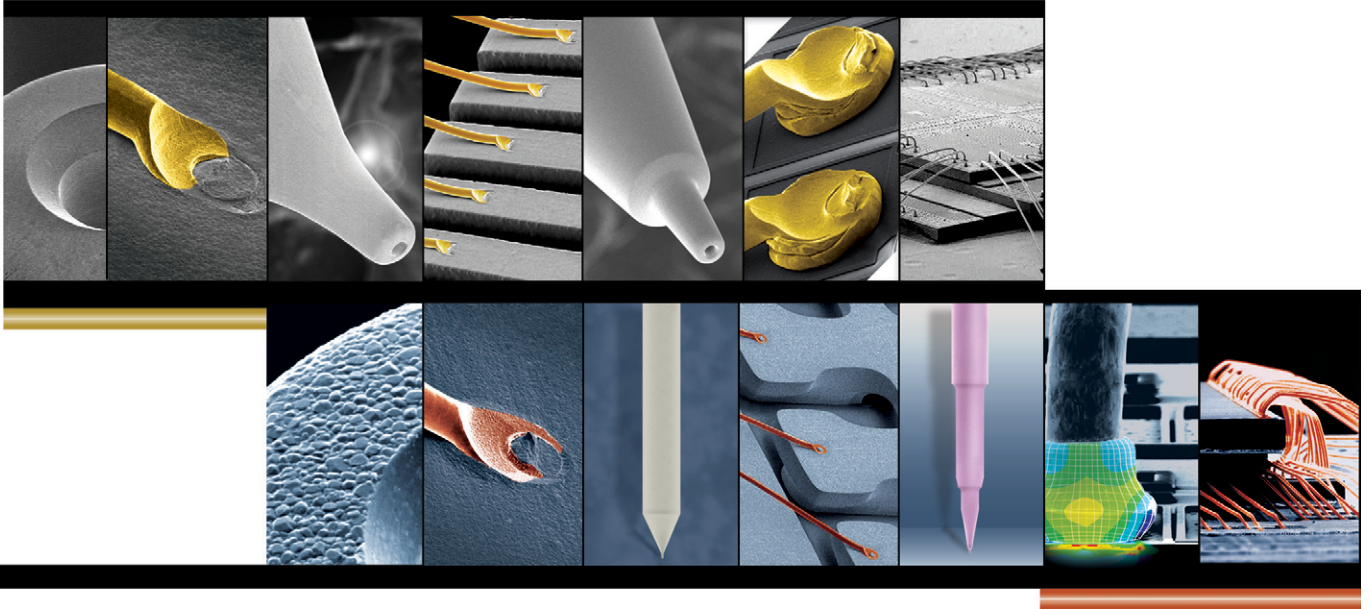


## Bonding Capillaries



## Bonding Evolution

## **Global Vision . World Leader . Local Presence .**

The SPT Roth Group's strategy centers on developing the Company into an integrated global corporation. Over the last thirty years, we have built on our global vision and invested in building manufacturing and sales facilities strategically around the world to be close to our customers.

The worldwide network combined with excellent logistic facilities ensures prompt and full compliance with customer requirements including ship-to-stock or just-in-time delivery programs. Dedicated and highly qualified sales and service engineers and application specialists ensure customers receive professional service and support at all times from the design phase to starting mass production.

SPT is open around the world, round the clock.





1890  
ROTH Group  
Lyss, Switzerland

**Pioneer . World Leader .**



1964  
Aprava Ltd.  
Lyss, Switzerland

Small Precision Tools - SPT - is the pioneer and leader of semiconductor bonding tools for over three decades.



1974  
Small Precision Tools Inc.  
California, USA

SPT is the only bonding tool manufacturer internationally established with marketing and production centres strategically positioned all over the globe, to be close to our customers.



1979  
SPT Asia Pte Ltd.  
Singapore

1982  
Moldinject, Perfectamould AG.  
Lyss, Switzerland



1991  
Small Precision Tools (Phils.) Inc.  
Manila, Philippines



1995  
Small Precision Tools Co. Ltd.  
Wuxi, China



2001  
SPT Japan Co., Ltd.  
Yokohama, Japan



2013  
SPT (Phil) Clark Corporation  
Manila, Philippines

## Creative Solutions . Research & Development . Customer Partnership

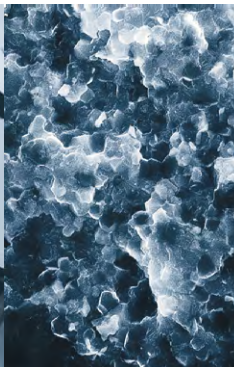
Customer partnership is our belief. At SPT, we listen to our customers. Because, every customer's needs are different, every solution is uniquely designed to satisfy those needs in the most effective way.

SPT offers a wide range of proactive support and services such as consulting, design, analysis, training seminars and benchmarking partnerships. SPT's material and process technology laboratories in Switzerland and Singapore offer technical support and services such as material analysis, process evaluation and characterization and tool design optimization.

Research



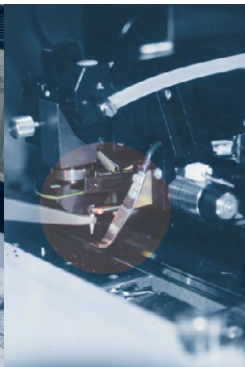
Development



Design



Partnership





# Quality . Product & Service Excellence

SPT is committed to quality and customer care. Our commitment to product excellence and continued support of our customers is part of the sustaining culture of SPT.

SPT's partnership philosophy has earned numerous prestigious awards and recognition from our customers.



Evaluation

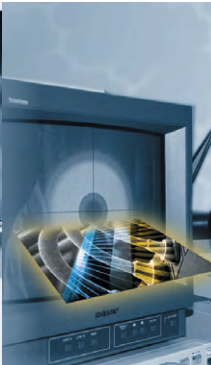
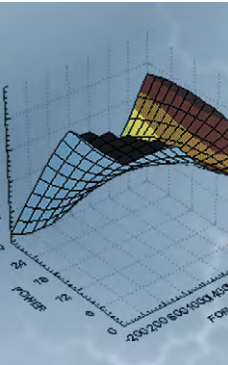
Optimization

Precision

Technology

Training

Excellence



## Product Technology . Excellence . Unsurpassed

SPT positions itself as a progressive high-technology tool manufacturer using state-of-the-art processes. Our production capabilities range from conventional to CNC machining including milling, turning, surface grinding, honing, Electro-Discharge Machining or EDM, jig grinding and more. Our exclusive Injection Molding technology of small complex parts through SPT's own in-house formulation and sintering assures customers of the highest quality in high alumina ceramic and carbide materials.

Our equipment and manufacturing techniques are the most advanced in the ultra precision tool industry.

We make standard and custom designs for specific customer requirements. All tools meet the high precision dimensional and quality standards maintained by Small Precision Tools.

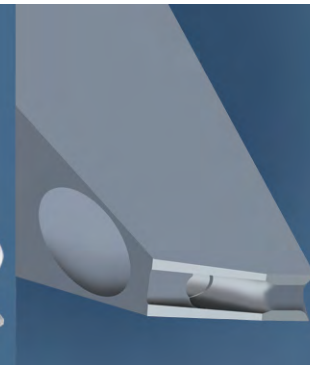
Bonding Capillary



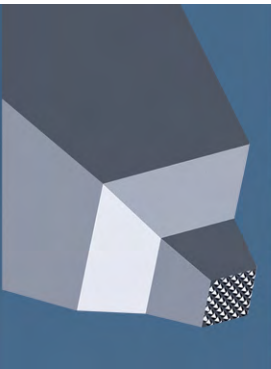
$\mu$ BGA Tab Tool



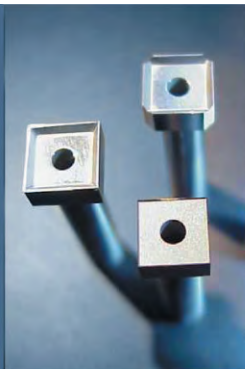
Fine Pitch Bonding Wedge



Waffle Tab Tool



Die Attach Collets



Bushings



Precision Parts



CIM & MIM Parts



Watch Gear



## CONTENT

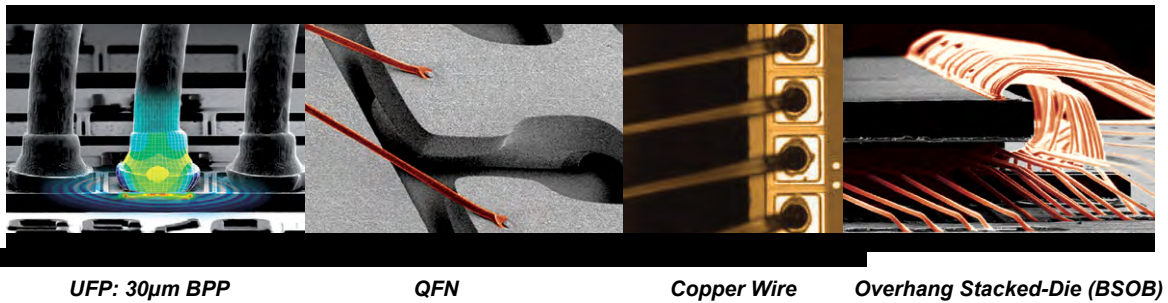
» *Click title to go to page*

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All dimensions are in  $\mu\text{m}/\text{inch}$  unless otherwise stated.  
We reserve the right to make changes to design or specifications at any time without notice.



## INTRODUCTION



The new generation of advanced electronics packages has driven the development of wire bonding technology to its full limits. Innovative package miniaturization approaches have been concertedly developed to deal with the packages' physical limitations. The end result is a compact, high performance, and low power consuming device with more functions. Important factors such as high reliability performance and lower cost of ownership have become major considerations in the overall package design.

The dynamic of package evolution from a simple leaded or laminated device to a multiple stacks, overhang, system-in-package, fine-pitch, stitch on bump, micro rough PPF leadframe, high pin count QFN drive the wire bonding technology to develop a solution for advanced packaging. This has posed a tremendous challenge in the wire bond interconnect technology to develop new generation of wire bonders with additional features. Nevertheless, proper capillary selection and consideration are also the key factors to the success of advanced wire bonding solution. The ultrasonic behavior, capillary basic and auxiliary geometries are studied diligently to adopt a solution based approach.

Driven by the escalating market price of gold as compared to copper, gold-to-copper wire conversion for wire bonding interconnect has become the major direction adopted by the semiconductor packaging assembly companies to further lower its manufacturing cost. The utilization of copper wire necessitates changes in the material, machine capability, bonding approach, and capillary used.

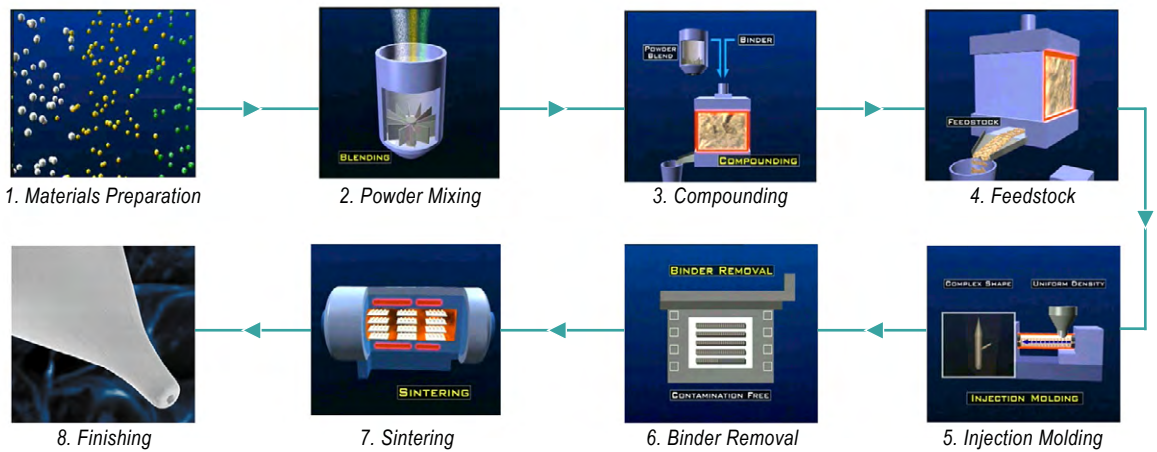
SPT offers a wide range of capillary designs based on the given device/package application type and optimized to produce consistent and robust wire bonding process. Customers are assured of high quality standards and conformity to specifications. SPT's SU (enhanced coupling feature) finishing combined with either DOP (Doppler) capillary design and SQ (ideal for QFN packages) are today's renowned solutions for copper wire bonding application. Today, SPT takes the lead in high volume copper wire bonding production, supplying copper wire bonding capillaries to major IDMs and OSAT companies and we have been accorded numerous accolades for our technical support and capillary performance for their gold to copper wire conversion programs. Other SPT's capillary series such as, Programmed Intelligence (PI) and Stitch Integrator (SI), are still commonly used to address gold wire bonding related issues.

