	R	125	BCT	Powder Al	RD11V914121021	Dry	CNC
-	R	100	BMX	Powder Al	RD11V914121022	Wet	CNC
-	R	125	BCT	Powder Al	RD11V914121023	Wet	CNC
-	R	100	BMX	Powder Al	RD11V914121024	Wet	CNC
-	R	100	BG	Powder Al	RD11V915050805	Dry	Manual
-	R	100	BG	Powder Al	RD11V915050806	Dry	Manual
-	R	100	BG	Powder Al	RD11V915050807	Dry	Manual
-	R	100	BG	Powder Al	RD11V915050808	Dry	Manual
-	R	100	BG	Powder Al	RD12V915050813	Dry	Manual
Face Angle (V)	**Hardness**	**Con**	**Bond Type**	**Core Material**	**GT Cust P / N**	**Wet or Dry**	**CNC or Manual**
40°	N	160	ME4	Steel	MD1V114060302-2	Wet	CNC
30°	N	150	ME4	Steel	MD1V114060302-1	Wet	CNC
25°	N	150	ME4	Steel	MD1V114060302	Wet	CNC
Face Angle (V)				**Core Material**	**GT Cust P / N**	**Wet or Dry**	**CNC or Manual**
-				70Wc/30Cu	MD1V115061104		
65°				70Wc/30Cu	MD1A115061104		
-				70Wc/30Cu	MD12A215061104		
Face Angle (V)	**Hardness**	**Con**	**Bond Type**	**Core Material**	**GT Cust P / N**	**Wet or Dry**	**CNC or Manual**
-	R	75	BB	Powder Al	RB11V952086-1	Wet/Dry	Both
-	R	75	B	Powder Al	RB11V954064-1	Wet/Dry	Both
-	R	100	BC	Powder Al	RB1A110043004	Wet/Dry	Both
45°	R	100	BC	Powder Al	RB1V110043004	Wet/Dry	Both

See our website www.Ehwa Diamond USA.com for the latest offer.

QUICK REFERENCE GUIDE

The first section of the Wheel Shapes and Availability section is designed to provide you with a quick reference guide in determining the appropriate wheel shape/type.
A drawing of each shape is presented along with letter codes used to indicate the various dimensional characteristics.
The Key to Letter Dimensions listed below applies to wheels.
The remaining pages in the Wheel Shapes and Availability section provide a listing of the most common dimensions and bonds offered for the most popular wheel types.

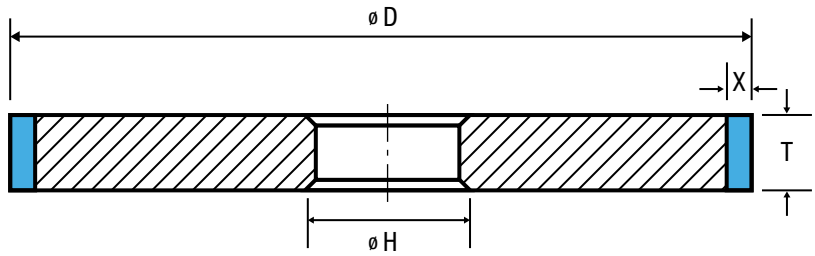
KEY TO LETTER DIMENSIONS FOR DIAMOND AND CBN WHEELS

B.C. : Bolt Circle
D : Wheel Diameter
d : Description of Mounting Hole
E : Back Thickness
H : Hole Size
J : Hub Diameter
R : Radius
T : Wheel Thickness
S : Back Angle
L : Length of Types DW, HH1, HMF, 2FF2, 6F2
n : Number of Mounting Holes
U : Diamond Face for Types 3A1, 14A1, 14EE1. 14U1 and Pencil Edgers
Insert Length for Types 1E6Q, 6A9, 11C9. 11V9. 11Y9, 12V9
V : Face Angle for Types 1V1, 4B2, 11B2, 12V4
Included Angle for Types 1E1, 1EE1, 1E6Q, 14EE1
W : Rim Width
X : Diamond and CBN Depth
K : Inside Flat Diameter
Y : Shank Diameter for Type DW, 6F2

** Please specify the dimensions if not filled in our tables.*

WHEEL SHAPES

TYPE 1A1



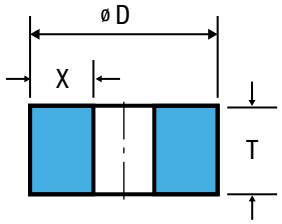
D	T	X	BOND
15	3 - 13	1.5, 2, 3	B, M
		3	V
20		1.5, 2, 3	B, M
		3	V
22		1.5, 2, 3	B, M
		3	V
25 - 35	3 - 20	1.5, 3, 5	B, M
		3, 5	V
40 - 70	3 - 22	1.5, 3, 5	B, M
		3, 5	V
75, 100, 125	3 - 10	3	B, M
150, 175, 200	3 - 25	3, 5	B, M, V
250, 300	5 - 25		
350, 400, 450	13 - 30		
500, 550, 600	20 - 45		

TYPE 1A1 - OVER 50MM THICK

D	T	X	BOND
250, 300, 350 400, 450, 500	50, 75 100, 125, 150	3, 5	B, M, V

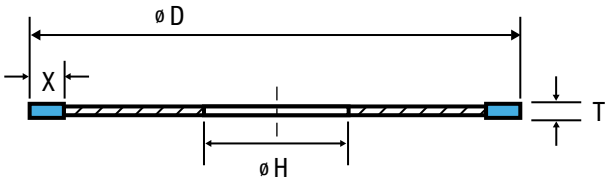
WHEEL AVAILABILITY

TYPE 1A8



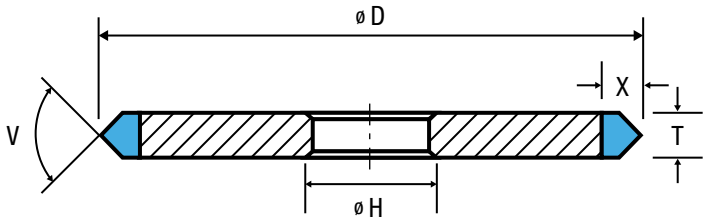
D	T	X	BOND
10	3 - 13	3	B, M, V
13	3 - 15	3, 5	
15	10 - 20	3, 5, 6	
20 - 30		3, 5, 8	

TYPE 1A1R



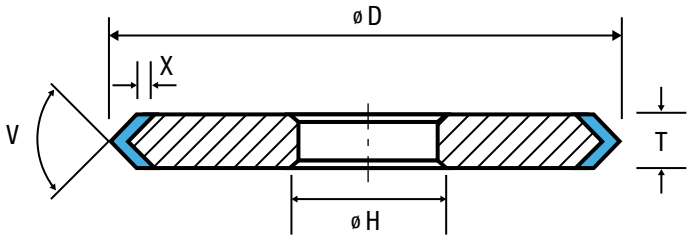
D	T	X	BOND
75, 100	0.5 - 0.65	4	B
125, 150	0.66 - 3.0	4, 7	
175	07 - 3.0		
200	0.8 - 3.0		
250	1.0 - 3.0		
300, 350	1.2 - 3.0	7	
400	2.2 - 3.0		

TYPE 1E1



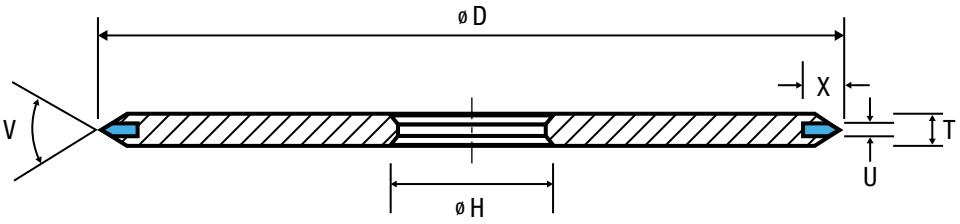
D	T	X	V	BOND
75, 100 125, 150	3	3	90° & larger	B, M, V
		5	60° & larger	
		6	45° & larger	
		8	30° & larger	
	5	5	90° & larger	
		8	60° & larger	
		10	45° & larger	
175, 200	5	5	90° & larger	
		8	60° & larger	
		10	45° & larger	

TYPE 1EE1



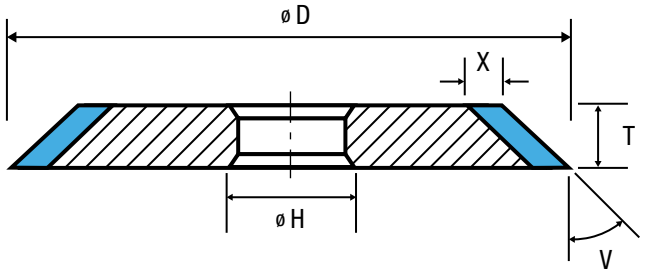
D	T	X	V	BOND
75, 100 125, 150	3, 5	3	30° & larger	B, M
	10		45° & larger	
	13		60° & larger	
	20		90° & larger	
175	10		45° & larger	
	13		60° & larger	
	20		90° & larger	
200, 250, 300	5, 10, 13		60° & larger	
	15, 20		90° & larger	

