PERFECT POINT
PRECISION CARBIDE TOOLS

Automated Drill Bit Resharpening

Ultrasonic Cleaning Is Essential

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Summary: Perfect Point reviews the Re-Sharpening of drill bits with a view to traditional defects being identified and then corrected using the latest "Fully Automated Techniques". When orders are submitted for re-sharpening, the condition of the drills is received in various states. To begin the process, there is only one way to determine the true condition of the bit.
"Clean it Ultrasonically" and let the Process begin……

Sharpening drill bits is like cleaning a spark plug with emery cloth. The cleaner they are, the better they will perform and in the case of the drill bit we go so far as to grind the metal to create that needed sharp edge.

When it comes to drill bits for the PCB industry, the drill point and its sharpness have a dramatic effect on the final Yield of the completed board. It has been estimated that about one quarter of the production cost of the printed circuit board is dependent on the performance of the drilling process. Without getting too much into the specifics, we know that PCB's are a composite material. This material consists of glass fiber, resins and ductile material such as copper foil. All of these elements can work against each other complicating the cutting process. In any case we know that hole-wall quality is vital to the success of plating and optimal plating transfers the electrical properties throughout the entire board.

The fact is …. the plated hole begins with the drilled hole and there is no tolerance for a poorly drilled hole.

Diagram 1 – Before Cleaning

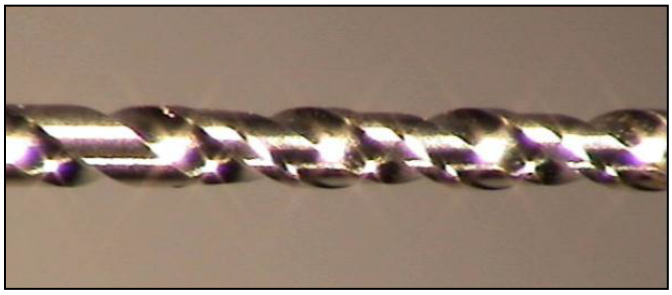


Diagram 2 – AFTER Ultrasonic Cleaning

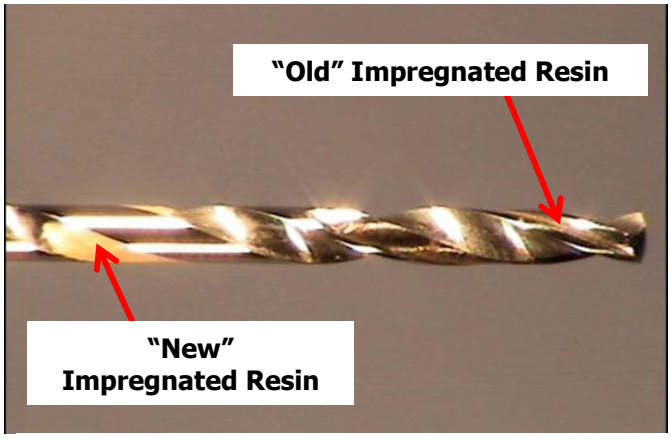


Diagram 3 – Impregnated Resins

The Repointing Process…….

Ultrasonic cleaning, rinse, and dry

After drill bits have been used by the PCB manufacturer, they are sent out for Re-sharpening. Drill bits typically arrive in drill boxes mixed in varying sizes and stages of previous repoints. It is therefore important to re-sort the bits to achieve the best uniformity. Bits also arrive with various types of debris including dirt, grime, metal turnings, melted resin and other unwanted contaminates.
Note some of the arrival conditions in Diagrams (1, 2, & 3)

They are then sent to the Ultrasonic cleaning station. This initial process is actually the first of three cleaning processes during the entire sharpening exercise. The specific time in the ultrasonic cleaning bath is carefully controlled and then the drills are removed and set up for rinsing and drying. Further cleaning takes place down the road when bits are subject to grinding carbide dust during sharpening. Drills with impregnated debris along the margin can cause clogged holes, smear, nailheading, burrs, drill breakage, miss registration among other problems. During the resharpening, ringsetting and AOI processes, every drill is cleaned twice.