SPT differentiates itself by providing customers with robust capillary products and designs to meet these new packaging technology challenges using state-of-the-art Ceramic Injection Molding (CIM) technology, superior fine grade of ceramic composite material and a fully automated nanotechnology finishing process. Today, SPT is the only bonding tool supplier with numerous factories, strategically located around the world to be as close to our customers as possible. SPT's team of sales and technical application specialists ensure that our customers receive professional service and support from design phase to mass production. Our commitment to product and service excellence to our customers is part of the sustaining culture of SPT. We welcome your enquiries and look forward to serve you.

This catalogue serves as handbook of wire bonding information and the layout guides you through to the selection of suitable capillary design for any specific device & package application. If you are still in doubt or require further clarification, please feel free to contact our local SPT technical assistance in your area.

## CERAMIC INJECTION MOLDING (CIM)

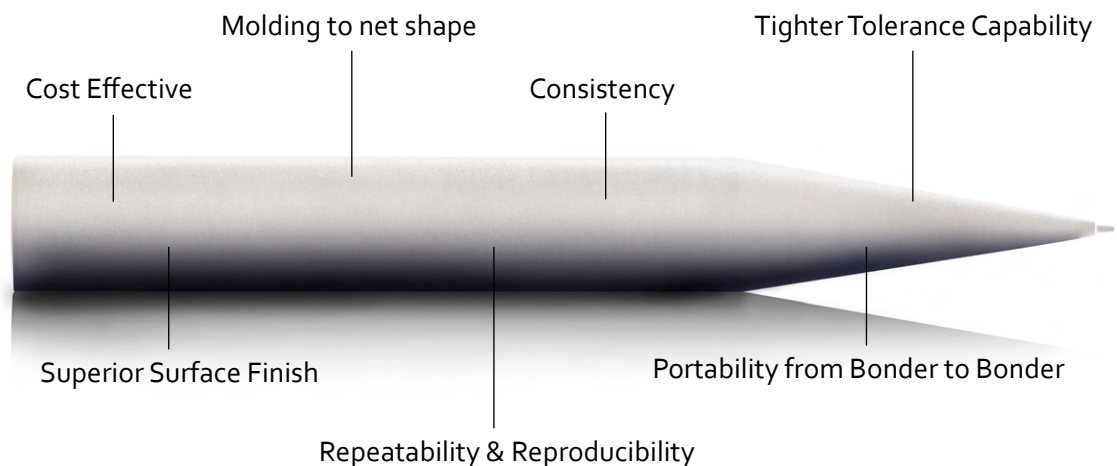
SPT's wire bonding capillaries utilize a state-of-the-art Ceramic Injection Molding (CIM) technology to achieve reproducibility from the first piece up to the  $n^{\text{th}}$  piece with excellent consistency to meet customers' tighter dimensional tolerance and robust bonding performance requirement in a cost effective way.



### The Process

Small Precision Tools' injection molding process is a combination of powder, injection molding, and sintering technologies. To obtain the necessary chemical and physical properties, powders are selected by size and shape and complemented with additives. Every particle of the powder is coated with binder components, which transport the powder for molding and gives the final form rigidity.

The ceramic injection molding is very suitable for high volume production of complex design with tight tolerances like bonding capillaries. It is an effective way of manufacturing complex precision components with the highest degree of repeatability and reproducibility.



## GOLD BALL WIRE BONDING PROCESS

Thermosonic tailless ball and stitch bonding is the most widely used assembly technique in the semiconductor to interconnect the internal circuitry of the die to the external world. This method is commonly called as Wire Bonding. It uses force, power, time, temperature, and ultrasonic energy (also known to as bonding parameters) to form both the ball and stitch bonds. Typically for the ball bond, the metallurgical interface is between gold (Au) and aluminum (Al) bond pad (usually with 1% silicon (Si) and 0.5% copper (Cu)). As for the stitch bond, it is bonded to a copper alloy with thin silver (Ag) or nickel-palladium (NiPd) plating.

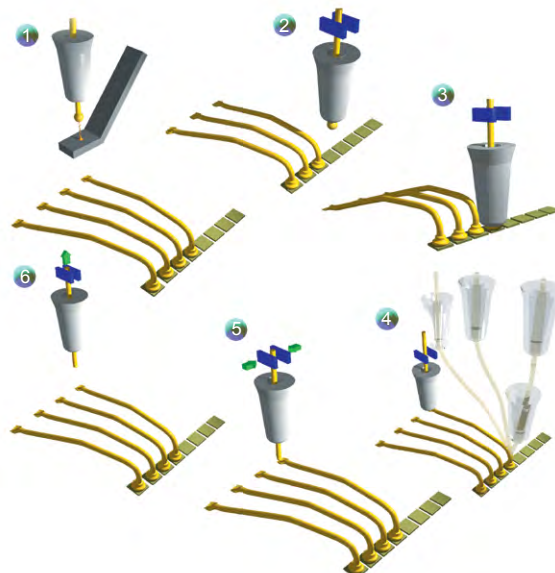
The ultrasonic transducer (typically for new generation of wire bonders, the piezoelectric element is  $>100\text{KHz}$ ), which converts the electrical energy into mechanical energy, transmits this resonant energy to the tip of the bonding capillary. The capillary that is clamped perpendicularly to the axis of the transducer-tapered horn is usually driven in a y-axis direction vibration mode.

Bonding capillaries are made of high-density Alumina ceramic material,  $\text{Al}_2\text{O}_3$ , typically  $1/16''$  (.0625" / 1.587mm) in diameter and .437" (11.10mm) in length. The final capillary design depends upon the package/ device application and wire diameter to be used. To determine the correct capillary design in general, bond pad pitch (BPP), bond pad opening (BPO), and target mashed ball diameter (MBD) are essential.

A fine gold wire made of soft, face-centered-cubic metal (FCC), usually ranging from  $18\mu\text{m}$  to  $33\mu\text{m}$  in diameter (depending upon the device/ package application) is fed down through the capillary. It is usually characterized by its elongation (shear strain), and tensile strength (breaking load). Selection of the appropriate wire type to be used for a given application would be dependent on the specification of these elongation, and tensile strength. In general, the higher elongation (or higher strain), it means that the wire is more ductile. This is a good choice for low-loop, and short wire type of wire bonding application. If the requirement is for higher pull strength readings, a harder wire type having a higher tensile strength has to be considered.

The small incursions of ultrasonic energy at the tip of the capillary are transmitted to the Au ball and down to the Al bond pad to form the ball bond. After which, the capillary lifts up and form the looping profile, and then comes down to form the stitch bond. This cycle is repeated until the unit is bonded.

An intermetallic compound, Au-Al, is formed when the Au is bonded thermosonically to the Al bond pad metallization. The metallurgical interface of void free Au-Al formation has a significant increase in the shear strength readings of the ball bonds tested provided that there are no impurities present in the bond interface even if it has been exposed to high temperatures. However, if the impurities in the interface are welded poorly, the ball shear strength produces a significant degradation in its readings.



*The Bonding Cycle*

## COPPER WIRE BONDING PROCESS

Wire bonding process is commonly used to interconnect chips to the outside world using gold wire since its inception in the mid 1950 using thermo-compression, an application of heat and force. However, it was not enough to form a more reliable oxide free ball and stitch bonds interface until the introduction of thermosonic bonding in 1960 incorporates ultrasonic energy. For decades, continuous progression to improve the device-package reliability has been the primary goal while cost of ownership has become one of the driving forces to make all the electronic gadgets available nowadays, affordable to the masses.

In general, the copper wire bonding process is very similar with gold wire bonding as it basically uses the same wire bonder equipment with minor hardware and software retrofits. Instead of gold wire, it is replaced by copper wire, though not limited; the range is typically from 15 $\mu$ m to 50 $\mu$ m in wire diameters depending upon the package-device application.

Copper wire bonding offers significant advantages over gold – superior product performance in terms of electrical and thermal conductivity; better product reliability due to slower intermetallic growth that causes voids; and higher break load during wire pull testing.

One of the early day drawbacks of using copper wire in the wire bonding process is oxidation problem which can impact the reliability and integrity of the encapsulated device inside the electronic package. As we all know, oxidation retards the welding of deformed ball into the bond pad, and stitch into the lead frame or substrate. Today, this has been overcome due to the vast improvement in the wire bonding technology and processing of different materials (e.g. copper wire, lead frame or substrate, device metallization, etc...) to complement the use of copper wire.

- The utilization of forming gas (a mixture of 95% Nitrogen and 5% Hydrogen)- for an oxidation free process during the formation of copper free-air-ball (FAB).
- All automatic wire bonders used for copper wire bonding process are all equipped with copper kit, comprising of EFO (electronic flame-off kit) with provision to ensure optimum flow of forming gas.
- Palladium coated copper (Pd coated Cu) wire is an alternative to choice retard oxidation.
- Software enhancements integrated in the new generation of copper wire bonders to improve ball bondability with minimal aluminum splash-out and programmable segmented stitch features.
- Special type of capillary surface finishing with granulated protrusion for better gripping and to reduce short tail related stitch bondability problems.

## GOLD & COPPER WIRE BONDING CYCLE

The wire bonding cycle using copper wire is almost the same as the gold wire as it forms the ball bond, loop, and stitch sequence. The introduction of forming gas during the free-air-ball formation for copper wire is the only difference in the process. Forming gas consist of 95% Nitrogen to prevent copper wire from oxidation and 5% Hydrogen for flammability enhancement to create concentric FAB during EFO (electronic flame off) firing. Highly oxidized copper free-air-balls are basically harder and more difficult to bond on sensitive silicon technology. In addition, the forming gas helps to inhibit the oxidation of copper wire once exposed to ambient temperature of wire bonders' heater block.

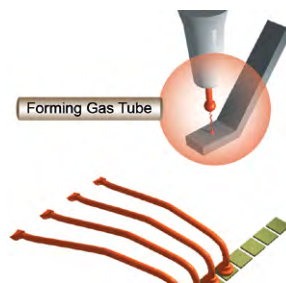
### 1 Free Air Ball (FAB)



To achieve consistency of the free air ball size, it requires consistent tail length after second bond formation, and consistent electronic flame-off (EFO) firing.

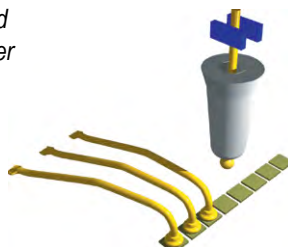


**Gold Wire** - After the second bond application, the capillary lifts up with its tail protruding outside the capillary tip. This action would then enable the electronic flame off (EFO) to be activated to form the gold FAB and then the bondhead goes to the reset position for the next bonding cycle. Thus, the FAB is already formed before the next bonding cycle begins.