TYPE 1E6Q



D	T	X	U	V	BOND
75, 100	5, 6	5, 6	1.3 - 2.0	45°, 60°, 90°	B
125, 150 175, 200	5, 10, 13	10, 13	1.3 - 3.0		

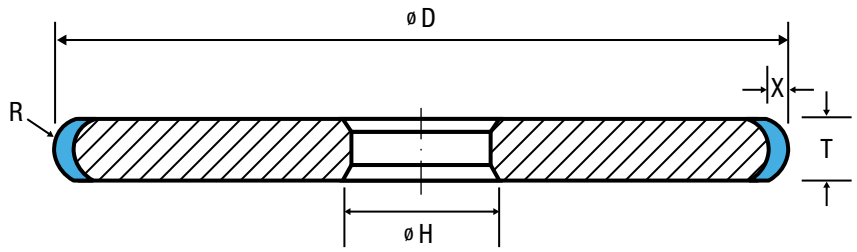
TYPE 1V1



D	T	X	V	BOND
75, 100	3 - 13	3, 5	5°	V
			5° - 45°	B, M
125			5°	V
			5° - 45°	B, M
	15, 20		10° - 30°	
150	3 - 13	3, 5, 6	5°	V
			5° - 45°	B, M
	15 - 25		10° - 30°	
175, 200	5 -13		5°	V
			5° - 45°	B, M
	15 - 25		10° - 30°	
250, 300	5, 10, 13		5°	V
			5° - 45°	B, M
	15 - 25		10° - 30°	

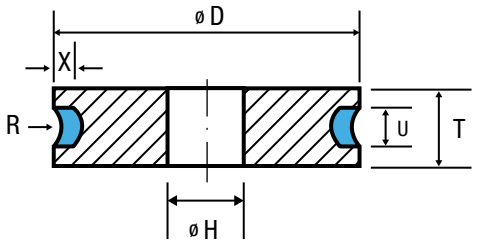
WHEEL AVAILABILITY

TYPE 1FF1



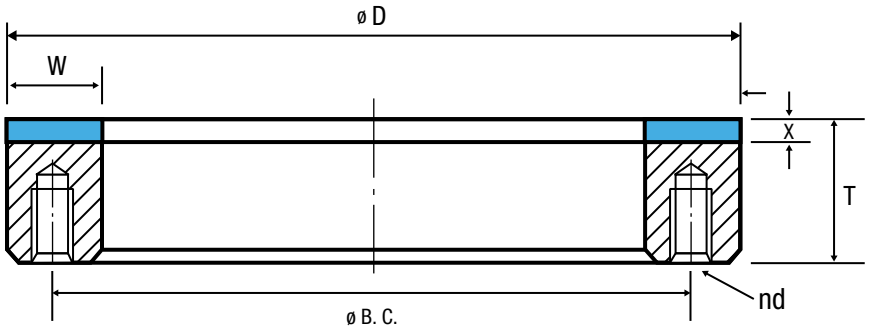
D	T	X	R	BOND
50, 75	3	3, 5	1.5	B, M
	5		2.5	
	6		3	
	8		4	
	10		5	
	12		6	
100, 125	3		1.5	
	5		2.5	
	6		3	
	8		4	
	10		5	
	12		6	
	15		7.5	
150, 175 200, 250	5		2.5	
	6		3	
	8		4	
	10		5	
	12		6	
	15		7.5	
	20		10	
	22		11	
	25		12.5	

TYPE 1FF6Y



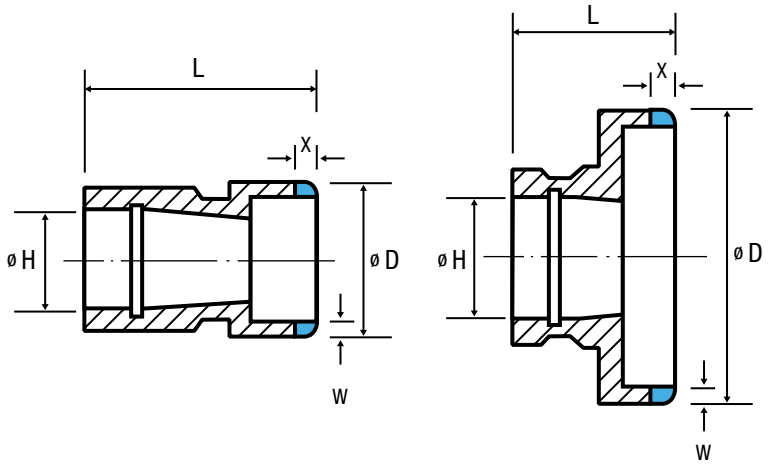
D	T	X	U	BOND
100, 125	20	3, 5	5 - 13	M
150, 175, 200, 250	15		2 - 5	

TYPE 2A2T



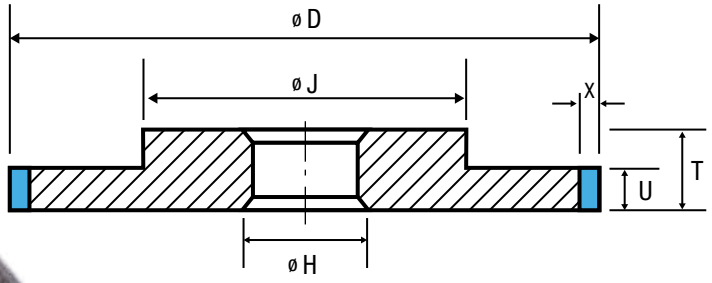
D	T	W	X	BOND
200, 250, 300	20, 22, 25	5, 10, 15, 20, 25	3, 5	B, M
350, 400 450, 500, 550		10, 15 20, 25		

TYPE 2FF2



D	W	X	BOND
10 - 125	2	6, 8	M

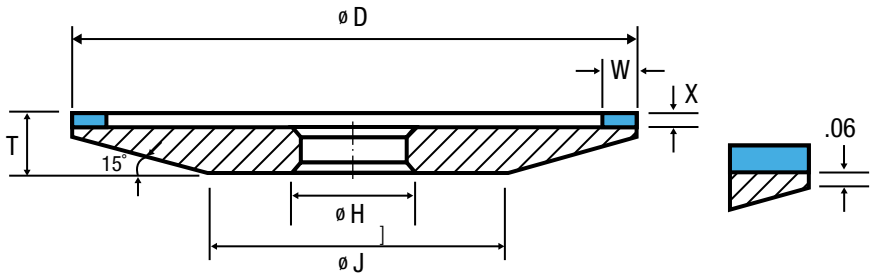
TYPE 3A1



D	T	U	X	BOND
75, 100, 125	15, 20, 25	3, 5	3, 5	V
150, 175, 200	15, 25, 30		2, 3, 5	B, M
		3, 5, 10	3, 5	B, M, V
250, 300, 350	25, 35	5, 13, 20		
400, 450 500, 550, 600	35, 50	13, 20, 25		

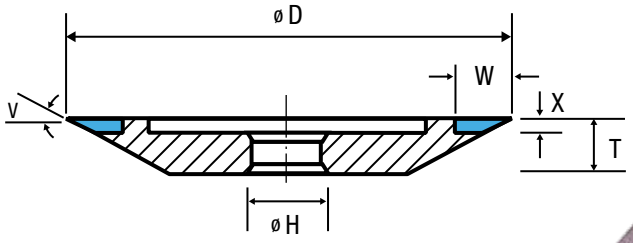
WHEEL AVAILABILITY

TYPE 4A2



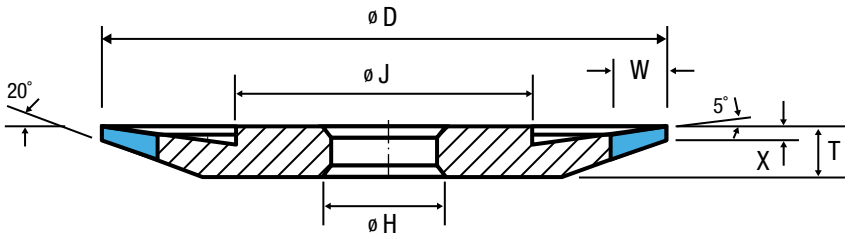
D	T	W	X	BOND
75, 100, 125, 150	6 - 25	3, 5, 10	1.5, 3	B, M
175, 200, 250	13 - 25	5, 10, 13	3, 5, 6	