Understanding the Technical Challenge

Over the years, drill bit engineers have developed comprehensive ways to identify and document defects while refining procedures to achieve the "Perfect Point". The Perfect Point is defined as Drill Bit dimensions meeting the minimum criteria of measurements for its class and size as defined by the parameters in (Diagrams 4 and 5)**.**
There are a host of specifications and tolerances for industry acceptance of drill bits.
Here is one example of specifications to address the "Gap" tolerances.

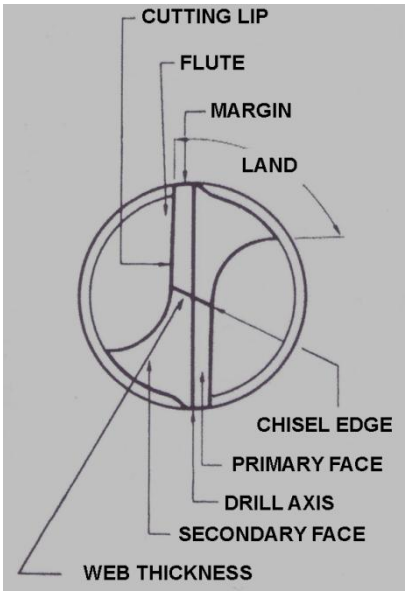


Diagram 4 – Geometry Illustration

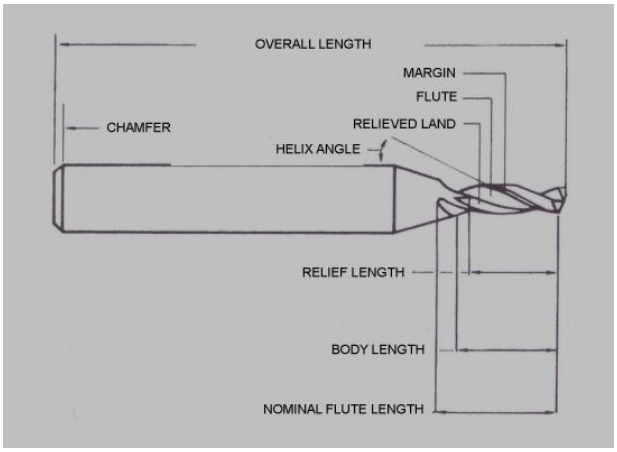
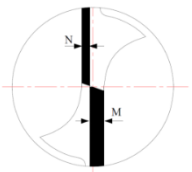
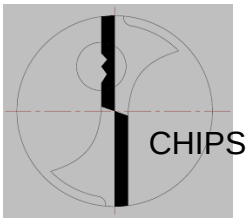


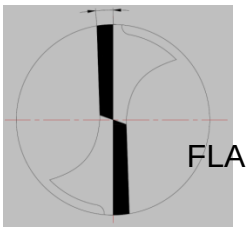
Diagram 5 – Geometry Illustration

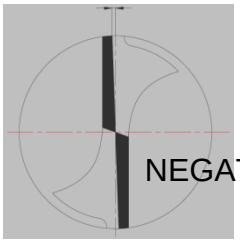
Diagram 6 - Specification allowances

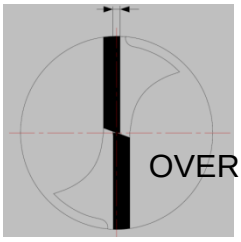
Point Illustration	Point Illustration	Maximum (IN specification) Point Conditions					
		.10mm - .13 mm .004 - .0050	#97 - #81 .0059 - .0130	#80 - #71 .0135 = .0260	.70mm - #52 .0276 - .0635	1.65mm – 1/8 .0650 - .1250	3.20mm – F .1260 - .2570
	GAP	.0002″	.0002″	.0003″	.0004″	.0004″	N/A

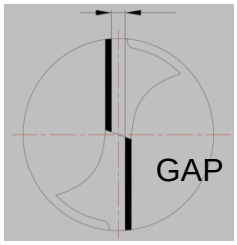
As well as our "GAP" example, there are a total of 8 specific industry classifications to define drill defects.