**Copper Wire** - To form a concentric copper free-air-ball, a "Copper Kit" is a must have to ensure continuous controlled flow of forming gas towards the tip of the capillary and torch electrode (EFO Wand) to prevent copper from oxidation. After the stitch bond application, the capillary lifts up with its tail protruding outside the capillary tip then the bondhead goes to the reset position with the absence of the FAB. The copper bonding cycle starts with a formation of the FAB.

### 2 Free-Air Ball is centered inside the capillary chamfer area



A wire tensioner is used to ensure that the free air ball is up and at the center of capillary face prior to being lowered onto the die bond area. If this condition is not met, there is a chance of producing an irregular ball bond deformation commonly known as "golf club ball bond".



### 3 Ball Bond Formation



The capillary is lowered with the free air ball at its tips' center, and initial ball deformation is made by the application of impact force.

The application of the ultrasonic energy, force, temperature and time enabled the initial ball to be deformed further to the geometrical shape of inside chamfer, chamfer angle and the hole.

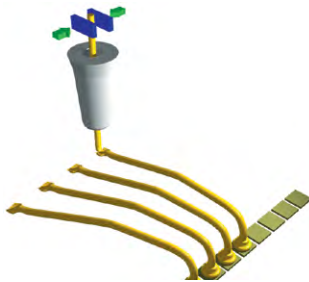
### 4 Capillary forms the loop and then stitch bond



After the ball bonding, the capillary raises, looping takes place as the capillary travels at the same time from the first position of the ball bond to the direction of the second bond to form the stitch.

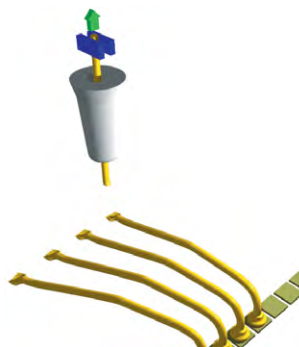
The looping can be varied to a different modes depending upon the device / package type. Achieving low-loop, long lead bonding is no more a problem because of the programmable looping algorithm that optimizes its formation for each different lead length.

### 5 Tail Formation after the stitch bond



Once the capillary reaches the targeted second bond position, the stitch is then formed with similar factors applied during the first bond. The capillary deformed the wire against the lead or substrate producing a wedge-shaped impression.

### 6 Capillary lifts and forms a tail

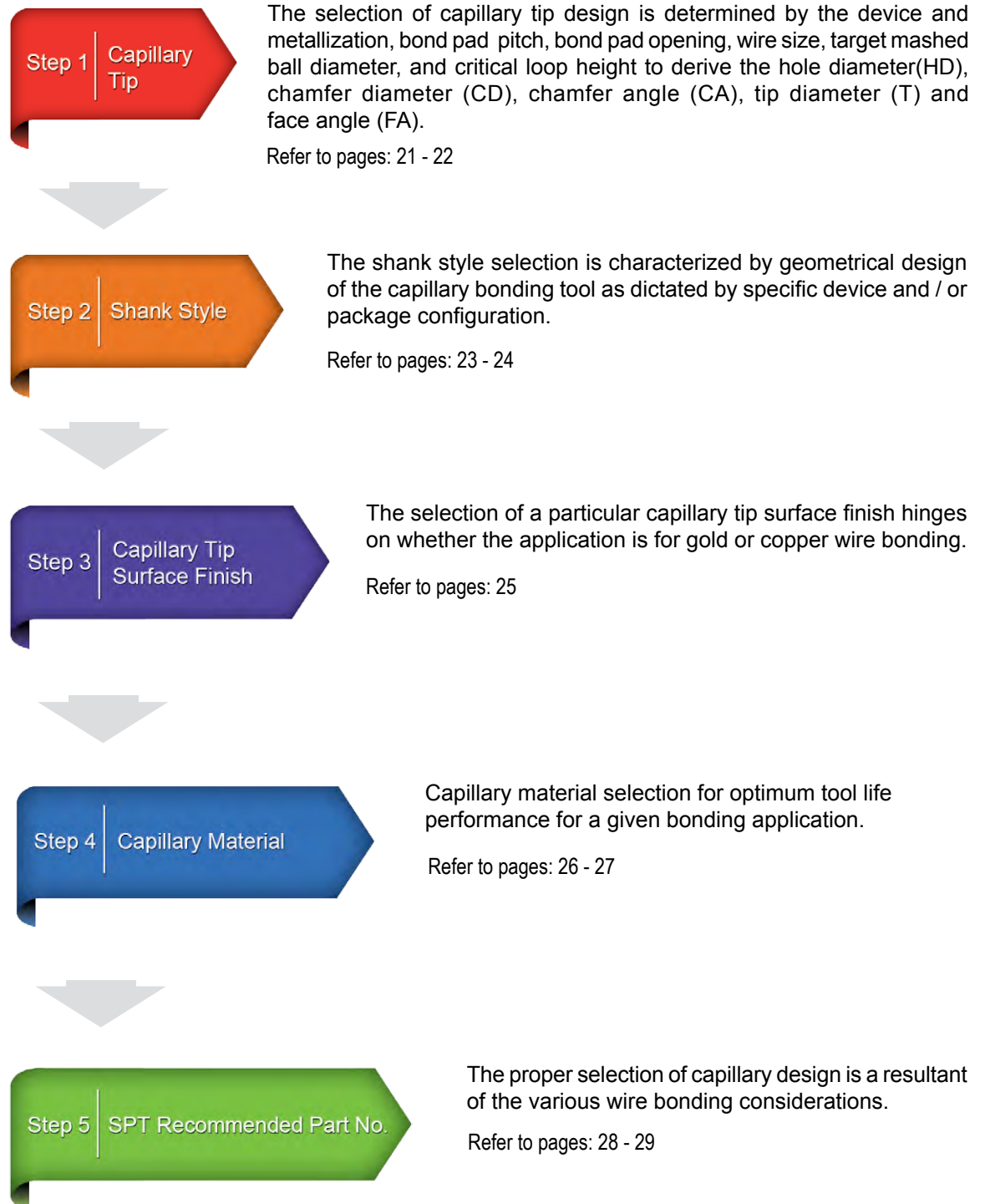


It is important to note that a certain amount of tail bond is left to allow pulling of the wire out of the capillary after the stitch bond application in preparation for the next free-air-ball formation.

## CAPILLARY DESIGNS & SOLUTIONS

### Capillary Part Number Selection Guide

The capillary design selection guide is always based on specific device & package configuration, wire type, and wire bonder. The selection of capillary part number process is simplified as follows:



## BASIC CAPILLARY DESIGN RULES

As the semiconductor industry braced itself for the transition from gold to copper, the copper wire conversion is relatively a tougher process to define as compared to gold wire bonding with challenges both on the ball bond and stitch bond. The problem the customer may face varies, depending on the bond pad metallization structure and the substrate or lead frame surface condition.

One of the basic principles to achieve an optimized wire bonding process is through proper capillary design selection. The synergy of different process variables coming from the wire (e.g. gold and copper), substrate or lead frame based metallization, bond pad metallization, and wire bonder are influential to the final geometrical design of the capillary.

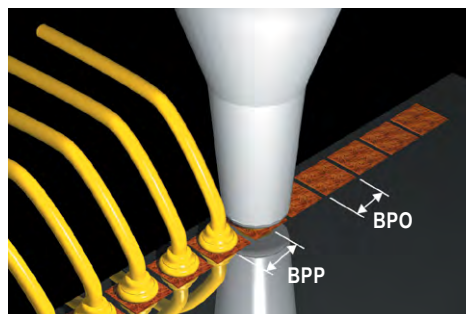
The proper selection of the copper wire (bare or coated) and capillary type are critical to resolve wire bonding issues like excessive aluminium splashed out, short tail, or fish tail which are inherent problems related to copper wire bonding. A proper design of experiment (DOE) needs to be conducted, not only involving the base settings but also considering auxiliary parameters such as scrub function and force/power profiling. Some high-end wire bonder platforms may have the feature to utilize segmented parameter profiling for specific bonding location of interest.

The capillary selection process for gold and copper starts with the determination of the following information defined by customers' device and package design configuration:

**Bond Pad Pitch (BPP)** –is defined as the center distance between two adjacent bond pads. Specifically for ultra- fine pitch application, the BPP dictates the design of tip diameter (T), bottleneck angle (BNA) and chamfer angle (CA).

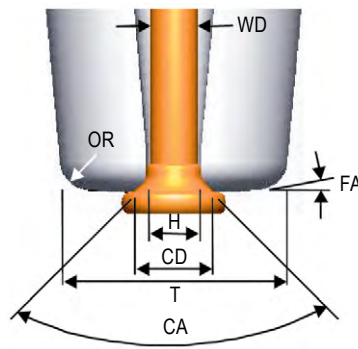
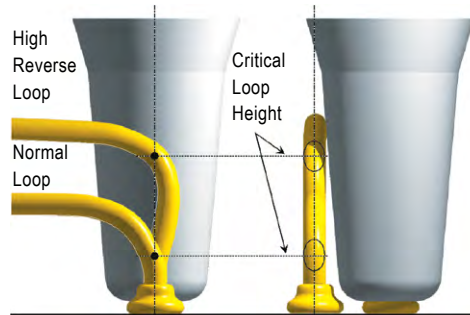


**Bond Pad Opening (BPO)**- is defined as the unpassivated area of the bond pad where the actual ball bonds are ultrasonically welded.



## BASIC CAPILLARY DESIGN RULES

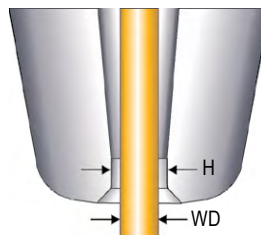
**Critical Loop Height (CLH)**- is defined as the height of the loop that is in-line with the centerline of the capillary when viewed from the side or parallel to the adjacent wire. Once the wire passed the centerline, the capillary has already cleared and no adjacent loop disturbance is observed.



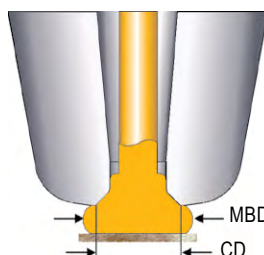
*Cross section diagram of Capillary Tip Profile*

### Capillary dimensions directly affecting the ball bond formation

- **Hole Size (H)** is determined based on the Wire Diameter (WD) to be used in a given application. Typically, the ratio is around 1.2X to 1.5X of the WD. A smaller hole size ratio is necessary for ultra-fine pitch application to compensate for the smaller chamfer diameter requirement.



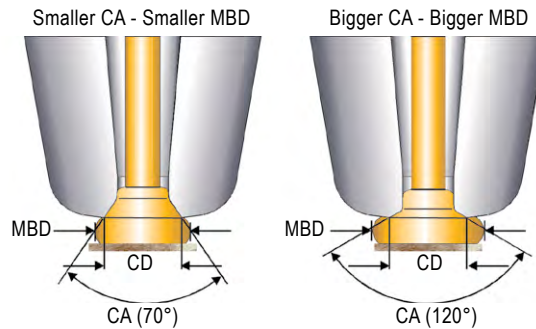
- **Chamfer Diameter (CD)** is determined based on the targeted Mashed Ball Diameter (MBD). Normally, the MBD is restricted by the bond pad-opening dimension.



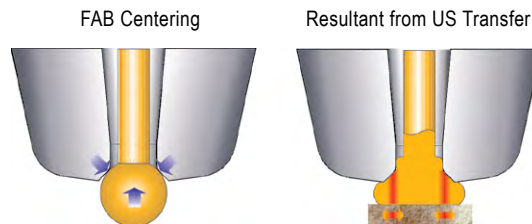
## BASIC CAPILLARY DESIGN RULES

- **Chamfer Angle (CA)** provides a certain amount of squash out in the formation of MBD. It also controls Free Air Ball (FAB) centering during its impact. Typical chamfer angle is 90°.