TYPE 4B2



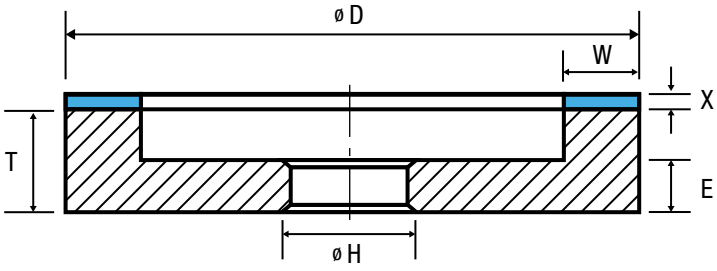
D	T	W	X	V	BOND
100	6	5	1.5	15°, 30°, 45°	B. M
		8			
		10	2.0		
125	10	8	1.5		
		10	2.0		
		12	3.0		
150, 175, 200	13	5	1.5		
		8			
		10	2.0		
		12	3.0		

TYPE 4M1



D	T	W	X	BOND
75	6	5, 6	1.0, 2.0	B, M
100	10	5, 6, 10		
125, 150	13			
175, 200	15			

TYPE 6A2

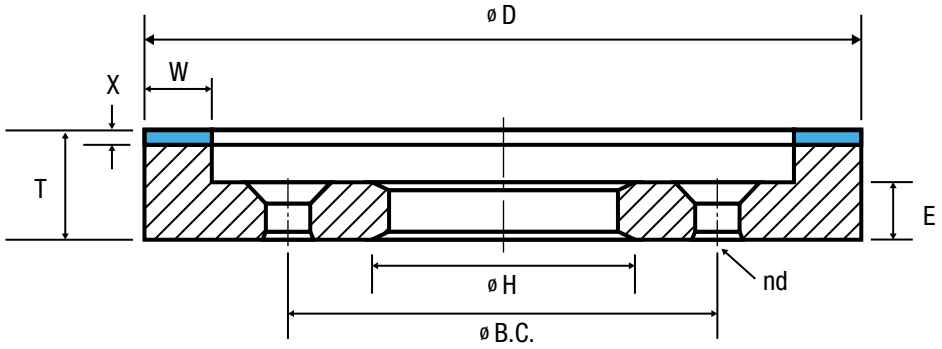


D	T	W	X	E	BOND
50	15	3	1.5, 3	5	B, M
			3		V
75		3, 5, 10	1.5, 3		B, M
			3		V
100, 125		3, 5, 10, 15	1.5, 3		B, M
	20, 25, 30		3, 5	10	V
150	20	5, 10 15, 20, 25	1.5, 3		B, M, V
	25, 30		3, 5		B, M
175, 200, 250					B, M, V
300, 350	30 - 95	10, 15, 20, 25		15	

TYPE 6A2 - OVER 25MM RIM WIDTH

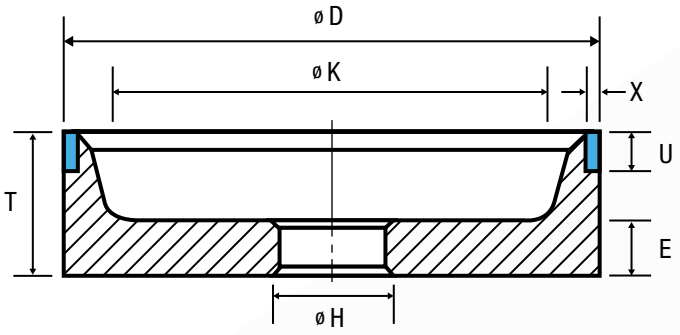
D	T	W	X	E	BOND
150, 175, 200	25	25, 50	3, 5	20	B, M
250, 300, 350	25, 50	25, 50, 75			
400, 450, 500	25, 50, 75	25, 50, 75, 100, 125			

TYPE 6A2C

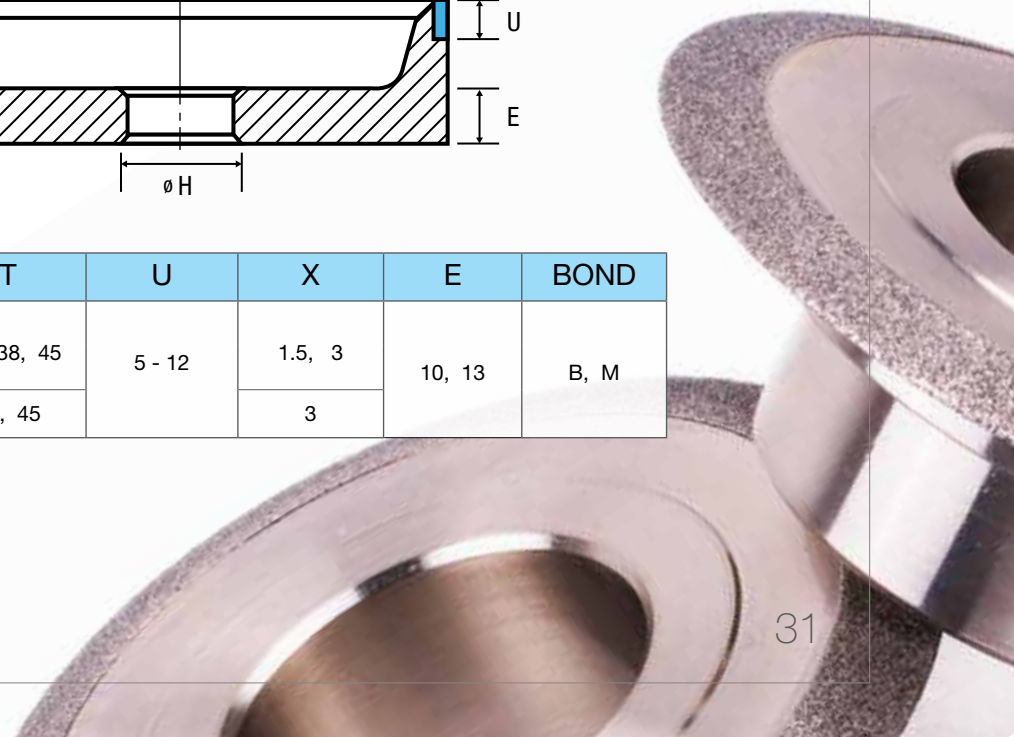


D	T	W	X	E	BOND
150	20	5, 10 15, 20, 25	1.5, 3	10	B, M
175, 200, 250	25, 30		3, 5		B, M, V
300, 350		20, 25, 50		13	

TYPE 6A9

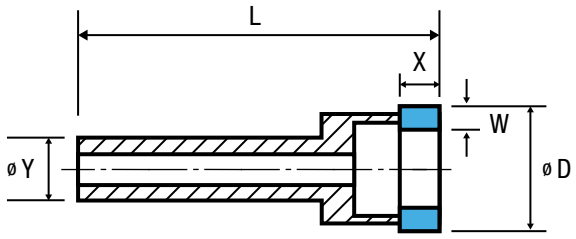


D	T	U	X	E	BOND
100, 125	30, 38, 45	5 - 12	1.5, 3	10, 13	B, M
150					
175, 200, 250, 300	38, 45		3		



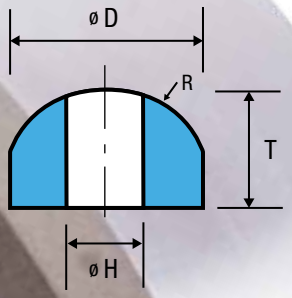
WHEEL AVAILABILITY

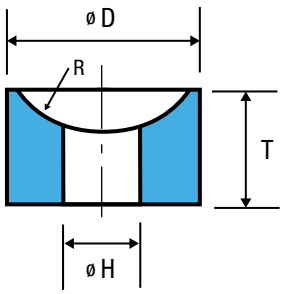
TYPE 6F2



D	W	X	L	BOND
5 - 25	1.0, 1.3	5	75, 100	M
27 - 100	1.5	9		

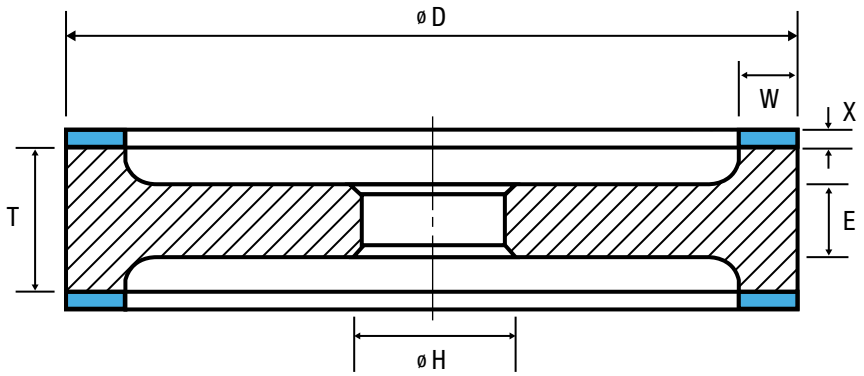
TYPE 6P5





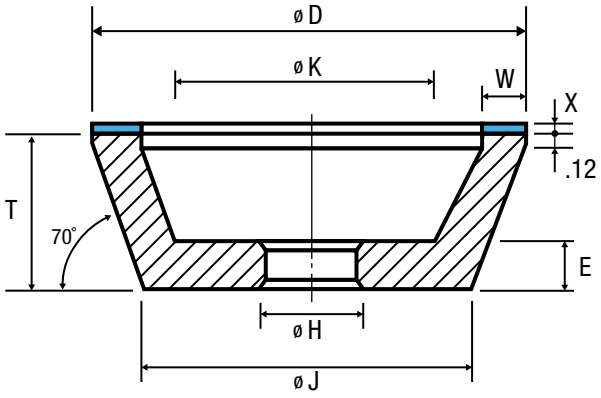
D	T	BOND
5 - 30	10, 13, 20	M

TYPE 9A3



D	T	W	X	E	BOND
100, 125	22, 25, 30	5, 10	1.5, 3	10	B, M
150, 175, 200	25, 30	5, 13, 20	1.5, 3, 5		
			3, 5		
250, 300, 350	30, 50			13	

