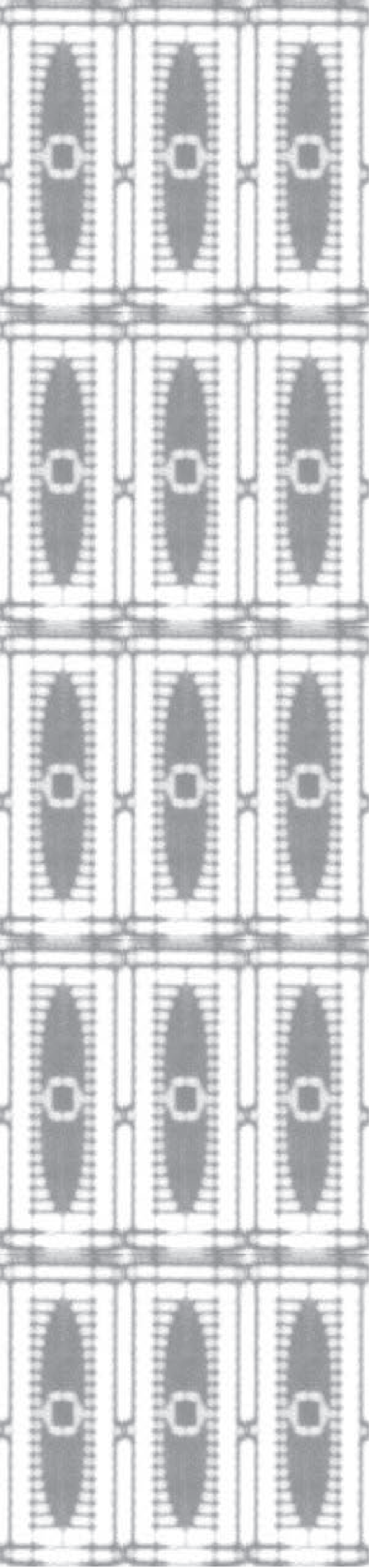

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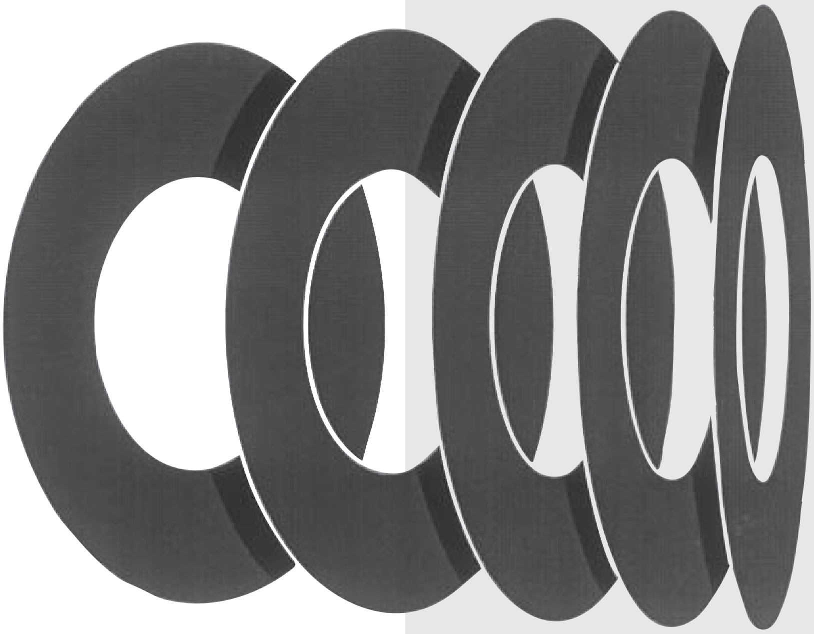
microkerf
Dicing Blades for 2“-Spindles



minitron
elektronik gmbh

Contents:

Dicing Blades: Construktion & Functional Principles

The Microsystems-Technology, consisting of Microelectronics, Micromechanics and Micro-Optics has adapted many batch-processing steps that originate from planar wafer processing. Micro-grooving, microprofiling and last but not least dicing are technologies perfected for semiconductor wafer processing applications. Those fabrication methods depend on precision made Cut-off-blades, in these applications called Dicing Blades.

Equipment: Dicing Saws for these applications incorporate very precise air-bearing spindles, driven by vibration free high-frequency motors. As those machirnes serve common dicing requirements, the tools employed are mostly standardized.

Machines in use are:

DISCO, K&S, MICRO AUTOMATION (MA)*) TEMPRESS *), ADVANCED TECHNOLOGIES *), SEMITRON*), LOADPOINT, ESEC, FARCO *), SEIER *), BERNEY and TOKYO SEIMITSU.

These Dicing Saws use so-called 2“-Spindles and are suitable for blade or wheel diameters of 2.00“, 2.187“, 2.25“, in some rare cases 2.5“. The spindle arbor on those machines is .750“ = 19 mm, so that all wheels or blade flanges haue 19,005 mm holes.

For applications which require very deep cutting, or where due to high self-sharpening a high wear rate has to be taken into account, blades with much langer O.D.’s (Outside Diameter) are advantageous. Machines in this category are:

DISCO, K&S and MEYER BURGER

They are based an so-called 4“-Spindles and incorporate blades from 4 - 5“, most commonly 4.6“.

The Dicing Technology knows two different versions of tooling concepts: There are blades which actually are free-standing rings that need to be clamped in flanges to be used, and there are wheels where the abrasive blade is already attached to a supportive body called hub, or hub-wheel (Fig. 1).

Dicing blades can be made by depositing a layer of an abrasive matrix around the edge of a steel core (SINGLE LAYER BLADE) or by growing multiple layers of abrasive matrix onto the edge of the steel disc (MULTI-LAYER-RIM-BLADE). Blades can also consist of a homogenious mix of abrasive from the inner to the outer diameter (MULTILAYER BLADE) (Fig. 2).