Inner chamfer grips the initial free air ball during the transfer of ultrasonic energy.



The combination and interaction of the hole size, chamfer diameter, chamfer angle, and inner chamfer determines the total amount of volume necessary to form the ball bond. The total volume of the FAB must be greater than the volume created by the above combination so that enough gold or copper material is squashed out of the chamfer area to form the desired MBD.



### Typical Capillary Hole Size Selection Based on Wire Diameter

The proper selection of hole size for a given wire diameter is vital in the design of the capillary. This applies not only for fine pitch application but also for standard designs. Table 1 summarizes the recommended combination, which would provide better control and consistent looping profile.

Given Wire Diameter (in $\mu\text{m}$ / inch)	Hole Size (in $\mu\text{m}$ / inch)
12 / .0005	15 / .0006 - 16 / .00063
15 / .0006	18 / .0007 - 21 / .0008
18 / .0007	21 / .0008 - 25 / .0010
20 / .0008	25 / .0010 - 28 / .0011
23 / .0009	28 / .0011 - 30 / .0012
25 / .0010	33 / .0013 - 38 / .0015
28 / .0011	35 / .0014 - 38 / .0015
30 / .0012	38 / .0015 - 41 / .0016
33 / .0013	43 / .0017 - 46 / .0018
38 / .0015	51 / .0020 - 56 / .0022
51 / .0020	64 / .0025 - 68 / .0027
64 / .0025	75 / .0030 - 90 / .0035
75 / .0030	90 / .0035 - 100 / .0039
100 / .0039	127 / .0050
127 / .0050	178 / .0070

Table 1

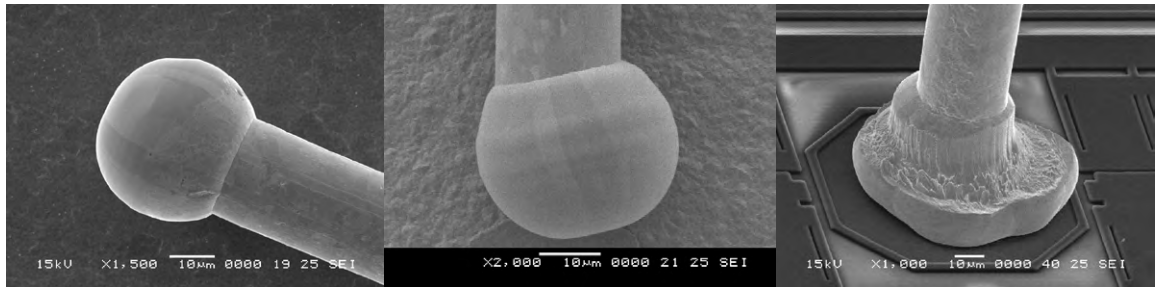


## BALL BOND

In ultra-fine pitch ball bonding, the consistency of the mashed ball diameter (MBD), looping, and stitch bonds are essentially required in order to define a robust process.

The following considerations are important to produce a consistent MBD:

1. Consistent and symmetrical free-air-ball (FAB) is important to produce a consistent MBD.

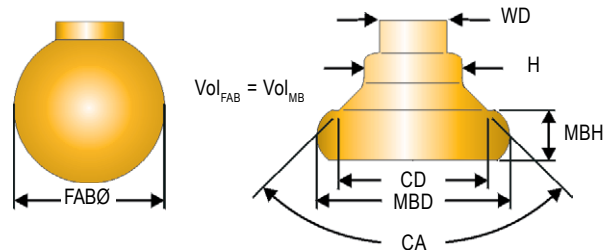


Consistent and Symmetrical FAB

Unsymmetrical FAB

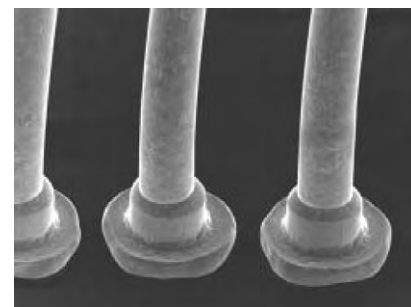
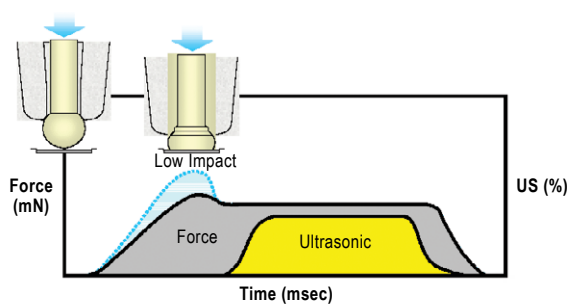
Unsymmetrical MBD from unsymmetrical FAB

2. Correct capillary design considering the hole size, chamfer diameter, chamfer angle, wire diameter, targeted MBD, and mashed ball height (MBH).



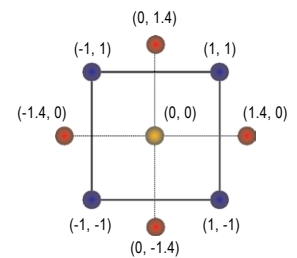
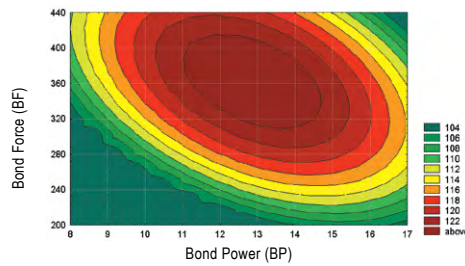
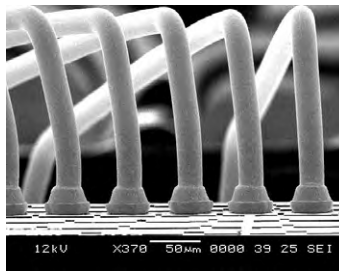
$$FAB\varnothing^3 = 1.5H^2(H-WD) + (CD^3-H^3) / 4\tan(0.5CA) + 1.5MBD^2(MBH)$$

3. Controlled impact or initial force is needed for better control and consistent ball height



Uncontrolled MBD & MBH due too high impact force

4. Optimized bond force, and bond power - for wider process window



**Consistency of the Small Ball Bond Deformation**

The continuous growth in the development of new packaging technology has posed a greater challenge for wire bonding process to optimize the ball and the stitch bonds. Maintaining consistency in the formation of bonds is the key to success. To attain a consistent small ball bond deformation, the following are essential consideration:

- Optimum capillary design selected - typically, the hole size, chamfer diameter, and chamfer angle are the major dimensions in consideration. A 90° chamfer angle (CA) as a standard; given a hole size (H)= WD + 8µm as the minimum; and chamfer diameter (CD)= H + 10µm as the minimum.
- Consistent free air ball and wire diameter aspect ratio- around 1.6 to 1.7x WD range.
- Consistent tail length protruding outside the capillary tip after the second bond
- Consistent electronic flame-off firing to form the free-air ball.
- Maintaining adequate gap between the tail and the EFO wand to prevent shorting or open wire problems.



Consistent EFO firing to form consistent free-air ball



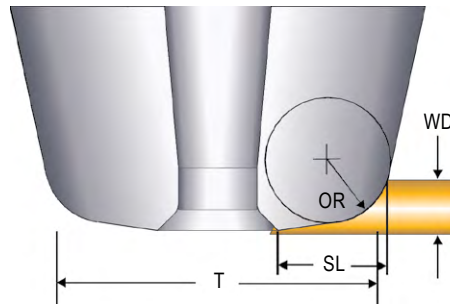
Consistent tail bond after stitch bond

## STITCH BOND

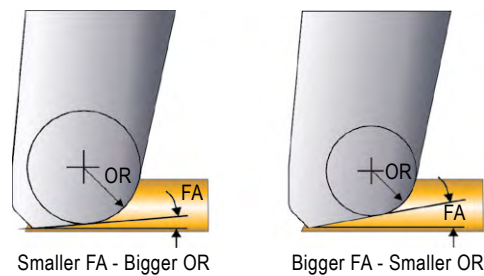
The length of the stitch bond is influenced by the capillary tip diameter. The size of the tip diameter is dependent upon the device bond pad pitch dimension. For ultra-fine pitch application, the considerations for good stitch bonds (which means higher pull strength readings) are the following:

### Capillary dimensions directly affect the stitch bond formation

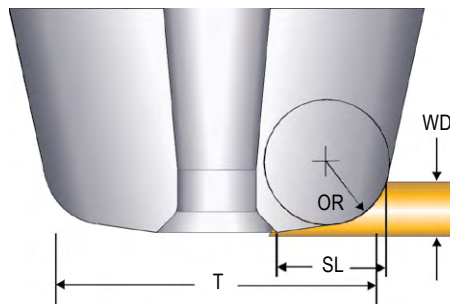
- Tip Diameter (T) determines the amount of Stitch Length (SL).



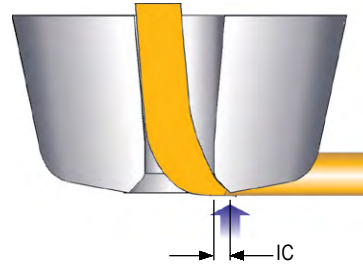
- Outer Radius (OR) provides a proper heel curvature of the stitch bond to minimize heel cracks.



- Outer radius (OR) must complement face angle (FA) design for given small tip diameter (T) - to provide an adequate thickness and smooth transition of the stitch.



- Face Angle (FA) provides a certain level of thickness of the stitch bond with a proper combination of OR transition. This is typically 8° for non-fine pitch and 11° for fine to ultra-fine pitch applications.



- Inner Chamfer (IC) bonds the necessary tail length before detaching it from the stitch bond in preparation for the next FAB formation.

**Typical Capillary Tip Diameter and Outside Radius Design Combination**

Another important consideration in the design of the capillary is the correct combination of outer radius (OR) and the tip diameter (T) with a given face angle (FA). This combination would ensure a smooth transition of the stitch bond as it guarantees that the outer radius (OR) would not nullify whatever face angle design applied, given the tip diameter design. Table 2 shows the typical T and OR combination.

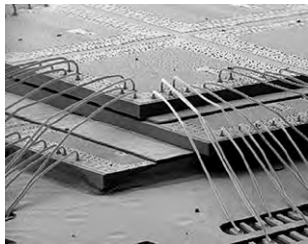
Tip Diameter (in $\mu\text{m}$ / inch)	Outer Radius 'OR' (in $\mu\text{m}$ / inch)
55 / .0022	8 / .0003
60 / .0024	8 / .0003
66 / .0026	10 / .0004
70 / .0028	10 / .0004
75 / .0030	12 / .0005
80 / .0031	12 / .0005
90 / .0035	12 / .0005
100 / .0039	12 / .0005
110 / .0043	20 / .0008
120 / .0047	20 / .0008
130 / .0051	30 / .0012
140 / .0055	30 / .0012
150 / .0059	30 / .0012
165 / .0065	38 / .0015
180 / .0071	38 / .0015
190 / .0075	38 / .0015
200 / .0079	51 / .0020
225 / .0089	51 / .0020
250 / .0098	51 / .0020
270 / .0106	51 / .0020
300 / .0118	64 / .0025
330 / .0130	64 / .0025
360 / .0142	75 / .0030

Table 2

## CAPILLARY SHANK STYLES SELECTION TO FIT SPECIFIC BONDING APPLICATION

With the rapid changes in the assembly and packaging technology requirements, new packaging solutions are being introduced in response to the demand for smaller, thinner, lighter and high performance multifunctional electronic products. The emerging global semiconductor assembly's direction to convert from gold to copper has added new sets of challenges to bond various types of packages such as ultra-fine pitch, stacked die, multi-tier, low-k and fine-pitch. In compliant with these new bonding requirements, SPT has developed a wide range of new capillary designs for a given specific application which is generally classified as follows: shank style; capillary tip finishing; and material.