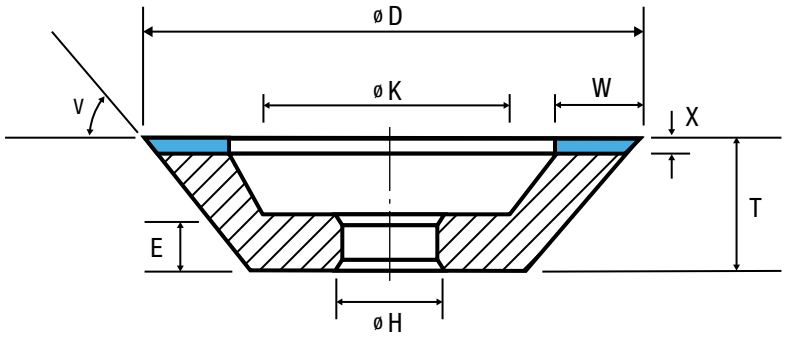
TYPE 11A2



D	T	W	X	E	BOND
75	22 - 30	3, 5, 10	1.5, 3	10	B, M
			3		V
100, 125		5, 10, 13	1.5, 3		B, M
			3		V
150	25 - 45		1.5, 3, 5		B, M
			3, 5		B, M, V
175, 200, 250					

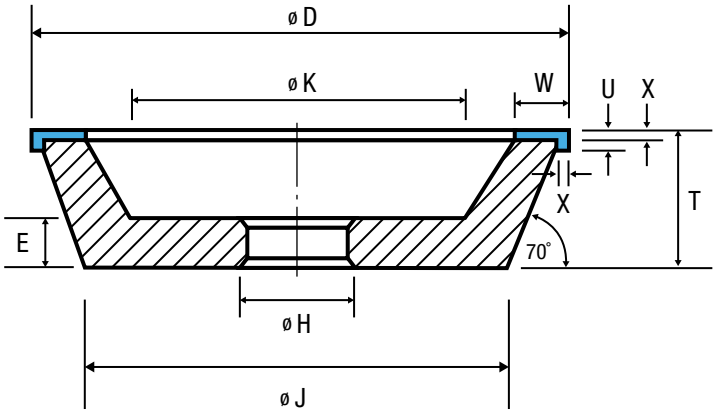
WHEEL AVAILABILITY

TYPE 11B2



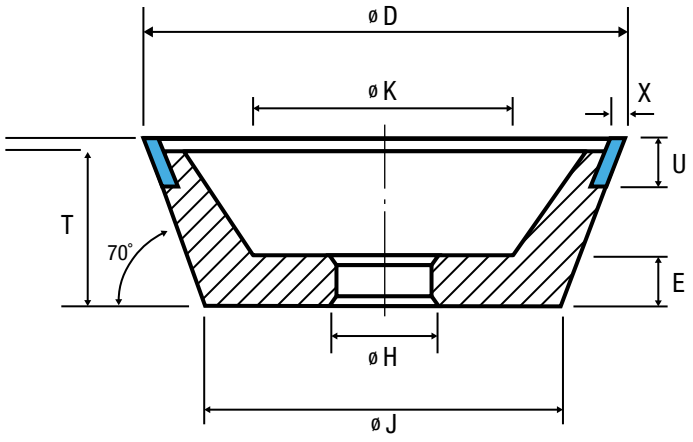
D	T	W	X	E	V	BOND
75	25	3, 5	1.5, 3, 5	10	70°	B
100, 125		3, 5, 10			60°, 70°	
150, 175, 200	25, 38	3, 5, 10, 12	3, 5		45°, 60°, 70°	

TYPE 11C9



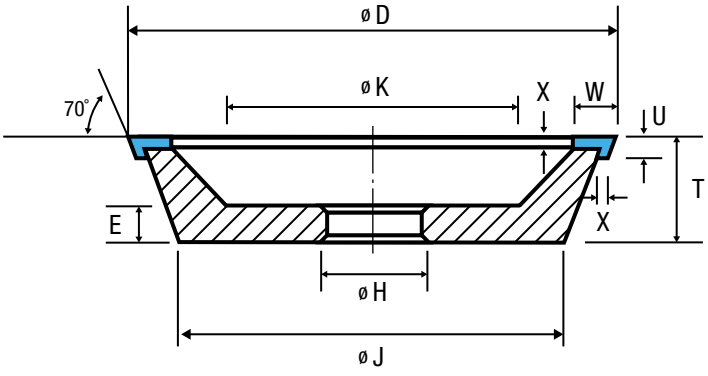
D	T	W	X	U	E	BOND
75, 100, 125	25, 38	5, 10	2, 3	5, 6	10	B, M
150, 175, 200	38	5, 10, 15				
250				6, 8		

TYPE 11V9

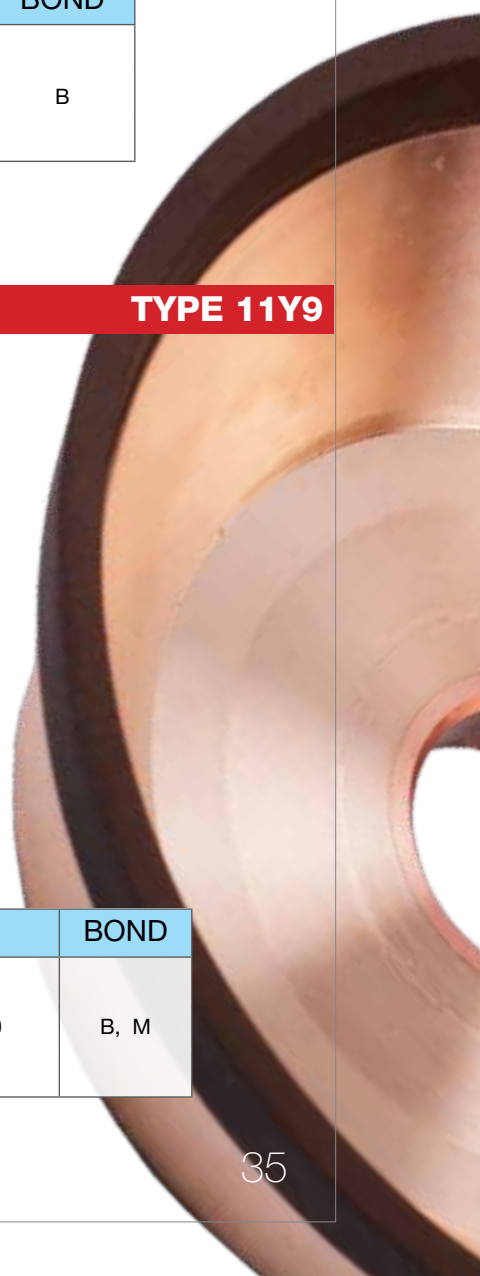


D	T	U	X	E	BOND
75	30	5 - 12	2, 3	10	B
100	30, 35				
125, 150					

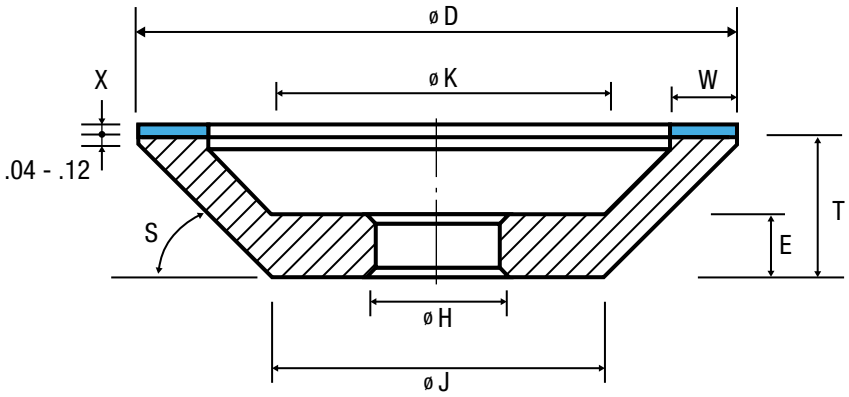
TYPE 11Y9



D	T	W	X	U	E	BOND
75, 100, 125	25, 38	5, 10	2, 3	5, 6	10	B, M
150, 175, 200	38	5, 10, 15				
250				6, 8		



TYPE 12A2



(S = 45°)