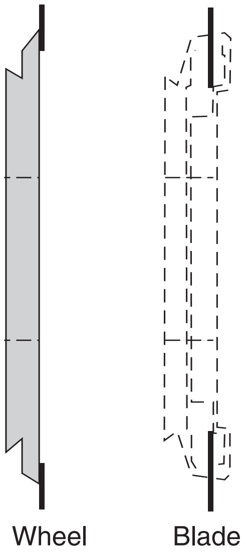


Figure 1: Hubtype Wheel and Hubless Blade

The abrasive mix is made of fine abrasive particles, diamond or CBN, a supporting matrix and filler particles when necessary.

As the supportive matrix especially for dicing blades, metal or resin are most commonly used. For metal blades and wheels the nickel matrix produced by electroplating is state-of-the-art for semiconductor dicing. Because of the ease of manufacturing

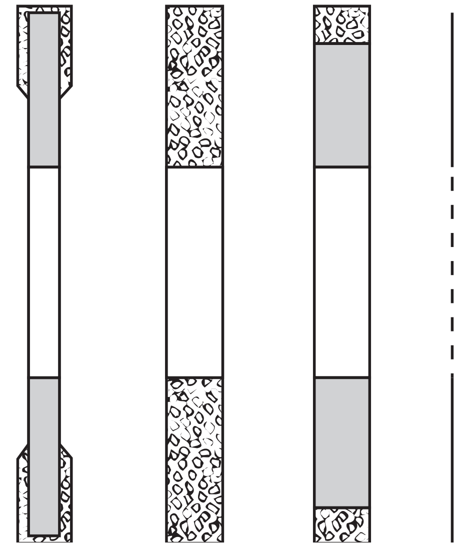


Figure 2: Types of Blades: The thicknesses are oversized. Correctly scaled drawing an the right.

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*): not produced anymore.
The machine manufactures mentioned and minitron are in no way connected.

and ease of use the blade plated directly onto an aluminium hub and back-etched to the desired exposure is the dominating tool for silicon wafer dicing.

This brochure will concentrate on resin-blades more than on other species, because for very hard and/or brittle materials the matrix made of a resinoid bond has so many superior characteristics.

For all dicing applications a common desire is long blade life (low wear). Metal bonds typically offer a long blade life and are therefore the choice when materials are being cut, which are not so hard, not brittle, and with little tendency to produce Chips or cracks. Silicon is such an easy to Cut material and as already mentioned the nickel matrix is dominant. Similar performance could be expected from blades in bronce- or nickel-bond made by sintering.

Much more durable than the three bonds mentioned is the microkerf TgC-bond that is available as Multilayer-Rim-Blade. The TgC blade is superior in applications that do not require any self-sharpening but only the most stable non-reducing O.D.

Other binders such as rubber, shellack, or very hard (but brittle) matrixes based an ceramic or glass, only play exotic roles in dicing applications.

Substrates employed in Micro-System-Technologies quite offen are Single crystals and their cleavage planes most offen are in conflict with the desired cutting plane, or they have amorphous structure and exhibit exceptional hardness.

Hard and brittle materials are demanding blades with a „weak“ matrix. Resinoid-bonds based an phenolic resins are most suitable due to their exeptional high temperature strength. The strength of the resin bond is its weakness, dull or worn-out diamond particles are broken out of the matrix, so that new sharp particles become exposed. This selfsharpening effect, which is based an wear, is the superior characteristic of the resinoid bond.

In addition to abrasive particles fillers are being used with influence on the wear-rate or to improve heat transfer or mechanical strength.

Exact dicing could not be performed without means of exactly determing the cutting depth. Apart from optical means several machines have a chuck-zero Feature to measure the blade O.D. via electrical contact. This requires conductive blades. All microkerf blades are tuned to an electrical resistance of $\rho < 1$ kΩcm.

After selecting the correct bond choosing the suitable abrasive size is important for the edge quality of the cut. As a general rule large abrasive particle means: high cutting speed, high blade life, coarse cut (large chipping). Small particles an the other hand result in low cutting speeds, low blade life, but clean cuts with little chipping.

Choosing the most suitable grain size greatly influences blade performance. Dicing blades are always in „long contact“ with the substrate, so it is necessary to provide space for the dicing debris on the sides of the blade.

Next to the filler and diamond concentration, which are composed for a „long contact“ for all microkerf blades, it is the diamond size that determines the space available for debris. Material removed from the substrate has to be transported out of the kerf in those spaces between the abrasive particles. Because some materials have a tendency to clogg these spaces (blade loading), if they are too small, it is necessary to create the Optimum space size by selecting the right particle shape and size. Should blade loading continue to occur, it will be necessary to increase blade wear e.g. by increasing table speed or by reducing rotational speed. If more wear does not stop the loading a dressing process is necessary additionally. Dressing in periodic Intervalls will remove loaded debris from the sides of the blade and open the spaces and pores for continued clean cutting.

If reduction of blade diameter is larger than practical for the given process, and a further reduction of the chuck-speed is not possible or economical, then a larger diamond grain size has to be used, or the bond matrix has to be changed.

The table an page 5 shows some prominent substrate materials and the suitable diamond particle size for resinoid blades.

Cooling

When dicing silicon with electroplated Ni-wheels the type and amount of cooling is of little importance. Usually deionisized water is being used. If wafers are sensitive to electrostatic charges, the required conductivity is set using CO_2 (bubbler).

When cutting hard materials guiding the coolant flow correctly is utmost importance for blade life.

The coolant flow setup shown in fig. 3 has prooven to be most advantageous. For the water beam to pass the blade symmetrically a dual nozzle system is highly recommended. The nozzles shall be as close as possible to the point where the blade enters the substrate. The water beam should blast with high velocity into the kerf to improve removing debris. Underestemating the importance of a correct coolant flow is the most common cause for wide kerfs and non-economical blade wear.