### P.I. Capillary



### Solution For Advanced Bonding Application Programmed Intelligence (PI) Capillary

PI capillary unique geometrical design is a popularly used for devices such as low-K, fine -pitch application , and advanced packaging which require ball-stitch-on-ball (BSOB), over-hang devices, and ultra-fine pitch wire bonding using gold, copper or Ag alloy wire. PI capillary is designed to improve repeatability and portability of ultrasonic transmission from one bonder to the next.

The PI capillary design characteristic exhibits higher amplitude displacement compared with conventional as shown in the laser test results as compared with conventional capillary.

	Amplitude of Vibration (nm)		
	Design A	Design B	PI Design
	454	488	544

### SQ Capillary



### Solution For QFN SQ Capillary

QFN (Quad Flat Non-Lead) is low-cost and high density package type used for both gold and copper wire bonding application. It comes with inherent drawback in wire bonding process that causes lead bouncing problem due to unsupported leads. Lead bouncing is more prominent on the Tape QFN where the polyimide tape actually softens when subjected to high bonding temperature. The softening effect actually absorbs (loses) certain amount ultrasonic energy needed to bond the stitch. SQ capillary is geometrically designed to provide massive stability in QFN packages to form excellent stitch bond using high thermo-compression bonding concept with lesser incursion of ultrasonic energy.

Capillary	Displacement @ transducer ( in mm )	Displacement @ tip point ( in mm )
SQ	175	287
Typical	180	476

Less displacement at the tip applying same power setting

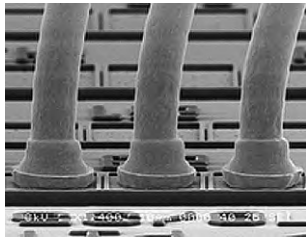


# CAPILLARY SHANK STYLES SELECTION TO FIT SPECIFIC BONDING APPLICATION

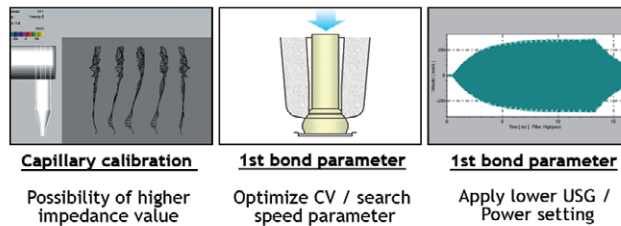


## Solution For ultra-low K, and sensitive metallization Doppler Capillary

DOPPLER with multiple cylindrical steps is a uniquely designed, patented capillary, engineered to enhance the ball bondability and reliability performance especially for devices with sensitive pad metallization structure configuration using gold or copper wire (e.g. BOAC, Ultra-Low K, and over-hanged dice) requiring efficient energy transfer but lesser incursions of USG/ bond power parameter and lower inertia at initial impact. Doppler capillary is designed to minimize bond pad damage due to cratering or peeling. This was made possible by higher amplification ratio at the capillary tip, higher amplitude displacement at the tip, and lower inertia at initial impact.

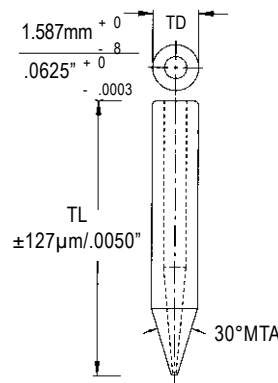
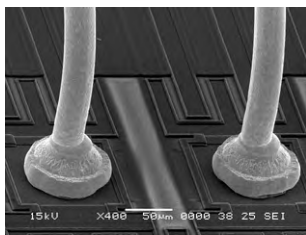


### Optimization Guide

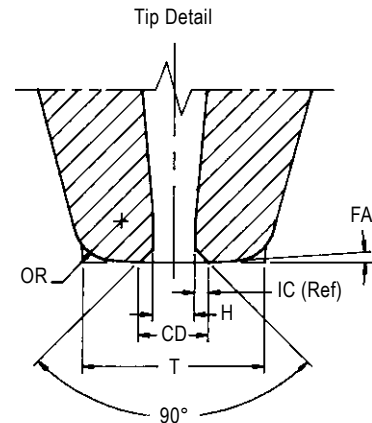


## Solution For Standard Bonding Applications UT Capillary

UT capillary series is geometrically designed for non-fine pitch, and non-bottleneck type used for gold and copper wire application. The main design feature is main taper angle (MTA) either 30° or 20° MTA with larger tip size 140µm and above. The UT design has become an ideal choice for LED (light emitting diodes) application.

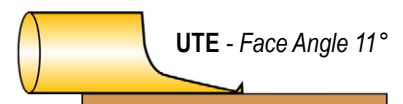
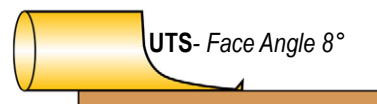
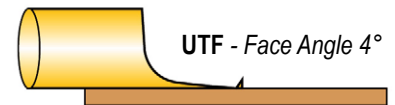


20°MTA available.  
Specify at end of part number.



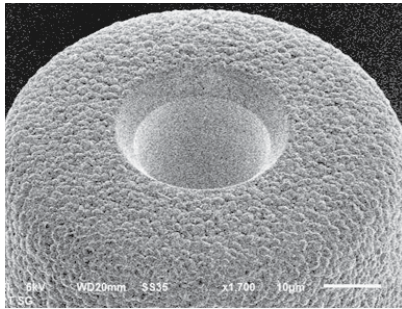
70° and 120° optional chamfer angles are available.  
Specify after tip style for alternate angles.

Example : UTF70, UTS120, UTE120



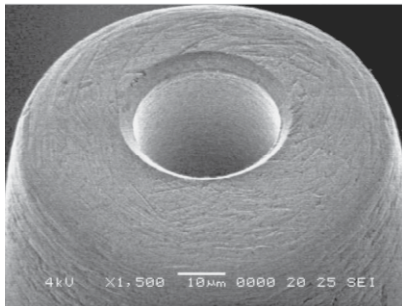
## CAPILLARY TIP SURFACE FINISH SELECTION

Over the years, the semiconductor IC assemblies have only two choices of capillary tip surface finishing either polished or matte finish for their gold wire bonding processes that was meant only for this specific application. However, as new semiconductor interconnect technology rapidly evolve, the industry starts to utilize variants of new packaging metallization plating finish on both leaded and substrate based materials that would lower the cost of ownership applicable for both gold and copper wire.



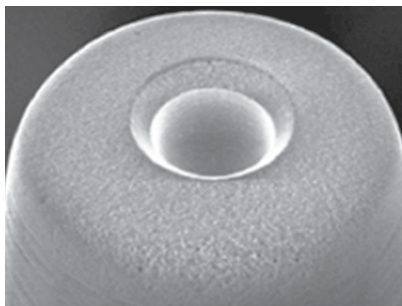
### SU Finish for Copper Wire Application

Another SPT's proprietary state-of-the-art finishing is the SU capillary which is highly recommended for high volume production using copper wire bonding, characterized by granulated protrusion surface morphology to enhanced better coupling between the Cu and lead frame or laminate based materials.



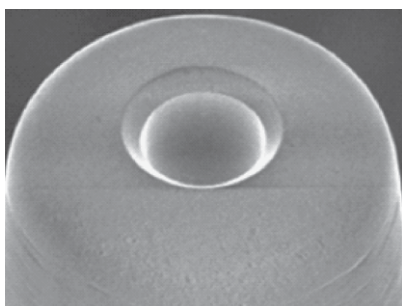
### SI Finish for Gold Wire Stitch Bonding Enhancement

SPT's proprietary SI (Stitch Integrator) finishing is ideal for hard to bond lead frame or substrate metallization using gold (Au) wire.



### Matte Finish for Gold Wire Application

SPT's fine matte finish capillaries provide better stitch adhesion between gold (Au) wire and substrate or leaded based metallization. The matte finishing only appears in the capillary tip surface while maintaining polished hole and chamfer area to ensure smoother exit of wire during looping.



### Polished Finish for Gold Wire Application

Polished capillary finishing has the advantage of lesser susceptible to load-up, and consequently, extending its useful life span. SPT's ultra-precision polishing technique ensures uniformly smoother surface finish that is desirable for gold (Au) wire bonding application.

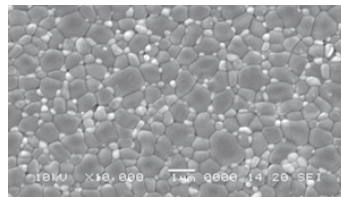
## CAPILLARY MATERIAL SELECTION

### Alumina Zirconia (AZ)

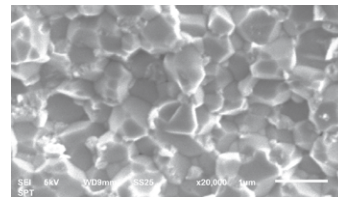
Small Precision Tools wire bonding capillaries are formed out of an ultra-pure  $\text{Al}_2\text{O}_3$  fine grade ceramic powder- high-density material for non-fine pitch, and composite ceramic (AZ) material for gold wire bonding or standard and ultra-fine pitch applications. The synthesis of ceramic microstructures such as purity, particle size, distribution, reactivity, and polymorphic form influences the final mechanical property and geometry of the wire-bonding capillary. Packaging technology's driven goal to reduce the chip size to handle more I/O- has pushed the physical and material properties at the threshold of its critical design limitations. Re-engineering is absolutely necessary for the ceramic wire bonding capillaries to cater for tighter bond pad pitch of less than  $60\mu\text{m}$ , where smaller tip diameter design is needed.

#### Physical and Mechanical Properties of AZ

	AZ
Color	White
Hardness (HV1)	2000
Grain size $\mu\text{m}$	<0.9
Density $\text{g/cm}^3$	4.25
Composition	$\text{Al}_2\text{O}_3 + \text{ZrO}_2$



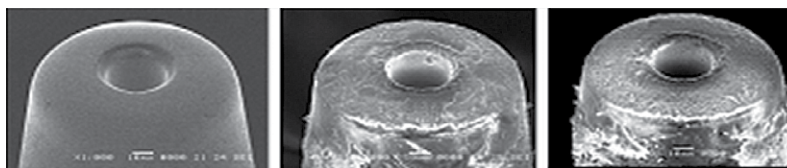
Polished and etched cross-section



Fracture

## EXTENDED TOOL LIFE FOR GOLD WIRE

### Infinity Capillary



Brand New - 0K bond

2 million bonds

3 million bonds

In Gold wire bonding process, load-up on the capillary face is inevitable as the bond touchdown increases. This is mainly due to the scrubbing action of the capillary from the ultrasonic energy applied in the process of making bonds. As the load-up amount increases, bond quality is affected. The useful life of the capillary can be defined as the maximum bond number before the bond quality produced by the capillary is deemed unacceptable. Depending on the types of substrate and bonding condition, the tool life of the capillary can vary from a few hundred thousand bonds to more than 1 million bonds.

An SPT proprietary process has been developed to extend the bonding tool life by at least 3 times its current limit, utilizing state-of-art controlled high purity process that enhances the sub-surface properties of the ceramic based material. Through various in-house testing and user evaluations, the **Infinity** capillary has proven to exceed the current tool life up to 3 times the standard.