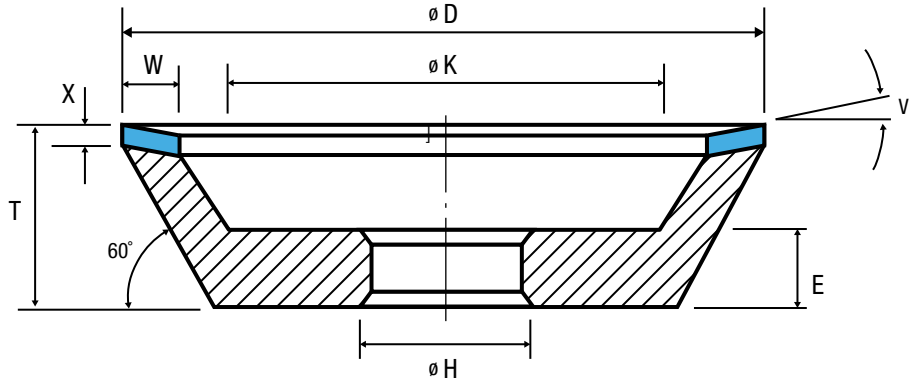
D	T	W	X	E	BOND
75, 100, 125	20	3, 5	1.5, 3	6	B, M
			3		V
150	25	5, 10, 13	1.5, 3, 5	10	B, M
			3, 5		V
175, 200		5, 10 15, 20, 25	1.5, 3, 5		B, M
			3, 6		B, M, V
250, 300	30				

(S = 20°)

D	T	W	X	E	BOND
75, 100	13	3, 5	1.5, 3	6	B, M
			3		V
125	20	3, 5, 10	1.5, 3	10	B, M
			3		V
150, 175	25	5, 10, 15	1.5, 3		B, M
			3, 5		B, M, V
200, 250	30				

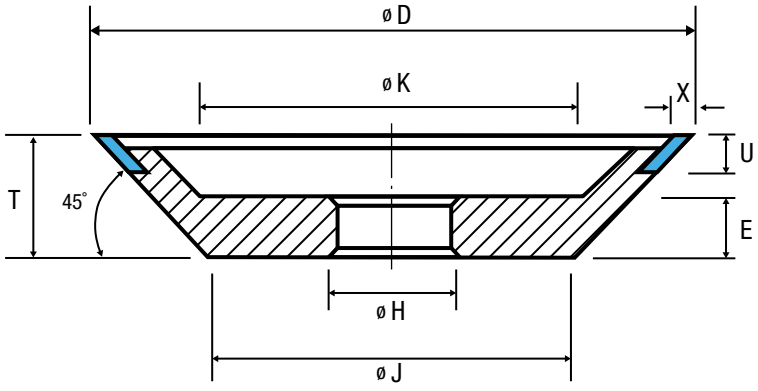
WHEEL AVAILABILITY

TYPE 12V4



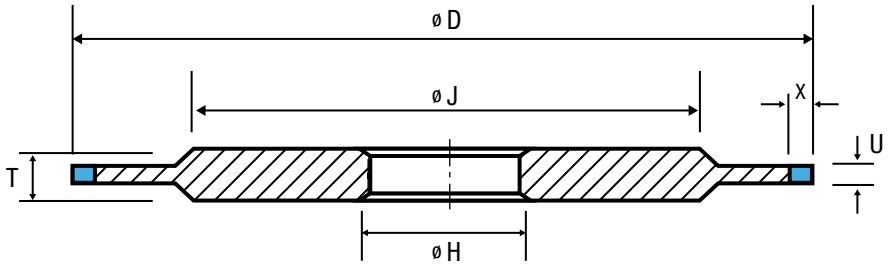
D	T	W	X	E	V	BOND
40	25	3	3, 5	10	10° 20°	B
50, 75						
100, 125, 150	40	3, 5				

TYPE 12V9



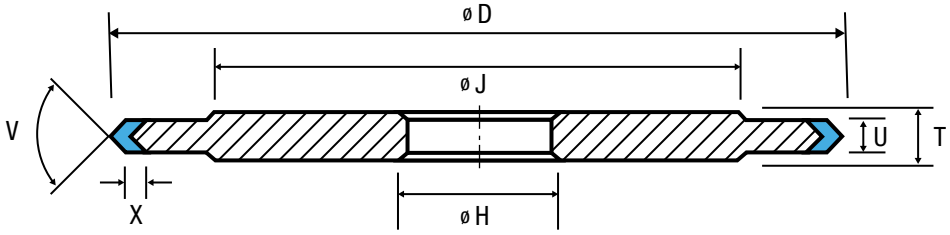
D	T	U	X	E	BOND
75, 90	20	5, 10, 12	1.5, 3	10	B
100	22				
125, 150, 175, 200	25				

TYPE 14A1



D	T	X	U	BOND
75, 100, 125	10	3	1.5	B, M
	13, 25	3, 5	3, 5, 10	B, M, V
150	10	5	1.5	B, M
	13, 25	3, 5	3, 5, 10	B, M, V
	25, 30		13 - 20	
			3 - 20	
175, 200, 250				
300, 350, 400			10 - 20	
450, 500, 550, 600	35, 50		25 - 30	

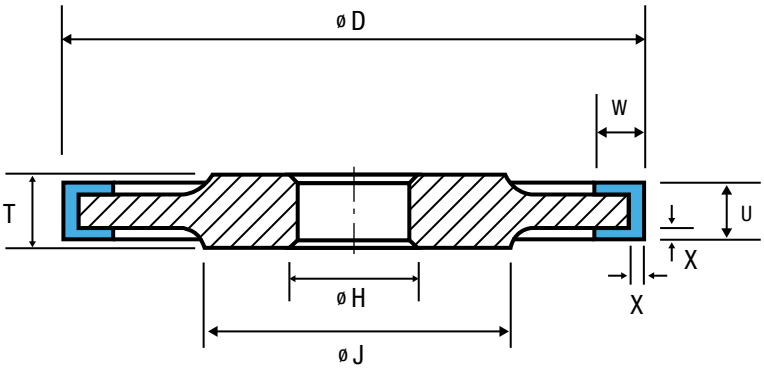
TYPE 14EE1



D	T	U	X	V	BOND
75, 100 125, 150	15, 22, 25	3, 5	3	30° & larger	B, M
		10		45° & larger	
	25, 30	13		60° & larger	
		20		90° & larger	
175	15, 22, 25	10		45° & larger	
	25, 30	13		60° & larger	
		20		90° & larger	
200, 250, 300	22, 25	5, 10, 13		60° & larger	
	30 - 40	10 - 25		90° & larger	
350, 400		13 - 25			

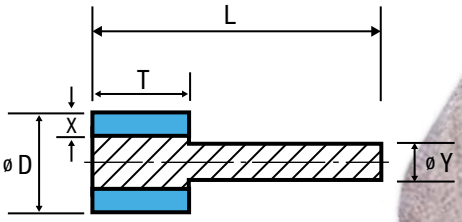
WHEEL AVAILABILITY

TYPE 14U1



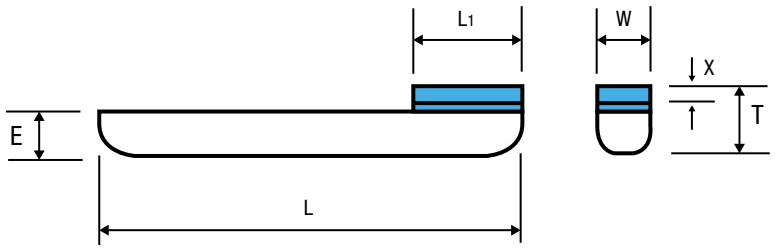
D	T	W	X	U	BOND
100, 125	15, 20, 22	3, 5, 10	3	10	B, M
150, 175	22, 25	5, 10, 15			
200, 250 300, 350	40				
		10, 15, 20		13 - 20	

TYPE DW



D	T	X	BOND
5	3, 5	1.5	B, M, V
		solid	B, M
8	5, 8, 10	1.5	B, M, V
		solid	B, M
10, 12	5, 10, 12	2, 3	B, M, V
		solid	B, M
15, 20, 25	5, 10, 12, 15	2, 3	B, M, V
		solid	B, M
25, 30, 35, 40	5, 10, 12	3	B, M, V
	15, 20, 25		
		solid	B, M

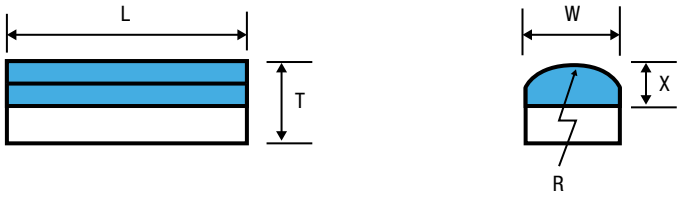
TYPE HH1



L	W	X	T	L_1	BOND
120	10	1.5, 3	11.5, 13	40	B

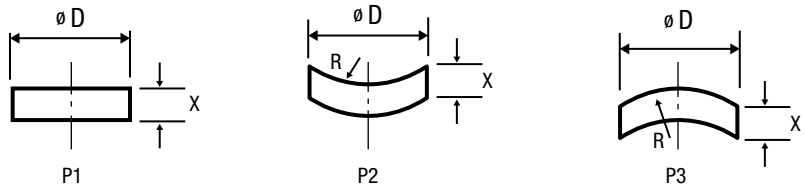
L_1: Length of Abrasive Section

TYPE HMF



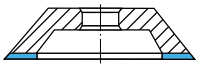
L	W	X	R	BOND
25 - 100	3, 5, 6	3, 6	specify	B, M, V
			flat	

TYPE P



D	X	BOND
10 - 25	3, 5, 6	M

GENERAL INFORMATION



GENERAL INFORMATION
DIAMOND GRINDING WHEELS

DIAMOND

The diamonds used in the manufacturing of EHWA diamond grinding wheels can be classified into two categories: natural diamonds and synthetic diamonds. Ever since synthetic diamonds were first introduced in 1957, their applications have been steadily increasing. Now they are accepted as the principal material for diamond grinding wheels.