Usually normal tap water is being used, sometimes with additives. Additives may reduce friction between the abrasive particle and the hard material, so self-sharpening is reduced and blade life is increased or

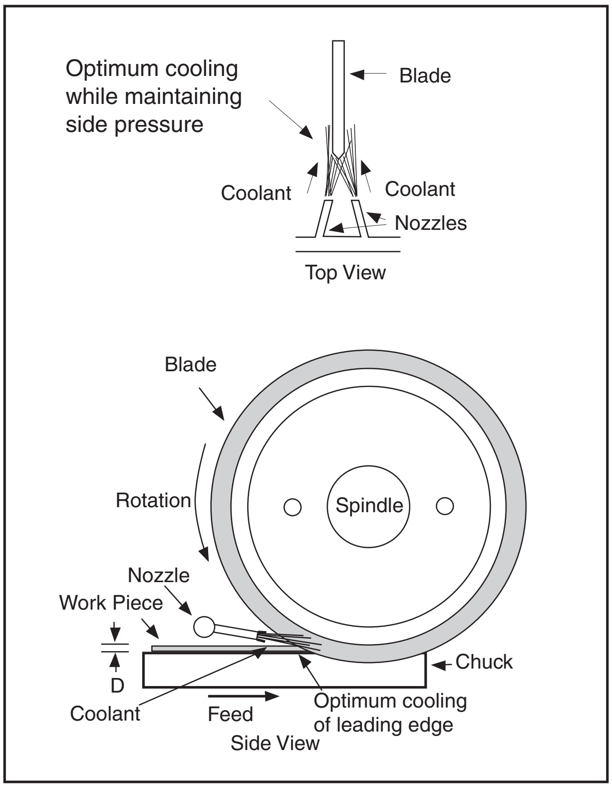


Figure 3: *Sketch of a cooling system*

to keep debris in suspension and not to settle on the substrate surface from where it might be difficult to be removed.

Cutting direction

When dicing silicon, the influence of the direction of cutting can be neglected. In fact most offen wafers are cut by moving the table back and forth. When cutting hard materials this is quite different.

The sketch in Fig. 3 shows the blade entering the material „cutting down“. The blade enters the surface of the substrate almost vertically. The Chips (form chipping) removed by the diamond particles are reduced in size the deeper the blade enters the substrate. The Chips are lange when the blade enters the material and small when exiting. For most material this cutting direction will provide Cuts with the least amount of chipping.

When cutting in the opposite direction the blade enters the substrate almost tangential. The Chips removed are being small at start but their size increases to maximize where the blade exits the face of the substrate. Much chipping at the surface is the result. Cutting in „up“ direction creates more edge chipping than cutting „down“. The spindle torque is noticed to be larger „cutting up“ than when „cutting down“

Typical surface speeds in dicing applications are in the range of 60-120 m/s (electroplated Ni Blades in silicon ≈ 90m/s). When using resinoid blades, the blade behaviour can be altered by changing the surface speed. Provided the chuck speed ist kept constant, an increase of rotational speed will act like increasing the bond hardness (longer blade life, more chipping), a reduction in rotational speed will have the opposite effect, i.e. act like a softer bond (higher shear strength an the abrasive particle, increased self-sharpening). This is often called „hard“ respectively „soft“-cutting action.

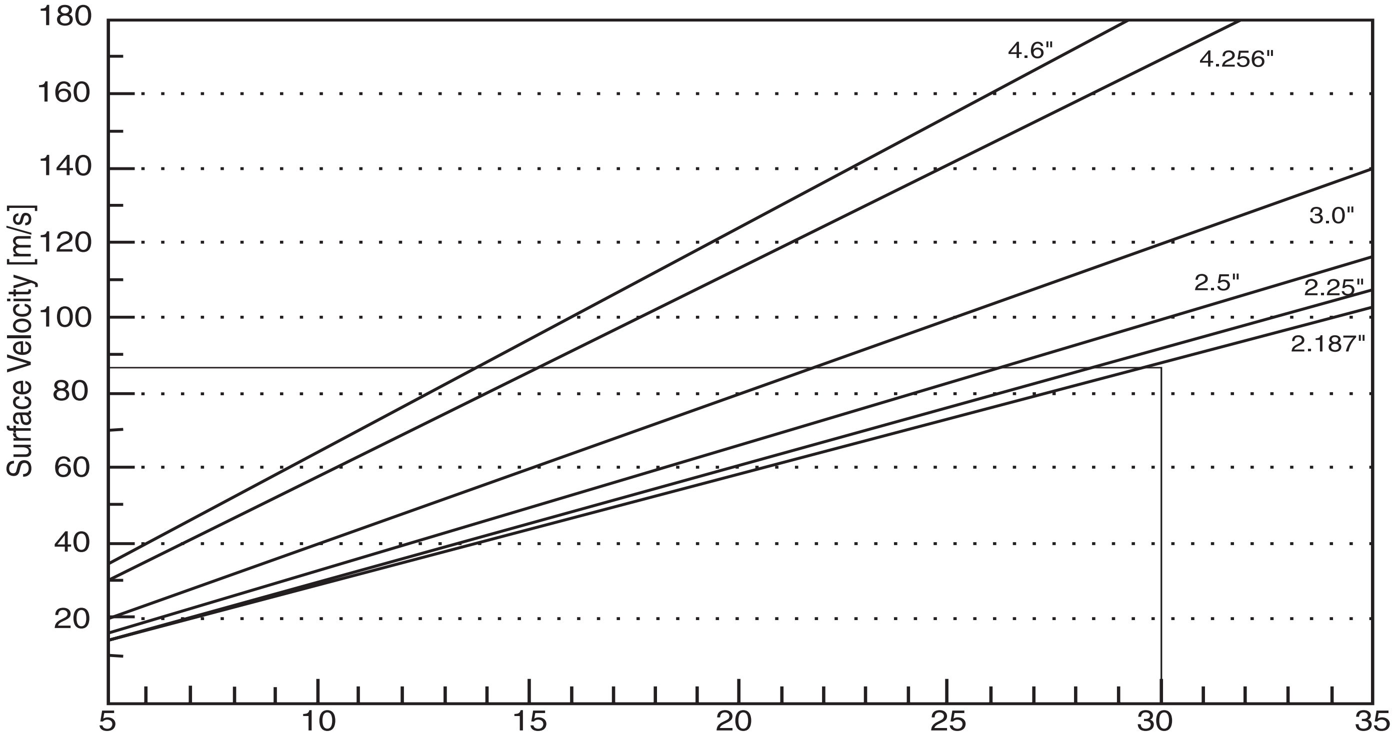


Fig. 4: *The surface is determined by the Blade O.D. and the rotational speed of the spindle (height of the crossing point of the straight line corresponding to the specific O. D. and the vertical line for the selected rotational speed; e.g. 30000 rpm; 2.187“ => Vo = 87 m/s)*

On the following page the structure of the part numbers is explained and an the opposite page the most common P/N's are listed.