## EXTENDED TOOL LIFE FOR COPPER WIRE

### Alumina Zirconia Ruby (AZR)

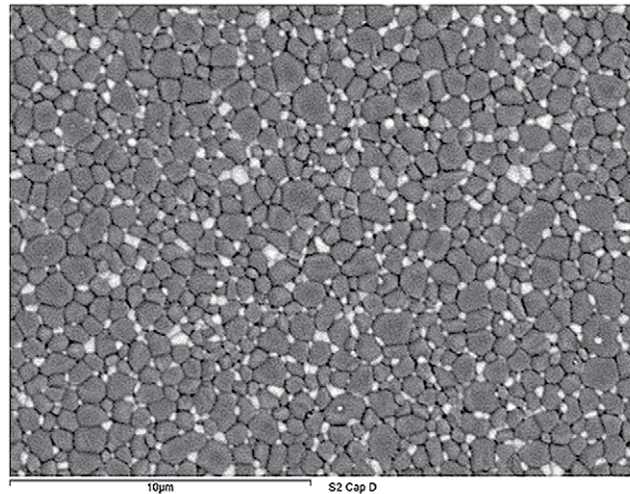


The conversion of gold-to-copper wire has been successfully implemented from simple to complex device-package combinations for leaded (e.g. SOIC, QFP, QFN) and laminates, ranging from low-to-high pin counts. Embracing the economic benefits of using copper wire interconnect to compete in the electronic consumer driven market, the semiconductor assembly companies are constantly searching for methods to reduce the cost of ownership, and one of which is through cost per number of touchdowns from the capillary.

#### Physical and Mechanical Properties of AZR

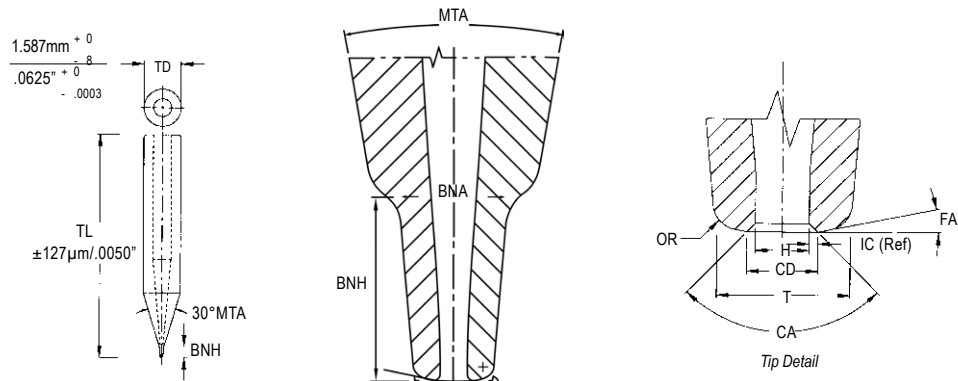
	AZR
Color	Pink
Hardness (HV1)	2050
Grain size $\mu\text{m}$	<0.9
Density $\text{g/cm}^3$	4.25
Composition	$\text{Al}_2\text{O}_3 + \text{ZrO}_2 + \text{Cr}_2\text{O}_3$

The AZR microstructure (Figure 1) is made of high purity, fine-grained homogenous Alumina Zirconia with Chromium Oxide totally dissolved in the matrix, a highly dense material with excellent hardness, which is most suitable for rugged metallization terrain used for copper bonding application.



The AZR mechanical properties were further enhanced using SPT's proprietary state-of-the-art thermal treatment process to ensure high material strength, by elimination of porosity through a combination of high pressure and exact sintering temperature.

## HOW TO ORDER - FINE PITCH SERIES



**DOP** - **33** **090** - **43** **5** **F** - **R** **U** **3** **4** **T** **P**

### Capillary Series

- SI
- PI
- SU
- SQ
- DOP

### Hole Size

090

### Tip Diameter

### Chamfer Diameter

### Chamfer Angle

- 90 deg : 5
- 120 deg: 8

### Face Angle

- 0 deg : A
- 4 deg : C
- 8 deg : E
- 11 deg : F

### For SI Series Only

- PI capillary design : P

### Bottle Neck Angle

- 10 deg: T

### Main Taper Angle

- 20 deg: 4
- 30 deg: 6
- 50 deg: 8/9

### Length

- L: 1
- XL: 3
- XXL: 5
- 16mm: 7
- 19mm: 9

### Finishing

- Matte: M
- Polish: P
- SI Finishing: B/S
- SU Finishing: U

### Material

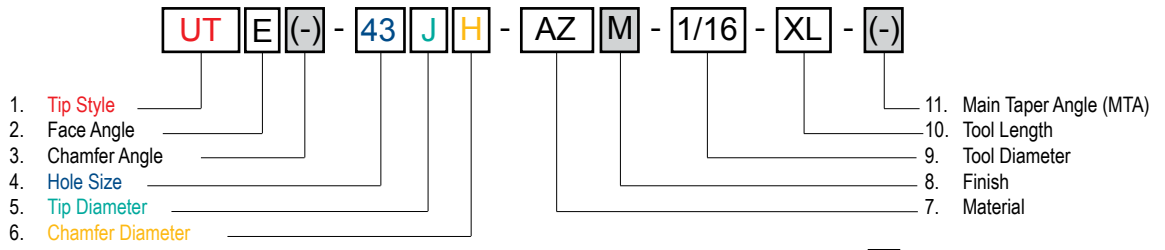
- Z : Zirconia composite
- R : Zirconia Ruby

## Capillary Sample Selection

Wire Type - Wire Size	Copper 20µm	Gold 20µm
Application Requirement: - Package Type - Bond Pad Pitch - Bond Pad Opening - Target Mashed Ball Diameter	QFN (Ni-Pd PP L/F) 60µm 55µm 42+/-2µm	BGA (Laminate Au Plated) 45µm 40µm 35+/-2µm
Shank Selection	SQ	DOP
Capillary Finish	SU	Polished
Capillary Material	AZR	AZ
Recommended Capillary Part Number	SQ - 25080 - 325E - RU39TS	DOP - 25058 - 291F - ZP34TP



# HOW TO ORDER - NON FINE PITCH SERIES



**Note :** (-) Specify if non-standard

1. **Tip Style :** UT - Standard capillary with Face Angle for non-Fine Pitch application

2. **Face Angle :** Z - 0° F - 4° S - 8° E - 11°

3. **Chamfer Angle :** Standard - 90° (no need to specify)

### 4. Hole Size

25 μm (.0010")
28 μm (.0011")
30 μm (.0012")
33 μm (.0013")
35 μm (.0014")
38 μm (.0015")
41 μm (.0016")
43 μm (.0017")
46 μm (.0018")
51 μm (.0020")
56 μm (.0022")
64 μm (.0025")
68 μm (.0027")
75 μm (.0030")
84 μm (.0033")
90 μm (.0035")
100 μm (.0039")
127 μm (.0050")
178 μm (.0070")

### 5. Tip Diameter

W = 70 μm (.0028")
Y = 75 μm (.0030")
Z = 80 μm (.0032")
A = 90 μm (.0035")
B = 100 μm (.0039")
C = 110 μm (.0043")
D = 120 μm (.0047")
E = 130 μm (.0051")
F = 140 μm (.0055")
G = 150 μm (.0059")
H = 165 μm (.0065")
I = 180 μm (.0071")
J = 200 μm (.0079")
K = 225 μm (.0089")
L = 250 μm (.0098")
M = 300 μm (.0118")
N = 190 μm (.0075")
P = 270 μm (.0106")
Q = 330 μm (.0130")
R = 360 μm (.0142")
S = 410 μm (.0161")
T = 420 μm (.0165")
U = 430 μm (.0169")
V = 710 μm (.0279")

### 6. Chamfer Diameter

A = 35 μm (.0014")
B = 41 μm (.0016")
C = 46 μm (.0018")
D = 51 μm (.0020")
E = 58 μm (.0023")
F = 64 μm (.0025")
G = 68 μm (.0027")
H = 74 μm (.0029")
I = 78 μm (.0031")
J = 86 μm (.0034")
K = 92 μm (.0036")
L = 100 μm (.0039")
M = 114 μm (.0045")
N = 127 μm (.0050")
P = 53 μm (.0021")
Q = 38 μm (.0015")
R = 43 μm (.0017")
S = 48 μm (.0019")
T = 97 μm (.0038")
U = 140 μm (.0055")
V = 152 μm (.0060")
W = 193 μm (.0076")
Y = 254 μm (.0100")

7. **Material :** AZ = Alumina Zirconia

8. **Finish :** Polish - No need to specify  
Matte (M) - Must be specified

9. **Tool Diameter :** Standard - 1.587mm (.0625")

10. **Tool Length :** L = 9.53 mm (.375") 16mm = .630"  
XL = 11.10 mm (.437") 19mm = .750"  
XXL = 12.0 mm (.470")

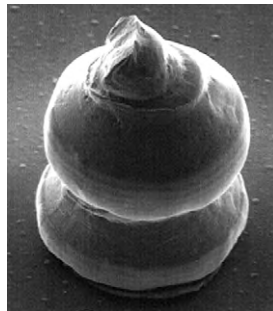
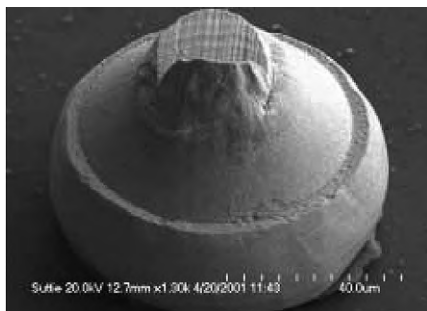
### 11. Main Taper Angle (MTA)

UT series - Standard 30° (No need to specify)  
Others - 20° (Must be specified)



## STUD BALL BUMPING (SBB)

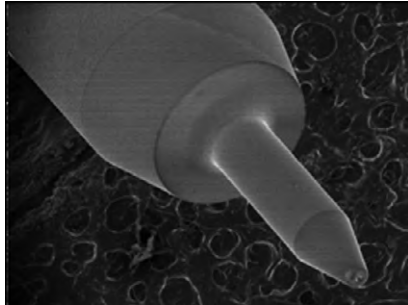
With continuous die size shrinkage and finer bond pad pitches of less than 60µm, this solder bumping process is expected to be the future option for packaging technology miniaturization. For CSP flip chip application, solder bumping of wafer are done either by electroplating method to form the 63Sn-37Pb solder balls, and the other method is by gold (Au) ball bonds formed on the aluminum bond pad (Al) by a conventional wire bonder. Special designed capillary is needed to meet the different bond pad pitches. The general design rule on the desired mashed ball (MBD) given the bond pad opening still applies. However, since there is no looping, the capillary with 20 deg main taper angle (MTA) is one of the design features.