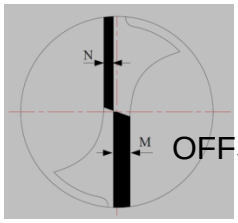


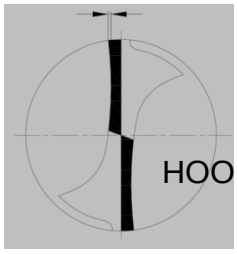


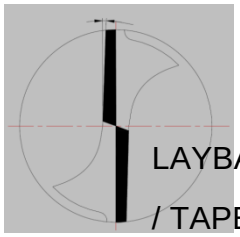












When we see actual microscopic pictures of bits ready for resharpening, the damages are complex and varied. Note some of the wear and tear in Diagrams (7, 8, 9).

With our goal to create a Perfect Point, the automatic equipment is designed to address all of these defects during repointing.

Diagram 8 shows the automatic system with each of its component stations.

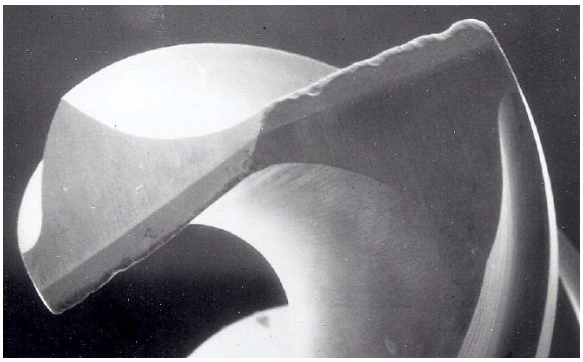


Diagram 7 – Primary cutting edge chips

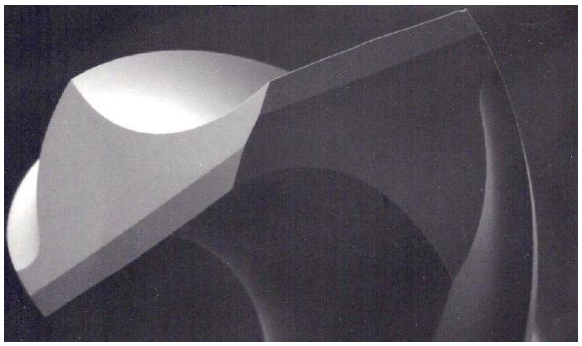


Diagram 8 – Excessive Gap

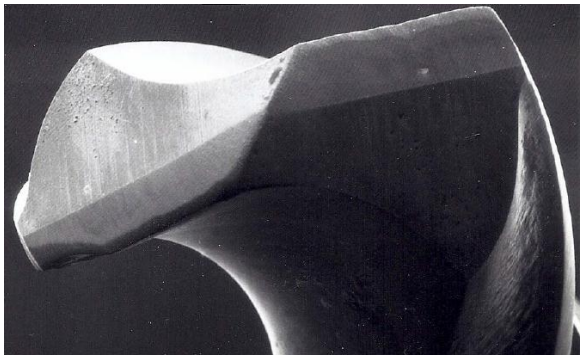


Diagram 9 – Excessive Corner Chip

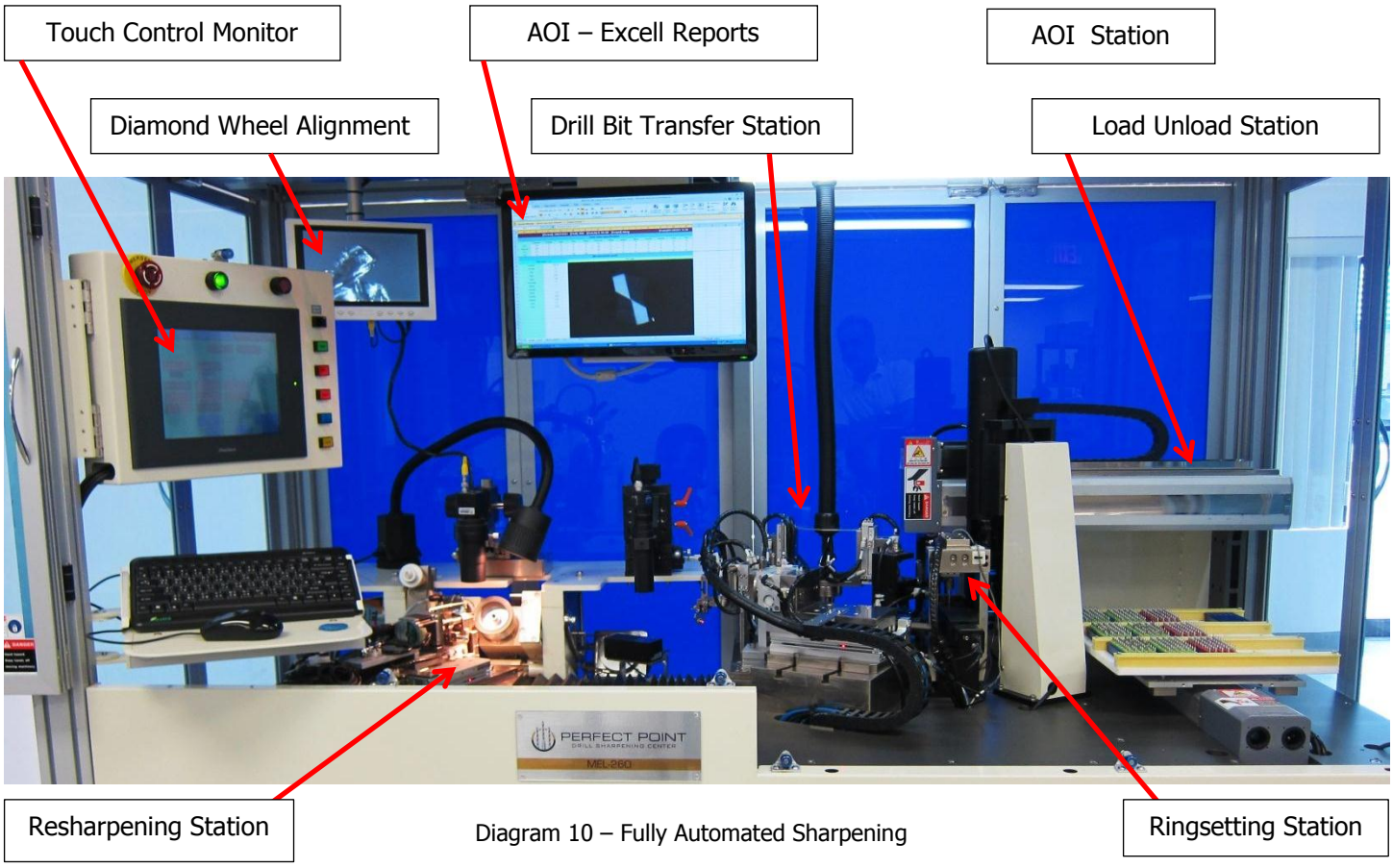


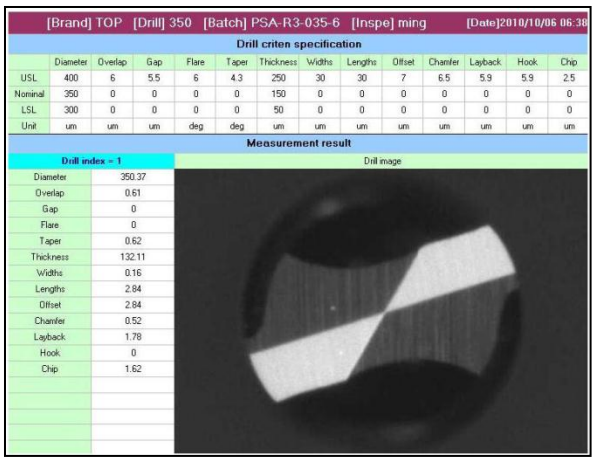
Diagram 10 – Fully Automated Sharpening

The Setup

The sharpening process begins with the selection of bits relative to their size. Drill bits smaller than 0.0118" are sorted for the fully automatic equipment. Typically the smallest (most fragile) bits are sized down to 0.006". In order to avoid breakage and to obtain a perfect point, the use of the automatic process including resharpening, ringsetting and AOI, makes this ideal for small drills. Drill bits greater than 1/8" are sorted for the semi-automated sharpening machines.