Knopp-hardness [kg/mm^2]	Material	Diamond Size [µm] for Resinoid Bond											
		200µ	150µ	125µ	105µ	86µ	67µ	53µ	45µ	30µ	15µ	9µ	5µ
		◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆
		75 Grit	100 Grit	120 Grit	140 Grit	180 Grit	220 Grit	270 Grit	325 Grit	600 Grit	1200 Grit	1800 Grit	3000 Grit
2000	Alumina							▨					
	Barium-Titinate								▨				
	Bismuth-Silicate $Bi_{12}SiO_{20}$										▨		
	Bismuth-Telluride								▨				
	Carbide TGC					▨							
430	Ferrite										▨		
	FR4 Circuit Boards			M									
750	Gallium-Arsenide GaAs												(M)
	Gallium Phosphide GaP											(M)	
	Germanium											M	
1360	GGG $NaGd(WO_4)_2$									▨			
530	Glass SiO_2								▨				
1400	Granat									▨			
	Kovar NiFeCo						▨						
	Lithium-Niobate $LiNbO_3$										(M)		
	Passivated Silicon										M		
	Plexiglass		M										
1000	Quartz SiO_2									▨			
2150	Ruby Al_2O_3 + Cr						▨						
2100	Sappire Al_2O_3 + Fe + Ti								▨				
850	Silicon Si											▨	
	Silicon-Carbide SiC										▨		
	Zink-Selenide ZnSe									▨			

Figure 5

M = metal bond is more economical

microkerf Dicing Blades

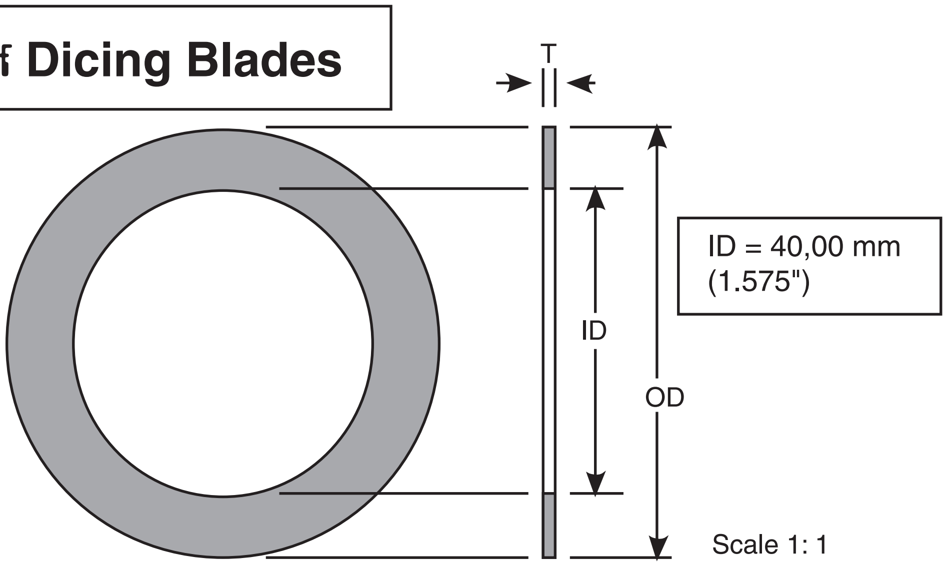


Figure 6

Part numbers:

Part numbers consist of O.D. [inch], Thickness [mil], Diamond Particle Size [Micron] and Type of Bond:

e.G. **2.187 - 15 -30 H**

Outer Diameter O.D.
standart:
2.187“ (55,55 mm)
additional sizes:
2.25“ (57,15 mm)
2.5“ (63,50 mm)
3.0“ (76,20 mm)

Thickness T [mil]	 ([µm])
1,5	(38)
2	(50)
3	(75)
4	(100)
5	(125)
6	(150)
8	(200)
10	(250)
further values to maximal 80 mil (2 mm) in steps of 2.0 mil (50µm)	

Diamond particle size [µm]	minimal thickness for the specific diamond size
3	**1.5**
5	**1.5**
9	**1.5**
15	**2.0**
30	**3.0**
45	**4.0**
53	**5.0**
67	**6.0**
86	**6.5**
105	**8.5**
125	**10.0**
150	**12.0**

Resinoid Bond
S: soft
H: hard
Metal Bond
CuZn **BSF** Bronce
S-Ni **NSF** Nickel
E-Ni **NiF** Nickel
E-Ni **NiR** Nickel
TgC **TgR** TgC

longer blade life ↓

higher self-sharpening ↑

microkerf diamond dicing blades of the most popular 2.187“ series are used on all dicing saws with 2“spindles:
DISCO, K&S, ESEC, MICRO AUTOMATION, AT, TEMPRESS, SEIER, LOADPOINT, TOKYO SEIMITSU, SEMITRON, FARCO, BERNEY.

Blades always have an inside diameter of 40 mm, the most popular outside diameter is 2.187 (55,55 mm). For applications that require more cutting depths O. D.'s of 2.25“ and 2.5“ can be provided. For LOADPOINT (SEMITRON) gang saws 3“ O.D. is available as well.