Two important achievements in the history of synthetic diamonds are the development of strong, tough diamond grits used for saw blades and the improvement of grits for resinoid bonds. Some grits for resinoid bonds are coated with metal which enables the resinoid bond grinding wheels to achieve better performance.

Diamond powder is commercially available in 50 grades, and each grade has its own unique features. Diamonds may be classified into the following three categories in terms of bonding method:

- **Resinoid Bond**
- **Metal Bond**
- **Vitrified Bond**

The grit types and grit sizes of grinding wheels can be selected depending on workpieces, bonds, and grinding conditions. To help us design the grinding wheels best suited to your purpose, please refer to “How to order diamond and CBN wheels” on page 5 and provide us with the necessary information.

CONCENTRATION

Concentration is the content of diamonds in a unit volume of a grinding wheel.
When content is 25 volume %, concentration is 100, which is equivalent to 4.4cts/cc of diamond in the grinding wheel. The relationship among grit content (in volume %), concentration, and diamond content (in cts/cc) is as follows:

GRIT CONTENT (VOLUME %)	CONCENTRATION	DIAMOND CONTENT (CT/CC)
25	100	4.4
18.75	75	3.3
12.5	50	2.2
6.25	25	1.1

As illustrated above, the price of a grinding wheel largely depends on its concentration. Since the appropriate concentration of a wheel depends on work materials, grinding conditions, etc., please refer to “How to order diamond and CBN wheels” on page 5 and supply us with the necessary details.

GRIT SIZE

Diamond grit sizes are classified into 22 grades as shown in the following table. The nominal grit size of a grinding wheel indicates the coarsest size grits which are present in the wheel. For instance, the grits in the #140/170 range pass through a #140 sieve and are trapped by a #170 sieve. The grit size in this range is noted as #140.

Grit size classification by sieves is only feasible up to #325 mesh. After this, the grit size is still indicated by number (#...), but the method of classification is different. Grit sizes can be more accurately understood by correlating them to their respective mesh sizes and grit size scatter in diameter (see chart below).

NORMAL GRIT SIZE (mesh)	GRIT SIZE RANGE (mesh of grit use)	FEPA	NORMAL GRIT SIZE (mesh)	GRIT SIZE RANGE (mesh of grit use)	FEPA
16	16/20		200	200/230	D 76
20	20/30	B 852	230	230/270	D 64
30	30/40	B 602	270	270/325	D 54
40	40/50	B 426	325	325/400	D 46
50	50/60	B 301	400		
60	60/80	B 252	600		
80	80/100	B 181	800		
100	100/120	B 151	1000		
120	120/140	B 126	1500		
140	140/170	D 107	2000		
170	170/200	D 91	3000		

BOND

There are three alternative bonding methods: resinoid bond, metal bond, and vitrified bond.

• RESINOID BOND

Resinoid bond grinding wheels are manufactured by using resinoid bonds to bond diamond grits.
There are two types of resinoid bonds: the phenol resin type and the polyimide resin type. The phenol resin type is currently in more common usage.
Resinoid bond grinding wheels have good elasticity, fine surface finish, and high grinding performance. They are effective for:
(1) grinding of cemented carbide
(2) combination grinding of cemented carbide and hardened steel
(3) grinding of cermet
(4) precision grinding of magnetic materials, glass, ceramics, etc. Polyimide wheels are recommended for heavy grinding and creep-feed grinding.

• METAL BOND

Metal bond grinding wheels are manufactured by sintering metal powder to bond diamond grits. These wheels are superior in grit retention, and therefore preferred:
(l) when a long service life is required
(2) when wear of the grinding wheel needs to be minimized (such as in form grinding)
(3) in hand grinding of cemented carbide
(4) in profile grinding
(5) in the cutting and grinding of hard, and brittle materials such as ceramics, glass, and quartz
(6) in the cutting and grinding of magnetic materials such as ferrite
(7) in the cutting and grinding of stone
(8) in the cutting and grinding of graphite, etc.
The high grit retention quality of metal bond can also cause grazing or loading. The increase of grinding pressure and of heating due to loading may cause thermal damage to the workpiece. In order to prevent thermal damage, please choose the grinding process, conditions, coolant, dressing intervals, etc. carefully.

• VITRIFIED BOND

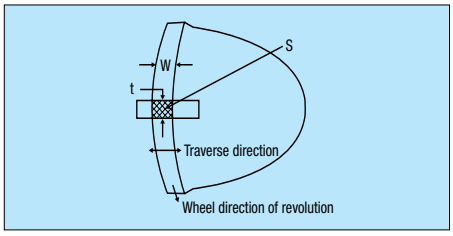
Vitrified bond grinding wheels are manufactured by using vitrified bonds to bond diamond grits. As vitrified bonds are porous, vitrified bond wheels can overcome the forming and dressing difficulties encountered with resinoid bond and metal bond grinding wheels. Vitrified bond wheels are used to grind cemented carbide, sintered diamond tools, etc.

WHEEL DIAMETER

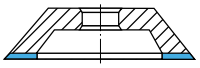
The heat produced by grinding with diamond wheels is cooled by the grinding fluid and by air. If the diameter of the wheel is small, the grits heated in the grinding process may not have sufficient time to be cooled before they come into contact with the workpiece in the next rotation. This results in progressive heat accumulation as grinding continues. And this in turn accelerates the wear of the diamond grits themselves as well as the deterioration of the resinoid bond in the vicinity of each grit, resulting in the early pull-out of the diamond grits.
It is always recommended that the diameter of the grinding wheel be made as large as possible. In high removal grinding, the heating is increased and the wheel life is shortened ; thus, the costs of grinding are also increased. For this reason, too, it would be advantageous to make the diamond wheel diameter as large as possible.

WHEEL RIM WIDTH

When the workpiece and the diamond wheel come into surface contact, stock removal is performed on the contact surface (s). The size of the contact surface is determined by the wheel rim width(w) and the contact length (t).



Stock removal is the cutting of the workpiece by the diamonds at the contact surface.
The force between the diamond wheel and the workpiece depends on the machine rigidity, the work supporting system, and the work type.
When the pressing force is constant, the surface pressure on the diamond wheel(kg/mm2) increases as the wheel width decreases.



The diamond grits then give a higher cutting performance, and the stock removal rate increases. This is of great practical significance in plunge grinding with a cup wheel or a straight wheel.
For greater efficiency, the wheel- -workpiece contact area should be made as small as possible. On the other hand, the life of the diamond wheel increases as the wheel width increases. The width of the wheel should be determined after taking into consideration the required working efficiency, the machine rigidity, and other pertinent factors.

MACHINE

The grinding machine should have sufficient rigidity. Vibration of the table or the spindle will most likely cause the forming of an oscillation mark" or severe wheel wear. In order to achieve the optimum grinding efficiency, enough machine power is required to ensure stabilized peripheral speed of the wheel and stabilized infeed. A machine without sufficient power will result in insufficient wheel speed, abnormal wear, and decreased grinding efficiency. It is always best to use a vibration-free, highly rigid grinding machine with sufficient horse power.

MOUNTING OF GRINDING WHEEL

If the wheel is not properly set and if the periphery and the sides of the grinding wheel attached to the machine spindle are subject to vibration, problems arise during grinding, including:
(1) Oscillation marks on the workpiece.
(2) Machine begins to vibrate; grinding noise increases
(3) Wheel life is notably shortened.

To avoid these problems, the grinding wheel must be mounted properly.
When a cup wheel or dish wheel is mounted on the machine, side runout should be less than 0.02mm. Likewise, peripheral runout should be less than 0.02mm when a straight wheel is mounted. If the wheel runout is over 0.02mm, reduce runout by following the procedures below:
(1) Fasten the grinding wheel gently on the flange fixed to the machine.
(2) Check the periphery runout using a dial indicator.
(3) Reduce the periphery runout by gently hammering the periphery of the grinding wheel.
(4) After adjusting as instructed above and tightly fastening the grinding wheel, recheck the periphery runout with the dial indicator.
The above procedures are valid only if there is a space between the internal diameter of the grinding wheel and the flange.
If there is no space, the runout of the grinding wheel itself must be adjusted.