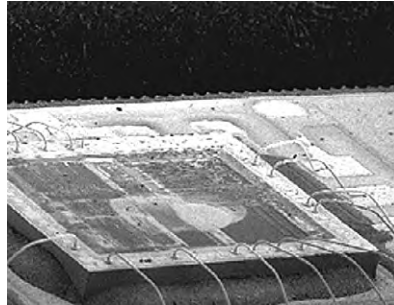
Bond Pad Pitch µm	Useable Wire Diameter µm	H µm	CD µm	FA °	T µm	Recommended SPT Part Number
100	30	35	55	0	130	SBB-35130-558A-ZP34
90	25	30	53	0	110	SBB-30110-538A-ZP34
80	25	30	51	0	100	SBB-30100-518A-ZP34
70	25	30	48	0	90	SBB-30090-488A-ZP34

## SPECIAL CAPILLARY TAPER DESIGNS FOR DEEP ACCESS APPLICATIONS

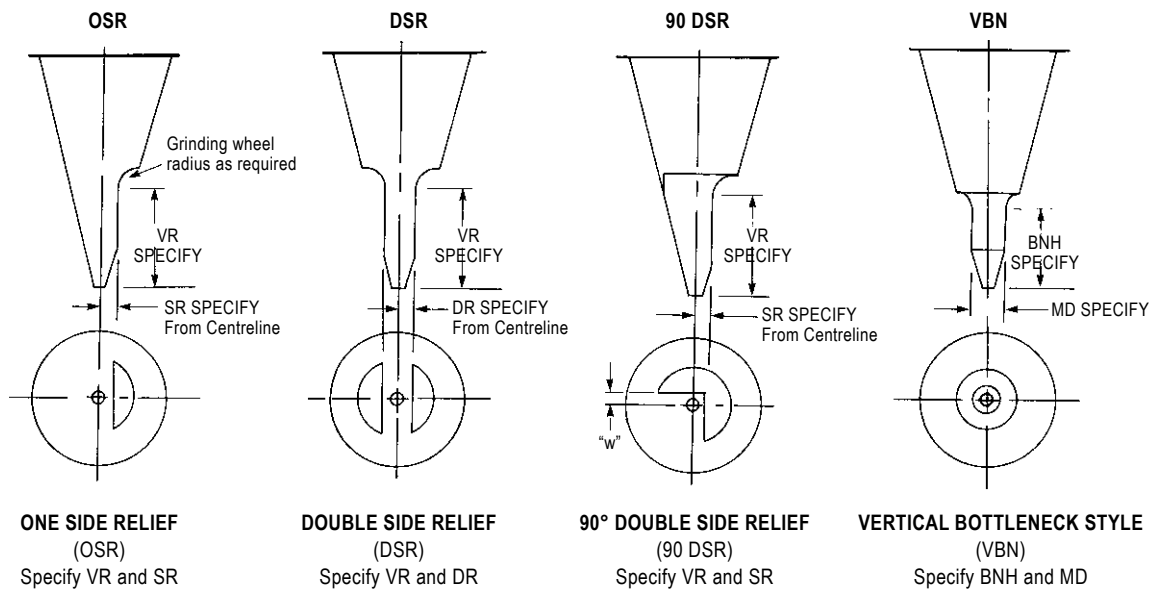
Capillaries for special deep access types of packaging application are available. The uniqueness of the tip taper design is dependent upon the die and package orientation. These capillaries provide vertical clearance between adjacent high loop profile and die edge.



VBN taper design



Deep access wire bonding

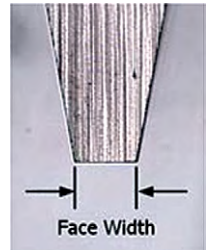


Bond Pad Pitch $\mu\text{m}$	Useable Wire Diameter $\mu\text{m}$	H $\mu\text{m}$	CD $\mu\text{m}$	FA $^\circ$	T $\mu\text{m}$	Recommended SPT Part Number
> 140	30	43	74	8	200	UTS-43JH-AZ-1/16-XL VBN BNH=1.50mm MD=0.800mm
> 140	30	38	58	8	150	UTS-38GE-AZ-1/16-XL BNH=1780 $\mu\text{m}$ VBN MD= 450 $\mu\text{m}$
80	30	38	58	8	100	SBNS-38BE-AZ-1/16-XL OSR BNH=400 $\mu\text{m}$ SR=280 $\mu\text{m}$ VR=2000 $\mu\text{m}$

**BOND SHEAR TOOLS**

In wire bonding, the assessment of the ball bond reliability after post bonding is determined through ball shear test. A ball shear tool mounted onto the shear tester is used to shear through the bonded ball with a shear height of 3-5µm from the bond pad surface. To produce accurate shear readings, the ball shear tool must fulfill the following criteria,

- The tip size of the shear tool must not interfere with the adjacent bonds, considering the bond pad pitch during actual testing.
- The width of the tip must be in full contact with the bonded ball.



SPT is capable of fabricating bond shear tools for different type of shear testers with tip sizes ranging from 30µm to 300µm. Beside the standard chisel type shear tool, SPT also provide customized shear tool to meet your testing requirements.

**How To Order:**

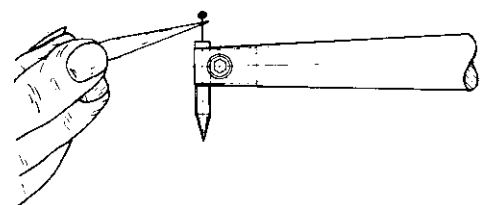
BST - Face Width - Drawing (Options)

Part Number	Face Width
BST-0.050	50µm
BST-0.060	60µm
BST-0.080	80µm
BST-0.100	100µm
BST-0.150	150µm

**Note:** Other sizes or design available on request

**CAPILLARY UNPLUGGING PROBE**

Capillary unplugging probes offer an easy, economical way to unplug capillaries. No special equipment is required and one size fits all SPT capillaries. Each probe can be used dozens of times.



Capillary Unplugging Probes

**Style CUP**

How To Order
CUP - 25PB - L = .750 (standard length)
CUP - 25PB - L = 1.00 (optional length)

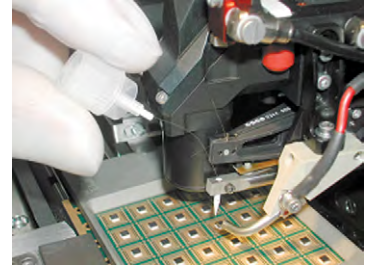
\* Capillary Unplugging Probes are packed 25 each in a protective box.

\*\* Probes also available without Epoxy Ball.

### CAPILLARY UNPLUGGING WIRE (CUW)

Capillary unplugging wire offers an easy and economical way to unplug clogged capillary. This is especially useful for engineers during evaluation as the gold ball tends to get clogged in the capillary holes since the optimum process parameters are not defined yet.

The unplugging wire has also proven to be helpful to production operators when they have difficulties threading the wire through the capillary. Instead of changing to a new capillary, the unplugging tool can help to push out gold residues, foreign particles and gold ball out of the hole. This can be done by simply inserting the tip of the unplugging tool from the top of the capillary and gently raises and lowers the wire within the capillary.



#### Advantages:

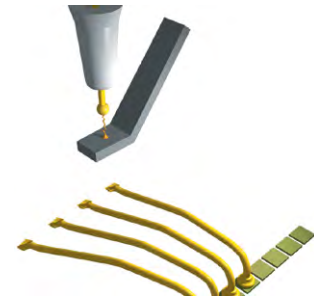
- Clogged capillaries can easily be unplugged, hence minimize capillary wastage before end of tool life.
- User friendly. Removal of capillary from the transducer is not necessary as the flexible tip of the unplugging tool can be inserted from the top of the capillary as shown.
- Optimize tip configuration to handle a wide ranges of capillary hole size.
- Each unplugging tool can be used more than dozen of times thus saving unnecessary wastage of capillary and production down time.

#### How To Order:

Part Number	Capillary Hole Size
<i>CUW-15</i>	<i>15-23<math>\mu</math>m</i>
<i>CUW-25</i>	<i>25-33<math>\mu</math>m</i>
<i>CUW-35</i>	<i>35-45<math>\mu</math>m</i>
<i>CUW-45</i>	<i>45-55<math>\mu</math>m</i>

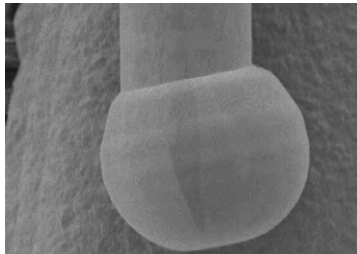
### EFO WANDS

The importance of consistent free air ball (FAB) for fine-pitch (FP) and ultra-fine pitch (UFP) bonding applications has led to the development of new alloy material to improve the performance of the EFO wand. Together with a new proprietary process, consistent EFO sparking effect can be achieved with SPT EFO wands. SPT is capable of making customized EFO wands used on different types of bonder with precise dimensions and accuracy.

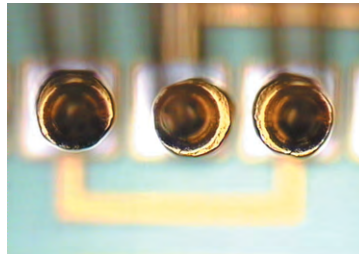


FAB formation during wire bonding process

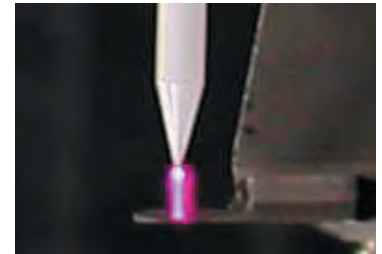
When a new EFO wand is installed for the first time on the bonder, inconsistent sparking normally occurs, causing inconsistent FAB formation. It can be also noticed that the spark direction, during firing tends to sway to the left or right during the initial sparks. This has the tendency to produce a tilted FAB as shown. This effect is mainly due to the inability of the new EFO wand to lead the current to flow from the same point.



Tilted FAB



Effect of the tilted FAB



Consistent firing of the EFO

To eliminate such adverse effect, SPT has introduced a proprietary process whereby new EFO wands are subjected to continuous sparking similar to those seen on the bonder. Such process will ensure that the new EFO wands can achieve its desired performance without having to “season” them, thus causing production delay and yield loss.

This process can be performed for a wide variety of EFO wands used for different types of bonders currently available in the market.

#### SPT EFO Wands Offer:

- Consistent free air ball formation.
- Consistent ball size control.
- Ball shape uniformity.
- Proprietary process for superior sparking performance.

#### How To Order

EFO - Model - Option.

Example : EFO - KNS8028

**Note:** Other standard or custom models available on request  
Please refer to opposite page for EFO models

## EFO WAND MODELS

### ASM

**ASM0309**  
For Bonder  
AB309



**ASM0339**  
For Bonder  
AB339  
Eagle 60



**ASM339C**  
For Bonder  
AB339  
Eagle 60



**ASM339D**  
For Bonder  
iHawk



### K&S

**KNS1484**  
For Bonder  
1484



**KNS1488**  
For Bonder  
1488



**KNS1489**  
For Bonder  
1488



**KNS8021**  
For Bonder  
8020



**KNS8028**  
For Bonder  
8028  
Maxµm  
NuTek



**KNS8098**  
For Bonder  
8098 Ball  
Bumper



**KNS8128**  
For Bonder  
8028



### SHINKAWA

**SHK025A**  
For Bonder  
ACB-25



**SHK0035**  
For Bonder  
SDW-35



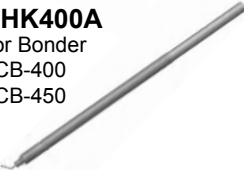
**SHK0200**  
For Bonder  
UTC-200  
UTC-205



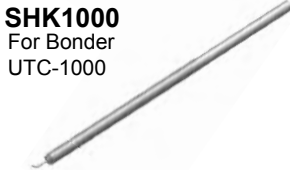
**SHK0300**  
For Bonder  
UTC-300



**SHK400A**  
For Bonder  
ACB-400  
ACB-450



**SHK1000**  
For Bonder  
UTC-1000



**SHK2000**  
For Bonder  
UTC-2000



### KAIJO

**KAJ0118**  
For Bonder  
FB-118



**KAJ131B**  
For Bonder  
FB-131



**KAJ137A**  
For Bonder  
FB-137



**KAJ0170**  
For Bonder  
FB-170  
FB-180  
FB-190



**KAJ1000**  
For Bonder  
FB-1000



### ESEC

**ESE3000**  
For Bonder  
3006  
3008  
3018  
3088



**ESE3100**  
For Bonder  
3100



**ESE3101**  
For Bonder  
3100  
(Cu + Au Wire)



### DELVOTEC

**DEL6200**  
For Bonder  
6200  
6210



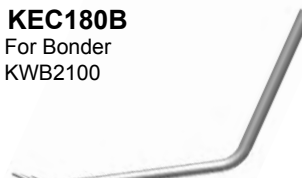
### RHOM

**RHMBW01**  
For Bonder  
ZWBC1



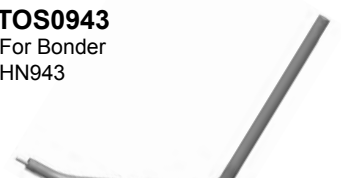
### KEC

**KEC180B**  
For Bonder  
KWB2100



### TOSHIBA

**TOS0943**  
For Bonder  
HN943





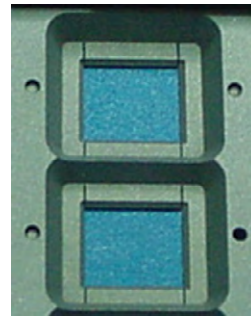
### HEATER BLOCKS

SPT's Heater Block Assembly offers yet another value-added product to further support end-users for their complex bonding application. SPT is capable to fabricate a wide variety of heater block assembly for all types of packages used on any type of wire bonder.