DICING BLADES TYPE LIST 2.187“ (55,55 mm) x 40 mm

Resinoid bond S (soft); H (hard)

Thick-ness	Diamond Size [µm]						
	5	9	15	30	45	53	67
40µ	2.187-1.6-5 S/-	2.187-1.6-9 S/-	2.187-1.6-15 S/-				
50µ	2.187-2.0-5 S/H	2.187-2.0-9 S/H	2.187-2.0-15 S/H				
65µ	2.187-2.5-5 S/H	2.187-2.5-9 S/H	2.187-2.5-15 S/H				
75µ	2.187-3-5 S/H	2.187-3-9 S/H	2.187-3-15 S/H	2.187-3-30 S/H			
100µ	2.187-4-5 S/H	2.187-4-9 S/H	2.187-4-15 S/H	2.187-4-30 S/H			
125µ	2.187-5-5 S/H	2.187-5-9 S/H	2.187-5-15 S/H	2.187-5-30 S/H			
150µ	2.187-6-5 S/H	2.187-6-9 S/H	2.187-6-15 S/H	2.187-6-30 S/H	2.187-6-45 S/H	2.187-6-53 S/H	
175µ	2.187-7-5 S/H	2.187-7-9 S/H	2.187-7-15 S/H	2.187-7-30 S/H	2.187-7-45 S/H	2.187-7-53 S/H	
200µ	2.187-8-5 S/H	2.187-8-9 S/H	2.187-8-15 S/H	2.187-8-30 S/H	2.187-8-45 S/H	2.187-8-53 S/H	
225µ	2.187-9-5 S/H	2.187-9-9 S/H	2.187-9-15 S/H	2.187-9-30 S/H	2.187-9-45 S/H	2.187-9-53 S/H	
250µ	2.187-10-5 S/H	2.187-10-9 S/H	2.187-10-15 S/H	2.187-10-30 S/H	2.187-10-45 S/H	2.187-10-53 S/H	
300µ	2.187-12-5 S/H	2.187-12-9 S/H	2.187-12-15 S/H	2.187-12-30 S/H	2.187-12-45 S/H	2.187-12-53 S/H	2.187-12-67 S/H
400µ	2.187-16-5 S/H	2.187-16-9 S/H	2.187-16-15 S/H	2.187-16-30 S/H	2.187-16-45 S/H	2.187-16-53 S/H	2.187-16-67 S/H

Figure 7

Nickel bond NiF; NiR

Thick-ness	Diamond Size [µm]						
	5	9	15	30	45	53	67
30µ	2.187-1.2-5 NIF	2.187-1.2-9 NIF					
35µ	2.187-1.4-5 NIF	2.187-1.4-9 NIF					
40µ	2.187-1.6-5 NIF	2.187-1.6-9 NIF	2.187-1.6-15 NIF				
50µ	2.187-2.0-5 NIF	2.187-2.0-9 NIF	2.187-2.0-15 NIF				
65µ	2.187-2.5-5 NIF	2.187-2.5-9 NIF	2.187-2.5-15 NIF				
75µ	2.187-3-5 NIF	2.187-3-9 NIF	2.187-3-15 NIF	2.187-3-30 NIF			
100µ	2.187-4-5 NIF	2.187-4-9 NIF	2.187-4-15 NIF	2.187-4-30 NIF			
125µ	2.187-5-5 NIF	2.187-5-9 NIF	2.187-5-15 NIF	2.187-5-30 NIF			
150µ	2.187-6-5 NIF	2.187-6-9 NIF	2.187-6-15 NIF	2.187-6-30 NIF	2.187-6-45 NIF	2.187-6-53 NIF	
175µ	2.187-7-5 NIF	2.187-7-9 NIF	2.187-7-15 NIF	2.187-7-30 NIF	2.187-7-45 NIF	2.187-7-53 NIF	
200µ	2.187-8-5 NIF	2.187-8-9 NIF	2.187-8-15 NIF	2.187-8-30 NIF	2.187-8-45 NIF	2.187-8-53 NIF	
225µ	2.187-9-5 NIF	2.187-9-9 NIF	2.187-9-15 NIF	2.187-9-30 NIF	2.187-9-45 NIF	2.187-9-53 NIF	
250µ	2.187-10-5 NIF	2.187-10-9 NIF	2.187-10-15 NIF	2.187-10-30 NIF	2.187-10-45 NIF	2.187-10-53 NIF	
300µ	2.187-12-5 NIF	2.187-12-9 NIF	2.187-12-15 NIF	2.187-12-30 NIF	2.187-12-45 NIF	2.187-12-53 NIF	2.187-12-67 NIF
400µ	2.187-16-5 NIF	2.187-16-9 NIF	2.187-16-15 NIF	2.187-16-30 NIF	2.187-16-45 NIF	2.187-16-53 NIF	2.187-16-67 NIF

Figure 8

Sinter Bond BSF (from 125µ); NSF (from 150); TgR (from 200µ)

Thick-ness	Diamond Size [µm]						
	45	53	67	86	105	125	150
125µ	2.187-5-45 BSF						
150µ	2.187-6-45 NSF						
175µ							
200µ	2.187-8-45 TgR			2.187-8-86 TgR		2.187-8-125 TgR	
250µ							
300µ							2.187-12-150 TgR
400µ							
500µ							

Figure 9

Blade-Flanges

microkerf flanges were developed for dicing saws with 2“ spindles (.750“ [19,00 mm] arbor) and the 2.187“ Blade series. The hole is for a 19.0 mm arbor. One unique Feature ist the practical snap-lock, which makes blade handling as easy as handling hub-type wheels. The other unique feature is the „recessed back“. It enables the blade to be located exactly where the exposed rim of a hub-wheel would be located. So switching back and forth between hub-wheels and flanged blades is possible without re-aligning the coolant nozzles or the saw-optics.