TRUING AND DRESSING

If the periphery runout is severe when the grinding wheel is mounted, or if profile wear of the straight wheel or cup wheel is found, the runout and profile of the wheel must be adjusted. Truing is the procedure of adjusting the runout and profile of the wheel. It involves shaving off the diamond grits and the bond to correct the runout and the profile of the wheel. The diamond grinding wheel cannot be used immediately after the truing procedure as the diamond grits are not properly exposed ; therefore, the wheel is not in prime condition to be used. To improve free-cutting ability, the bond must be dug out and the diamond grits exposed onto the surface of the wheel. This process is called dressing. Diamond grinding wheels cannot satisfactorily perform unless the above procedures are followed correctly.

• SELECTION OF DRESSING STICK

In order for the truing of the diamond grinding wheel to be effectively performed in a timely manner, the grit size of the silicon carbide truing wheel must be 2 grades coarser than that of the diamond grinding wheel. As shown below, the grade of the silicon carbide wheel must be relatively hard.

GRIT SIZE OF DIAMOND WHEEL	SILICON CARBIDE WHEEL FOR TRUING
#80 or coarser	C46 - M
#100 - #200	C60 - M
#230 - #325	C80 - M
#400 or finer	WA200 - G

• TRUING METHODS

There are four truing methods:
(1) Brake dresser
(2) Abrasive stick
(3) Mild steel
(4) Tool post grinder

1. Brake Dresser
For truing with the wheel still mounted on the machine, the brake dresser is the best option of the above four methods by providing fast, simple, and stable truing.
2. Abrasive Stick
Truing of the diamond grinding wheel can also be performed by grinding the abrasive stick fixed on the chuck with the grinding wheel. Please pay careful attention during truing, as this method tends to make the wheel edge round.
3. Mild Steel
This method does not require any special devices and is easy to accomplish by grinding the mild steel with the diamond wheel. The diamond wheel could be damaged, however, if it is not sufficiently flooded with grinding fluid while grinding.
4. Tool Post Grinder
This truing method involves removing the diamond grinding wheel from the machine and grinding it with a silicon carbide wheel on another machine. Vibration of the diamond grinding wheel could possibly occur during the resetting of the trued on the first machine.

• SELECTION OF DRESSING STICK

Since the purpose of dressing the diamond grinding wheel is to expose the diamond grit by removing the bond only, the grit size of the stick should be 2 grades finer than that of the diamond grinding wheel.
Below is a guide to selecting a dressing stick:

GRIT SIZE OF DIAMOND GRINDING WHEEL	STICK FOR DRESSING
#80 or coarser	WA120 - G
#100 - #200	WA200 - G
#230 - #325	lapping stick
#400 or finer	lapping stick

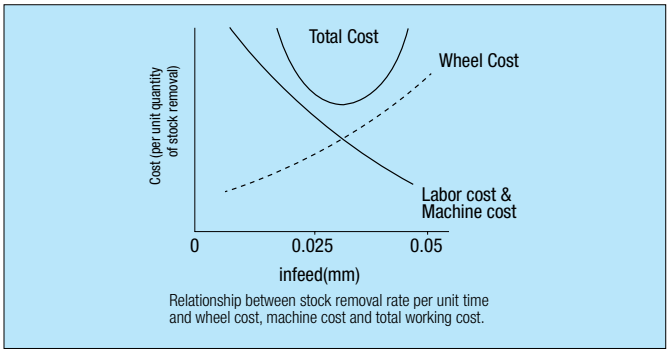
• DRESSING WITH STICK

A diamond wheel is dressed by pushing the stick on the surface of the diamond grinding wheel by hand. Coolant must be used. In case of dry dressing, a wet stick should be used. When using a lapping stick, dry dressing is recommended.

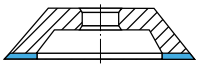
ANALYSIS OF WORK CONDITIONS

In the past, when diamond wheels were “expensive and precious tools”, the life of the wheel was considered the most important factor. Today, however, diamond grinding wheels are often evaluated based on total working costs. Total working costs are:
(Wheel cost) + (Other expenses, including cost of labor).

Recently, as labor costs have been soaring, the component of “other expenses” has been increasing steadily, Consequently, grinding efficiency has become more important.
Making a graph such as the one shown below can help in finding optimum working conditions which minimize the total working costs.



Relationship between stock removal rate per unit time and wheel cost, machine cost and total working cost.



• PERIPHERAL SPEED

Wheel life, stock removal rate, and surface finish all depend largely on the peripheral speed of the wheel.
It is therefore very important to find the optimum peripheral speed for the diamond wheel. The table below shows recommended peripheral speeds:

RESINOID BOND	METAL BOND
Wet 1400 - 1600 m/min	Wet 1000 - 1800 m/min
Dry 900 - 1200 m/min	Dry 600 - 900 m/min

Peripheral speed is a function of wheel diameter and spindle speed(rpm).

• GRINDING FLUID

Since regrinding is performed by physically watching the point of contact between the wheel and the workpiece, dry grinding is usually employed.
When the wheel- -workpiece contact area is relatively large, the heat from grinding increases. For this reason, dry grinding may result in workpiece burning, wheel loading, bond wear, and other conditions which lead to a shortened wheel life. Consequently, the proportion of wheel cost to total costs increase. In such a situation, then, wet grinding is recommended. In wet grinding, the grinding fluid should be applied directly to the point of contact between the wheel and the workpiece. In heavy grinding or in creep-feed grinding, when heat increases, use a grinding fluid with a high lubricating performance and apply the fluid to the grinding point under high pressure.

• INFEED

Infeed is an important factor in determining grinding efficiency. However, a too-high increase in infeed in an attempt to improve the grinding efficiency can shorten the wheel life.

To determine the proper infeed, follow the guide given below. In form grinding, however, increase the depth of the cut and decrease the feeding speed to prevent deviation from the shape.

GRIT SIZE OF DIAMOND GRINDING WHEEL	DEPTH OF CUT
#100 - #120	0.02 - 0.03 mm
#140 - #200	0.01 - 0.02 mm
#230 or finer	0.01 mm or less

• SURFACE FINISH

Because the surface finish of the workpiece depends on many factors--the grinding method and the workpiece material as well as the grit size of the diamond--it is difficult to make specific recommendations for surface finishing. In order to achieve a high rate of material removal and a good surface finish, grinding should be accomplished in two separate processes. The diamond grit sizes should be as follows:

ROUGH	FINISH
#100	#270
#120	#325
#140	#400
	#600

In any case, surface finish can be improved by spark-out.

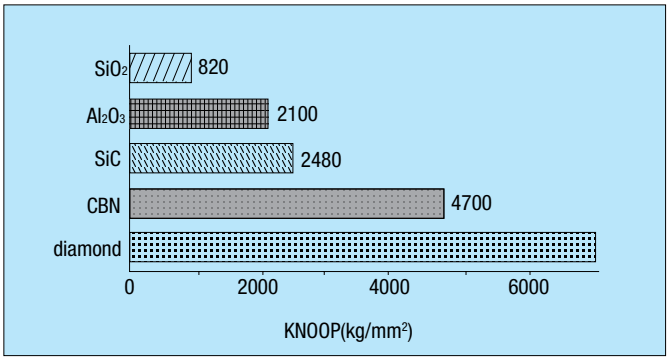
GENERAL INFORMATION
CBN GRINDING WHEELS

CBN

CBN (Cubic Boron Nitride) is the super abrasive used for steel grinding. CBN is crystallized from the nitric material in boron using a high pressure, high temperature method similar to the one used in diamond synthesis.

• CHARACTERISTICS OF CBN

Next to diamond, CBN is the second hardest material known on the earth. As shown by the figures below, it is harder than both Al_2O_3 (abrasive for WA and A grinding wheels) and SiC (abrasive for GC and C grinding wheels).
When considering the hardness only, diamonds would seem to grind steel easily, being the hardest materials. But at temperatures of 600-700°c, diamonds in contact with air begin to wear due to oxidation.
Also, since diamonds are basically composed of carbon, they react to the iron in steel, resulting in diamond wear. In contrast, CBN does not wear in these conditions, as it is stable up to 1370°c and does not react to iron.



AVAILABILITY OF CBN ABRASIVES

CBN abrasives are classified into two types: metal- coated and uncoated. Metal-coated CBN is used mainly in resinoid bond grinding wheels, and uncoated CBN is used in electroplated metal bond and vitrified bond grinding wheel.