Automated Sharpening Process

The fully automatic robotic process combines all operations in one piece of equipment; sharpening, ringsetting and AOI. These "hands off" procedures are designed to address the industry's defined 8 classifications for the Perfect Point.


[Brand] TOP [Drill] 350 [Batch] PSA-R3-035-6 [Inspe] ming [Date]2010/10/06 06:38

Drill criten specification

	Diameter	Overlap	Gap	Flare	Taper	Thickness	Widths	Lengths	Offset	Chamfer	Layback	Hook	Chip
USL	400	6	5.5	6	4.3	250	30	30	7	6.5	5.9	5.9	2.5
Nominal	350	0	0	0	0	150	0	0	0	0	0	0	0
LSL	300	0	0	0	0	50	0	0	0	0	0	0	0
Unit	um	um	um	deg	deg	um	um	um	um	um	um	um	um

Measurement result

Drill index = 1

Diameter	350.37
Overlap	0.61
Gap	0
Flare	0
Taper	0.62
Thickness	132.11
Widths	0.16
Lengths	2.84
Offset	2.84
Chamfer	0.52
Layback	1.78
Hook	0
Chip	1.62

Drill image

Diagram 11

13 point AOI Inspection with picture of each bit

AOI Reporting

With today's sub miniature PCB drilling bits, they become impossible to inspect by eye and even using a microscope it is a tedious task to review every tool specification. The computer and its AOI capability is the ideal device to perform analysis of the completed task. The AOI operation is particularly extensive with checks against 13 potential defect areas at drill point including the key 8 defined industry classifications. They include: Diameter, Overlap, Gap, Flair, Taper, Thickness, Width, Length, Offset, Chamfer, Layback, Hook, and Chip. The accompanying diagrams (11, 12) indicate the specific areas and each is accompanied with a clear monitor display of the area. Hard copy reports/pictures are available for each occurrence. Similarly, "Sigma and CPK" values are made available in graphic form, fully describing the incidence of defect – an excellent way to determine corrective action required in key areas.

Edson Bosetti is the General Manager of the Perfect Point (PP) division of Matrix Electronics. PP is one of the leading Drill bit re-sharpening services in the US and Canada as well as a distributor of new Drills and Routers for the PCB Industry.

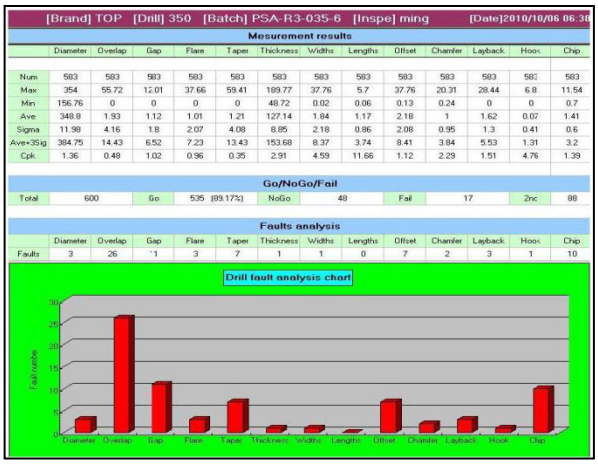


Diagram 12

13 point AOI Inspection with Sigma & CPK