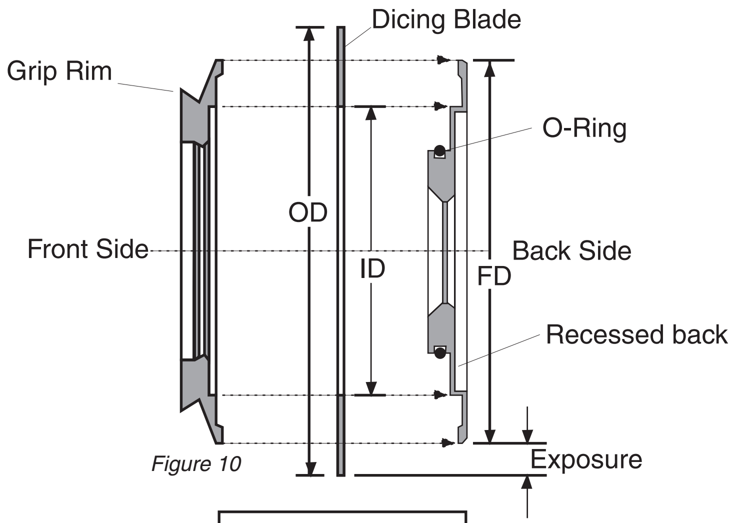


Figure 10

ID=40,00mm
(1.575“)

Flanges are available with the following O.D.’S:

Flange-Diameter FD	Part Number	Exposure for a blade with O.D.=2.187“
2.164“ / 54,91mm	**F-6**	.011“ / 0,28mm
2.157“ / 54,79mm	**F-1**	.015“ / 0,38mm
2.148“ / 54,56mm	**F-7**	.019“ / 0,48mm
2.127“ / 54,03mm	**F-2**	.030“ / 0,76mm
2.107“ / 53,52mm	**F-3**	.040“ / 1,02mm
2.057“ / 52,25mm	**F-4**	.065“ / 1,67mm
2.008“ / 51,00mm	**F-8**	.090“ / 2,29mm
Flange Opener	**F-DX**	

Figure 12

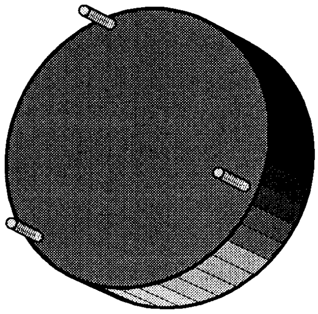


Figure 11: Flange Opener
F-DX

Mounting Instructions:

1. Seperate both halfs of the flange by inserting the 3 pins of Flange Opener F-DX in the holes provided and press an inner ring against opener (Figure 13).
2. Clean both halfes of the flange, inspect for burr, and locate flange half (with O-ring) an table.
3. Remove dicing blade from package and wet with water. Carefully position the blade onto the flange half (with O-ring). Rotate blade until concentric with flange adapter. The surface tension of the water helps to keep the blade in its position.
4. Take the flange front half by it’s grip rim, place it on the flange back, slightly rotate for proper centering. Press together until both halfes are snap-locked (Figure 14).
5. Slide flange onto the 19mm arbor. Never use force! The part with the O-ring goes first. The recessed back faces the spindle. Tighten carefully, using the tools provided by manufacturer of the saw.
6. After the exposed blade ist consumed, it ist recommendet to remove all parts of the blade that protrude from the flange O.D. while the flange is still closed and on the spindle.

Figure 13

Figure 14

BLADE EXPOSURE:

is the measure by which the blade protrudes from the flange O.D. [OD Blade - OD Flange] * ½ = Exposure. The minimum exposure required for cutting is determined by the following requirements: substrate thickness + depths into mounting media + minimum gap substrate / flange O.D. Over-exposure can be the cause for a variety of problems, as explained later. The acceptable exposure depends on material, chuck speed, spindle rotation coolant flow, and especially from cutting depth. As a rule of thumb the following may be used as a guide: Exposure = 20-times blade thickness, when 1/3 of the exposed blade is guided in the kerf. Once a blade exposure is worn to the required minimum, it is most practical to break away all parts of the blade that protrude from the flange O.D. with the fange still being closed. Now the blade will be ready to be used on a smaller fange.

SCRIBING / DICING:

Two different cutting processes are popular: Scribing is the process when cutting is not entirely through the material. Final separation is done by breaking.

The process is called dicing when cutting completely through into the mounting material.

Dicing is the rapidly expanding process, as it creates almost perfect edges, but scribing allows muck higher cutting speeds. Blade life is factor 2-4 higher when scribing.

DRESSING:

Galvanic tools (Ni) always require dressing. Hubtype wheels are already dressed by the manufacturer. A blade should be dressed by the user, even when „pre-dressed“ by the manufacturer. Resinoid blades typically will not require any dressing. A new resinoid blade will be reduced in size overproportionally during the first few cuts. This phenomena is called „trueing“ and will be completed when running concentricity is achieved. The blade wear rate should only be determined when trueing is completed. In some hard materials the abrasive grain is not sufficiently stressed to break away dull cutting particles or to Crack grain and create new sharp cutting edges. When cutting these materials it is necessary to use dressing plates to sufficiently stress the blade, removing loaded debris, breakingoff dull diamonds and creating new, sharp cutting edges.

BLADE LIFE:

By using different blade matrixes (bond strentghs) it is possible to create dicing blades with different characteristics. As a general rule: the higher the blade life, the lower is the wear rate and the lesser is the self-sharpening effect. Self-sharpening is related to blade wear. Blade wear typically causes a reduction in O.D. Material- and process variations have such a significant influence on blade wear, that it is not possible to define exact figures. As a rule of thumb the following figure gives a good wear indication:

Nickel Blades:

6 - 8µ / 100m	pure Si (Scribing)
25 -30µ / 100m	Si+Adhesion+Tape (Dicing)

Resinoid Blades:

70 - 100µ / 10m	Glass
250 - 400µ / 10m	Al_2O_3 (96%, burned)

SELF SHARPENING:

Selecting the blade matrix means choosing the required self-sharpening effect. Metallic bonds are prefered when long blade life is required and the material being diced does not tend to chipping. The self-sharpening range of all metal blades is rather narrow: starting at the ultra hard TgC bond driving towards the softer sintered matrix such as bronce. In contrast resinoid blades with their high degree of selfsharpening offer a much wider range.

microkerf Resinoid Dicing Blades are available in the two bond types H = hard and S = soft. Because the self-sharpening effect is already quite high with hard bonds and economics require the highest possible life, the hard matrix (postfix H) is most offen specified. Single crystalline materials and some glass/ceramics, however, which tend to excessive chipping, are demanding a higher wearing matrix (postfix S).