#### HB SOLUTION FOR QFP SOP MULTI-LEAD PACKAGE

SPT's "butterfly" design has proven to eliminate the bouncing effect on the lead finger. The "butterfly" design has shown excellent gripping & clamping stability on lead fingers, especially for high pin counts QFP packages.

With SPT's "butterfly" design, no high temperature tape is required. This has been tested and proven at many customer production sites with superior performance as compared to conventional design.



Top View "Butterfly" Design



Bottom View "Butterfly" Design

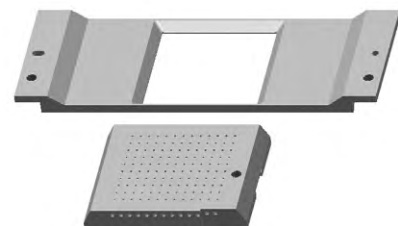
#### Advantages:

- Absolute lead finger stability during bonding with the "butterfly" design heater block assembly.
- The "butterfly" heater block assembly can be applied to a wide range of lead frame design for all types of wire bonder.
- Especially useful for FP and UFP high pin count devices.

#### HB SOLUTION FOR QFN AND POWER QFN

The emergence of thinner form factor requirement, the QFN package has primarily become a popular choice because of its size and electrical performance. However, there is a draw back in wire bonding process using QFN lead frames. The polyimide tape adhered underneath the QFN lead fingers introduce a certain level of difficulty in stitch bonding.

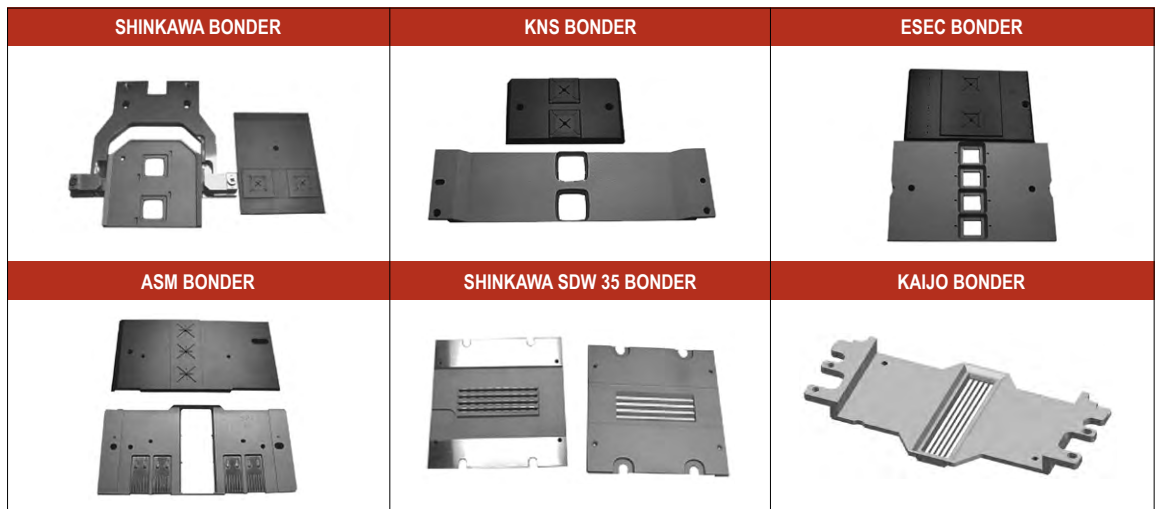
SPT's specially pipelined designed heater block provides maximum vacuum suction while accommodating a larger QFN panel per index- in order to achieve a stable support during stitch bond formation with minimal bouncing effect.



#### HB SOLUTION FOR COPPER WIRE BONDING

SPT provides innovative solution for copper wire bonding using heater block design with multi-holes and window clamp- arranged in such a way providing optimum supply of nitrogen forming gas to prevent package oxidation.

## HEATER BLOCKS & WINDOW CLAMPS



### How To Order

HBXX - User Code - Bonder Model - Package Type (Batch Number)

**HBXX:** Part Type + Bonding Window Quantity

HB: order both clamp and heater block

HBC: order clamp only

HBH: order heater block only

Example :- HB4X - Semicon - ASM 339 - QFP208L (A123)

# CAPILLARY WIRE BONDING TOOLS REQUIREMENT CHECKLIST

**SPT Roth Ltd**

(Switzerland)  
E-mail : info-ch@spt.net  
Fax : + 41 32 387 80 88

**Small Precision Tools Inc**

(California, USA)  
E-mail : info-usa@spt.net  
Fax : +1 707 559 2072

**SPT Asia Pte Ltd**

(Singapore)  
E-mail : info-sg@spt.net  
Fax : +65 6250 2725

**Small Precision Tools**

**(Phil) Corp**

(Philippines)  
E-mail : info-ph@spt.net  
Fax : +632 531-5780

**Small Precision Tools  
Co Ltd**

(China)  
E-mail : info-cn@spt.net  
Fax : +86 510 8516 5233

**SPT Japan Co. Ltd**

(Japan)  
E-mail : info-jp@spt.net  
Fax : +81 45 470 6755

Customer : \_\_\_\_\_ Date : \_\_\_\_ / \_\_\_\_ / \_\_\_\_

Department : \_\_\_\_\_ Contact No : \_\_\_\_\_ Extn : \_\_\_\_\_

Company : \_\_\_\_\_ Order taken by : \_\_\_\_\_

Application : \_\_\_\_\_

Lead Count : \_\_\_\_\_

Wire Diameter : \_\_\_\_\_

Bonder / Model : \_\_\_\_\_

Bond Pad Size : \_\_\_\_\_

Pad Pitch : \_\_\_\_\_

Loop Height (target) : \_\_\_\_\_

Mashed Ball Diameter : \_\_\_\_\_

Bond Pad Metallization : \_\_\_\_\_

Distance between Pad to Lead : \_\_\_\_\_

Lead Width : \_\_\_\_\_

Lead Pitch : \_\_\_\_\_

Lead Metallization : \_\_\_\_\_

Bonding Temperature : \_\_\_\_\_

Ultrasonic Bonding Frequency : \_\_\_\_\_

Present Capillary Part Number(s) : \_\_\_\_\_

\_\_\_\_\_  
\_\_\_\_\_

Wire Bonding Top 3 Defects : \_\_\_\_\_

\_\_\_\_\_  
\_\_\_\_\_

Any Other Wire Bonding problems? \_\_\_\_\_

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Recommended SPT Capillary Part No: \_\_\_\_\_

\_\_\_\_\_  
\_\_\_\_\_

# EFO WAND REQUIREMENT CHECKLIST

**SPT Roth Ltd**

(Switzerland)  
E-mail : info-ch@spt.net  
Fax : + 41 32 387 80 88

**Small Precision Tools Inc**

(California, USA)  
E-mail : info-usa@spt.net  
Fax : +1 707 559 2072

**SPT Asia Pte Ltd**

(Singapore)  
E-mail : info-sg@spt.net  
Fax : +65 6250 2725

**Small Precision Tools**

**(Phil) Corp**  
(Philippines)  
E-mail : info-ph@spt.net  
Fax : +632 531-5780

**Small Precision Tools  
Co Ltd**

(China)  
E-mail : info-cn@spt.net  
Fax : +86 510 8516 5233

**SPT Japan Co. Ltd**

(Japan)  
E-mail : info-jp@spt.net  
Fax : +81 45 470 6755

Customer : \_\_\_\_\_ Date : \_\_\_\_ / \_\_\_\_ / \_\_\_\_

Department : \_\_\_\_\_ Contact No : \_\_\_\_\_ Extn : \_\_\_\_\_

Company : \_\_\_\_\_ Order taken by : \_\_\_\_\_

Application : \_\_\_\_\_

Bonder / Model : \_\_\_\_\_

Wire Type / Diameter : \_\_\_\_\_

Any Specific problems : \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

Recommended SPT EFO Wand Part No: \_\_\_\_\_

# HEATER BLOCK REQUIREMENT CHECKLIST

## SPT Roth Ltd

(Switzerland)  
E-mail : info-ch@spt.net  
Fax : + 41 32 387 80 88

## Small Precision Tools Inc

(California, USA)  
E-mail : info-usa@spt.net  
Fax : +1 707 559 2072

## SPT Asia Pte Ltd

(Singapore)  
E-mail : info-sg@spt.net  
Fax : +65 6250 2725

## Small Precision Tools

### (Phil) Corp

(Philippines)  
E-mail : info-ph@spt.net  
Fax : +632 531-5780

## Small Precision Tools Co Ltd

(China)  
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Fax : +86 510 8516 5233

## SPT Japan Co. Ltd

(Japan)  
E-mail : info-jp@spt.net  
Fax : +81 45 470 6755

Customer : \_\_\_\_\_ Date : \_\_\_\_ / \_\_\_\_ / \_\_\_\_

Department : \_\_\_\_\_ Contact No : \_\_\_\_\_ Extn : \_\_\_\_\_

Company : \_\_\_\_\_ Order taken by : \_\_\_\_\_

Package  QFP  BGA  TSOP  SOIC  DIP  QFN

Type :  Others (Please specify) \_\_\_\_\_

Please provide bonding diagram

Bonder / Model : \_\_\_\_\_

L/F detailed drawing (Auto CAD appreciated) \_\_\_\_\_

Window Quantity : \_\_\_\_\_

Part Type Ordered :  HB : order both clamp and heater block

HBC : order clamp only

HBH : order heater block only

Special Request : \_\_\_\_\_

Any Specific Problems ? : \_\_\_\_\_

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Recommended SPT HB Part No. & Drawing No. : \_\_\_\_\_

\_\_\_\_\_

### **SPT Roth Ltd.**

Werkstrasse 28, CH-3250 Lyss, Switzerland

Tel : + 41 32 387 80 80

Fax : + 41 32 387 80 88

E-Mail : [info-ch@spt.net](mailto:info-ch@spt.net)

### **Small Precision Tools Inc.**

1330 Clegg Street, Petaluma, CA 94954, USA

Tel : +001 707 765 4545

Fax : +001 707 778 2271

E-Mail : [info-usa@spt.net](mailto:info-usa@spt.net)

### **SPT Asia Pte. Ltd.**

970 Toa Payoh North, #07-25/26, Singapore 318992

Tel : +65 6253 5577

Fax : +65 6250 2725

E-Mail : [info-sg@spt.net](mailto:info-sg@spt.net)

### **Small Precision Tools (Phil.) Corp.**

35, Domingo M. Guevara Street, Mandaluyong City 1550, Philippines

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Fax : +632 531 5780

E-Mail : [info-ph@spt.net](mailto:info-ph@spt.net)

### **Small Precision Tools Co. Ltd.**

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Wuxi, Jiangsu, P.R.China 214072

Tel : +86 510 8516 1968

Fax : +86 510 8516 5233

E-Mail : [info-cn@spt.net](mailto:info-cn@spt.net)

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901, 2-5-2, Shin-Yokohama, Kohoku-ku,  
Yokohama-shi, Kanagawa, 222-0033 Japan

Tel: +81 45 470 6288

Fax: +81 45 470 6755

E-Mail: [info-jp@spt.net](mailto:info-jp@spt.net)

## **Bonding The Future With You**