CONCENTRATION (SEE PAGE 40)

GRIT SIZE

NORMAL GRIT SIZE (mesh)	GRIT SIZE RANGE (mesh of grit use)	FEPA
60	60/80	B 252
80	80/100	B 181
100	100/120	B 151
120	120/140	B 126
140	140/170	B 107
170	170/200	B 91
200	200/230	B 76
230	230/270	B 64
270	270/325	B 54

NORMAL GRIT SIZE (mesh)	GRIT SIZE RANGE (mesh of grit use)	FEPA
325	325/400	B 46
400	G 45	
800	G 30	
1000	G 15	
1500	G 9	
2000	G 6	
3000	G 3	
5000	G 1	

GENERAL INFORMATION
CBN GRINDING WHEELS

BOND
There are three alternative bonding methods: resinoid bond, metal bond, and vitrified bond.

• RESINOID BOND
Resinoid bond grinding wheels are manufactured by using resinoid bonds to bond CBN grits. The resinoid bond CBN grinding wheel has a wider range of uses than other bond wheels. It is mainly used for surface grinding, cylindrical grinding, creep-feed grinding, centerless grinding, double-disc grinding, and internal grinding.

CBN grinding wheel is economical in cases where the workpiece is an iron material with hardness of over HRC50. EHWA has succeeded in developing a resinoid bond which enables the full performance of the CBN grit.

• METAL BOND
Metal bond grinding wheels are manufactured by sintering metal powder to bond CBN grits. They are used for the honing and cutting of hardened steel and for accomplishing a high removal rate in the grinding of mid-range hard steel.

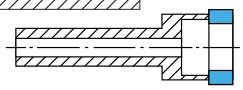
• VITRIFIED BOND
Vitrified bond grinding wheels are manufactured by using vitrified bonds to bond CBN grits. They have good cutting ability, excellent wear-resistance, and free-cutting, and they are also used for internal grinding.

• PERIPHERAL SPEED
Wheel life, stock removal rate, and surface finish depend largely on the peripheral speed of the wheel. Finding the optimum peripheral speed for the CBN wheel is therefore very important. The table below shows recommended peripheral speeds.

RESINOID BOND
Wet 1750 - 1850 m/min Dry 900 - 1200 m/min

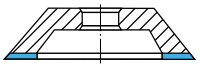
Peripheral seed is a function of wheel diameter and spindle speed (rpm).
However, if the coolant pressure for grinding is kept high enough to keep the wheel from heating, the peripheral speed of the grinding wheel can be raised up to 13000ft/min. If the wheel speed (rpm) increases, the material removal speed can also be increased while maintaining a long wheel life.

• GRINDING FLUID
There are two types of grinding fluids. One is straight oil (water immiscible) and the other is water soluble. Straight oil is a coolant with an oily ingredient immiscible in water. It lubricates well, but it is an ineffective coolant with poor usability. However, straight oil enable CBN grinding to achieve maximum performance when grinding tough but soft workpieces such as stainless steel, inconel, and waspaloy. Straight oil also enables superior performance in heavy duty grinding.
Water soluble coolants are subdivided into three types: emulsion, soluble, and chemical.
The emulsion type becomes milky and opaque in water. Compared with straight oil, it has the next best lubricating effect, and emulsion type is better than straight oil for cooling. If the working place is not suited to straight oil, the emulsion type is recommended, but the concentration of coolant must be high - - above 5%.
The soluble type becomes translucent in water. Compared with emulsion type, it has the next best lubricating effect, and soluble type is better than emulsion type for cooling. In general grinding, soluble type is sufficient.
The chemical type becomes transparent in water. It is the best fluid for cooling, but the least effective for lubrication. If the chemical type is being used for general grinding, there is no need to change to the soluble type.

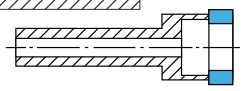


CONVERSION TABLE OF SURFACE FINISH

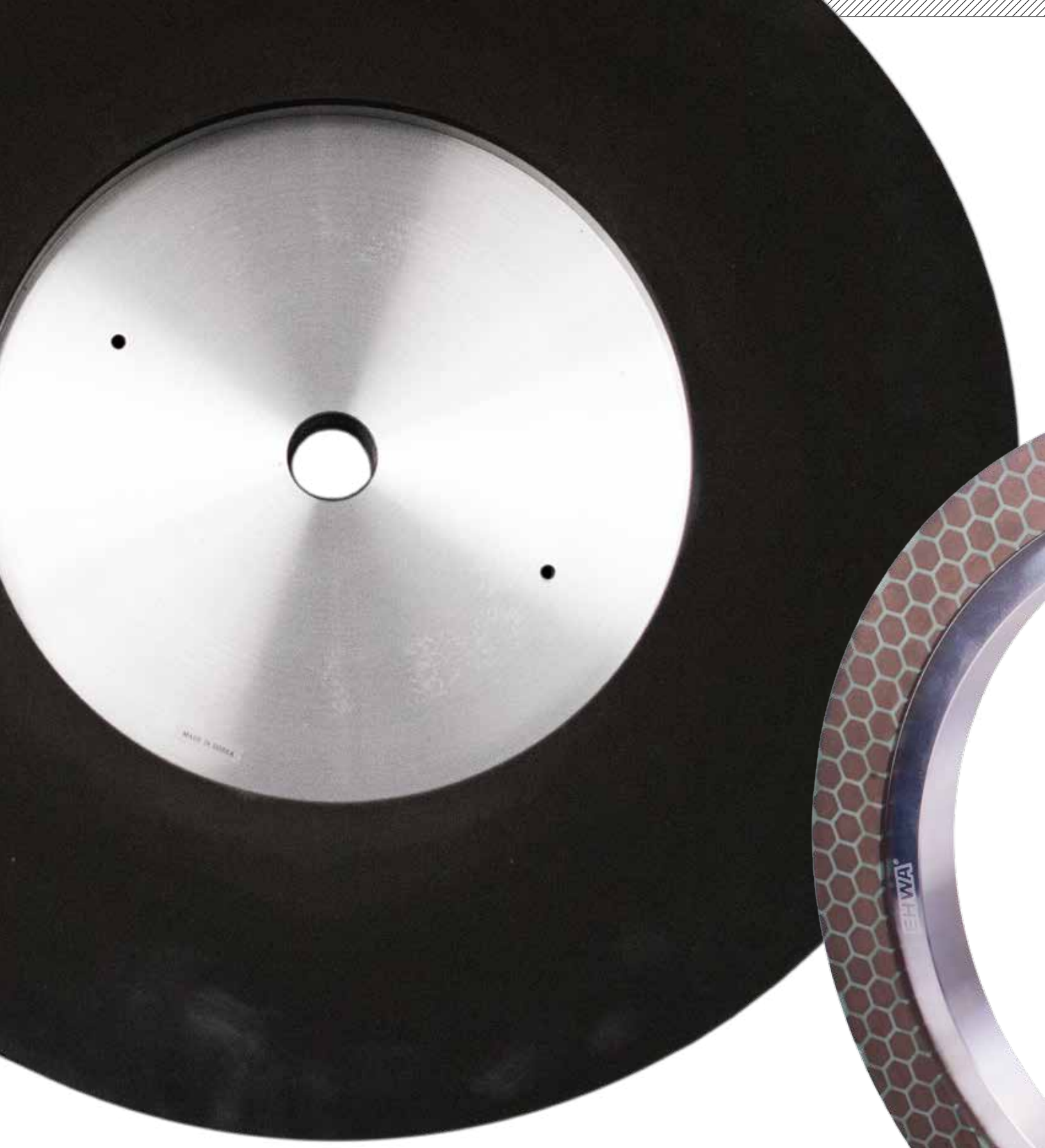
Rmax(μm)	Ra(μm)	Rms(μm)	Rz(μm)	Rms(μin)	Rmax(μm)	Ra(μm)	Rms(μm)	Rz(μm)	Rms(μin)
0.1	0.02	0.02	0.1	1	2.4	0.41	0.46	2.2	24
0.2	0.03	0.04	0.2	2	2.8	0.48	0.53	2.5	28
0.3	0.05	0.06	0.3	3	3.2	0.54	0.61	2.9	32
0.4	0.07	0.08	0.4	4	3.6	0.61	0.68	3.2	36
0.5	0.09	0.10	0.5	5	4.0	0.68	0.76	3.6	40
0.6	0.10	0.11	0.5	6	4.5	0.77	0.86	4.1	45
0.7	0.12	0.13	0.6	7	5.0	0.85	0.96	4.5	50
0.8	0.14	0.15	0.7	8	5.5	0.94	1.05	5.0	55
0.9	0.15	0.17	0.8	9	6.0	1.02	1.14	5.4	60
1.0	0.17	0.19	0.9	10	7.0	1.19	1.33	6.3	70
1.2	0.20	0.23	1.1	12	8.0	1.36	1.52	7.2	80
1.4	0.24	0.27	1.3	14	9.0	1.53	1.71	8.1	90
1.6	0.27	0.30	1.4	16	10.0	1.70	1.90	9.0	100
1.8	0.31	0.34	1.6	18					
2.0	0.34	0.38	1.8	20					



NOTE:



NOTE:



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