Self-sharpening is not only influenced by the bond specified. By variing the process parameters and causing „hard-“ or „soff-“cutting action the self-sharpening effect can be controlled by the cutting process. When keeping chuck speed constant an increase in spindle revolution acts like increasing the bond hardness, in contrary reducing spindle revolution acts like softening the bond.

CUTTING WIDTH:

Cutting width is defined as follows: BLADE WIDTH + KERF + CHIPPING = CUTTING WIDTH. Kerf and chipping both relate to the material being cut and depend an the grit size chosen.

Again as a rule of thumb the following figures might be looked at when cutting silicon: Blade Width + 10µ Kerf + 20µ Chipping = Cutting Width (nickel bond; grain size 6µ)

For resinoid blades cutting hard materials the following approximation is valid: Blade Width + 10% Kerf + 10% Chipping = Cutting Width.

CHIPPING: in general / too big.

Chipping is directly proportional to the abrasive grit size and to the chuck speed. By reducing these two influences chipping can be reduced. Reducing diamond particle size, however, might increase loading that, by itself, is a cause for chipping. A solution could be increase of table speed to increase the stress an the blade or the use of Dressing Plates.

CHIPPING: On one side of the cut, left or right.

A common cause is that the coolant flow is an one side only. The side exhibiting chipping has too little coolant flow. This problem is most efficiently resolved by installing a dual-nozzle system, creating an almost parallel high velocity dual water beam to blast away dicing debris.

Another cause might be that the spindle axis / table feed axis are not exactly 90°. In addition to one sided chipping the blade life will be low.

Solution: saw will need factory calibration.

CHIPPING: at the bottom or top surface.

If switching to one step smaller diamond particle size does not help, check coolant flow, increase coolant flow, check cutting direction.

CHIPPING: at the bottom surface (back chipping).

This effect is commonly caused by dicing on tape or on soft mounting media. Blade wear will cause the blade edges to get rounded. When the cutting depth only enters shallow in the mounting media such as on thin dicing tape, a lip will be created where the kerf protrudes through the substrate. When pressure is applied to this lip due to high chuck speed, it will break away rather than being abraded causing large chips on the back side (back chipping).

Solution: reduce table feed. Use thicker mounting media to allow for deeper cutting.

MICRO-CRACKS:

Due to their self-sharpening nature resinoid blades will continuously create new sharp cutting edges for smooth, clean kerfs. Some very brittle monocrystalline materials with weak cleavage planes, however, tend to chip. Chips are the starting point of micro cracks. This is caused by the pressure transmitted to the substrate that cannot be compensated in the substrate's crystallic lattice. Cracks are created along the crystal planes. A solution is to make a double (or triple) cut. A first cut 2-3 mils deep will generate little pressure to the substrate. If the subsequent dicing step is performed in this groove the resulting cut will transmit less strain.

INCLINED CUT / WEAVINESS:

The kerf is not exactly perpendicular to the substrate's surface. The kerf is not straight but reflects a slight form of a wave. The ratio of blade exposure to blade thickness is too large. The blade stiffness is proportional to the square of the blade thickness and reverse proportional to the square of the blade exposure. Table feed (chuck speed) is too high! Under the pressure of cutting the blade tries to flex sideways, finally it will break.

Solution: Reduce chuck speed. Reduce ratio exposure / thickness.

BLADE OFTEN BREAKS:

There can be many causes. Provided the cause is not related to the machines condition, uneven chuckfeed, or poor spindle / table alignment, then the following potential causes should be checked: Coolant flow: Water beam has high velocity and meets the blade symmetrical an both sides in the 5 o'clock position. Distance (gap) substrate surface - fange O.D. = 0,125 mm at minimum. Abrasion rate is sufficiently high for the chuck speed selected. Blade thickness is providing sufficient strength. Blade exposure ist not too high. Blade does not load. Chips do not move, but are held firmly to the chuck so they cannot tilt or rotate when separated from wafer.

KERF TOO WIDE:

The total cutting width is more than 20% wider than the dicing blade. This can be the cause of too little coolant flow or saw-misalignment. The blade flexes under too high cutting pressure. The required corrective actions are achieved by eliminating the causes mentioned under „BLADE OFTEN BREAKS". Eventually a higher spindle revolution will cause higher blade stiffness.

CHIPS COME LOOSE FROM THE CHUCK:

The formula for calculating the area shows that the adhesive performance of a tape or any other holding media is proportional to the square of the chip size. When small chips, in particular thick ones, are to be processed, it is quite difficult to fix them in such a way that no movement occurs when singulated. As soon as movement occurs the chip tends to be catapulted from the chuck due to the high friction transmitted from the blade to the chip's edges being cut. In critical gases it might be necessary to fill the kerfs with a suitable medium for increased chip stability before making the second cut.

Even when tape with sufficient adhesion is selected, it is easily possible that chip movement occurs due to plastic deformation of the relatively soft tape. Tape is a most elegant way, when the chip orientation is to be maintained alter dicing for subsequent assembly processes. If this orientation is not required, mounting

Dressing Plates

Dressing Plates / Blocks are made out of a thermically stable resin and grains of an abrasive material.

For Nickel Blades /-Wheels made by the electroplating process dressing is mandatory, if clean Cuts free most commonly used on silicon, it is practical to perform the dressing cycle also in silicon. Dressing programs consist of various steps of table speeds, starting slow and increasing until production speed is almost reached. Care has to be taken that the dressing depth is deeper than the required production cutting depth, so that only dressed blade sections are used for production cutting.

Resinoid and sintered blades typically require no dressing. However, if materials are being processed, which do not strain the blade adequately, it will happen that the self-sharpening effect is not sufficient. Periodic cutting in dressing plates then causes a higher wear on the blade so that dull diamond particles are removed or new sharp edges are being produced.

Another reason for dressing blades is to clean a „loaded“ blade form debris that is filling the pores between the abrasive particles. Cutting into the dressing plate creates mechanical and thermal stress and thus produces clean surfaces.

For each level of stress required there are dressing plates in different hardness, grit sizes and dimensions:

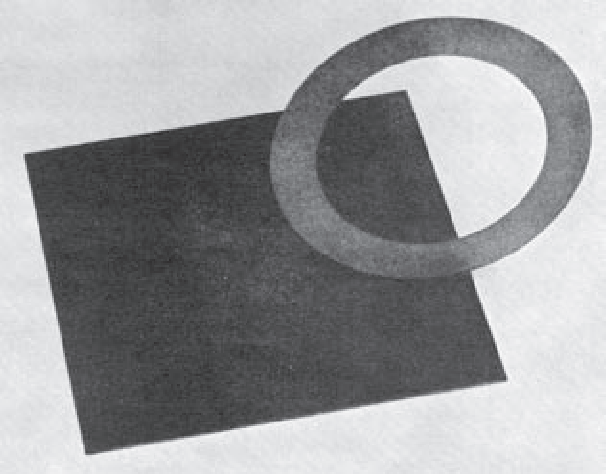


Figure 15

Part.No.	Description
FD-32	microkerf DRESSING BLOCK TYPE S Dimensions 3 x 3 x .040“ (soft)
FD-33	microkerf DRESSING BLOCK TYPE H Dimensions 3 x 3 x .040“ (hard)
FD-19	microkerf DRESSING BLOCK 30 Micron LUNZER 600 (1 x 3.5 x .190“) H
FD-12	microkerf DRESSING BLOCK 30 Micron LUNZER 600 (0.5 x 2 x .190“) H
FD-18	microkerf DRESSING BLOCK 45 Micron LUNZER 320 CS-M (1 x 3.5 x .190“) H

Figure 16

Recommended Dressing Procedure

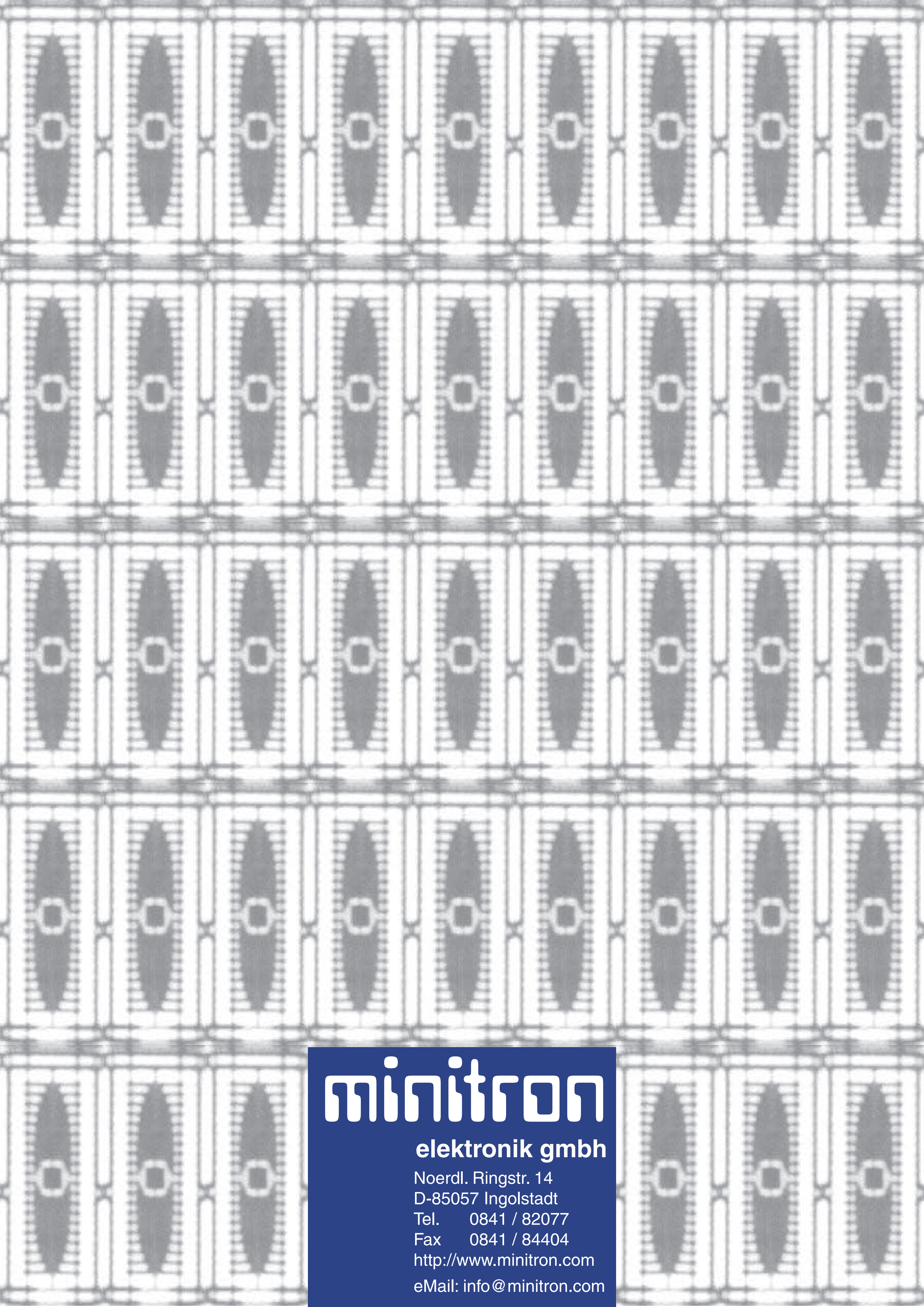
Dressing procedures are established by the end user and are based on experience and the application concerned. There is not one common method to be followed, but the following procedure may be adopted as a good staring point.

Most wafer saws provide a dressing program as part of their set-up routines:

Number of Cuts	Depth	Table Speed
5 - 10 cuts	50 µ	50 mm/s (Trueing)
5 - 10 cuts	PD + 100 µ	10 mm/s
5 - 10 cuts	PD + 100 µ	20 mm/s
5 - 10 cuts	PD + 100 µ	30 mm/s
continue until production table speed is reached		

PD = Production Cutting Depth

Figure 17



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