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

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.
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.
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.
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.
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All dimensions are in µm/inch unless otherwise stated.
We reserve the right to make changes to design or specifications at any time without notice.
The new generation of advance electronics packages has driven the development of wire bonding technology to its full limits. Innovative package miniaturization approaches have beenconcertedly developed to deal with the packages’ physical limitation. 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.
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 $n$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.
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 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 >100KHz), 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 18µm to 33µm 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 forms 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.
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 15µm to 50µm 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.
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.

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”.

2. **Free-Air Ball is centered inside the capillary chamfer area**
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.
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:

**Step 1 | Capillary Tip**

The selection of capillary tip design is determined by the device and metallization, bond pad pitch, bond pad opening, wire size, target mashed ball diameter, and critical loop height to derive the hole diameter (HD), chamfer diameter (CD), chamfer angle (CA), tip diameter (T) and face angle (FA).

Refer to pages: 21 - 22

**Step 2 | Shank Style**

The shank style selection is characterized by geometrical design of the capillary bonding tool as dictated by specific device and/or package configuration.

Refer to pages: 23 - 24

**Step 3 | Capillary Tip Surface Finish**

The selection of a particular capillary tip surface finish hinges on whether the application is for gold or copper wire bonding.

Refer to pages: 25

**Step 4 | Capillary Material**

Capillary material selection for optimum tool life performance for a given bonding application.

Refer to pages: 26 - 27

**Step 5 | SPT Recommended Part No.**

The proper selection of capillary design is a resultant of the various wire bonding considerations.

Refer to pages: 28 - 29
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.
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.

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.
**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.

<table>
<thead>
<tr>
<th>Given Wire Diameter (in µm / inch)</th>
<th>Hole Size (in µm / inch)</th>
</tr>
</thead>
<tbody>
<tr>
<td>12 / .0005</td>
<td>15 / .0006 - 16 / .00063</td>
</tr>
<tr>
<td>15 / .0006</td>
<td>18 / .0007 – 21 / .0008</td>
</tr>
<tr>
<td>18 / .0007</td>
<td>21 / .0008 – 25 / .0010</td>
</tr>
<tr>
<td>20 / .0008</td>
<td>25 / .0010 – 28 / .0011</td>
</tr>
<tr>
<td>23 / .0009</td>
<td>28 / .0011 – 30 / .0012</td>
</tr>
<tr>
<td>25 / .0010</td>
<td>33 / .0013 – 38 / .0015</td>
</tr>
<tr>
<td>28 / .0011</td>
<td>35 / .0014 – 38 / .0015</td>
</tr>
<tr>
<td>30 / .0012</td>
<td>38 / .0015 – 41 / .0016</td>
</tr>
<tr>
<td>33 / .0013</td>
<td>43 / .0017 – 46 / .0018</td>
</tr>
<tr>
<td>38 / .0015</td>
<td>51 / .0020 – 56 / .0022</td>
</tr>
<tr>
<td>51 / .0020</td>
<td>64 / .0025 – 68 / .0027</td>
</tr>
<tr>
<td>64 / .0025</td>
<td>75 / .0030 – 90 / .0035</td>
</tr>
<tr>
<td>75 / .0030</td>
<td>90 / .0035 – 100 / .0039</td>
</tr>
<tr>
<td>100 / .0039</td>
<td>127 / .0050</td>
</tr>
<tr>
<td>127 / .0050</td>
<td>178 / .0070</td>
</tr>
</tbody>
</table>
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.

\[ \text{FABØ}^2 = 1.5H^2(H-WD) + \frac{(CD^3-H^3)}{4\tan(0.5CA)} + 1.5\text{MBD}^2(\text{MBH}) \]

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

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

Uncontrolled MBD & MBH due to high impact force
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.

Contour Plot (Ball Shear Stress N/mm²)
Z=211.474+26.525*x+0.911*y-0.729*x*x-0.021*x*y-8.763e-4*y*y
Star Points

Consistent EFO firing to form consistent free-air ball
Consistent tail bond after 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.

<table>
<thead>
<tr>
<th>Tip Diameter (in µm / inch)</th>
<th>Outer Radius ‘OR’ (in µm / inch)</th>
</tr>
</thead>
<tbody>
<tr>
<td>55 / .0022</td>
<td>8 / .0003</td>
</tr>
<tr>
<td>60 / .0024</td>
<td>8 / .0003</td>
</tr>
<tr>
<td>66 / .0026</td>
<td>10 / .0004</td>
</tr>
<tr>
<td>70 / .0028</td>
<td>10 / .0004</td>
</tr>
<tr>
<td>75 / .0030</td>
<td>12 / .0005</td>
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<tr>
<td>80 / .0031</td>
<td>12 / .0005</td>
</tr>
<tr>
<td>90 / .0035</td>
<td>12 / .0005</td>
</tr>
<tr>
<td>100 / .0039</td>
<td>12 / .0005</td>
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<tr>
<td>110 / .0043</td>
<td>20 / .0008</td>
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<td>120 / .0047</td>
<td>20 / .0008</td>
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<tr>
<td>130 / .0051</td>
<td>30 / .0012</td>
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<tr>
<td>140 / .0055</td>
<td>30 / .0012</td>
</tr>
<tr>
<td>150 / .0059</td>
<td>30 / .0012</td>
</tr>
<tr>
<td>165 / .0065</td>
<td>38 / .0015</td>
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<tr>
<td>180 / .0071</td>
<td>38 / .0015</td>
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<tr>
<td>190 / .0075</td>
<td>38 / .0015</td>
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<td>200 / .0079</td>
<td>51 / .0020</td>
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<tr>
<td>225 / .0089</td>
<td>51 / .0020</td>
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<tr>
<td>250 / .0098</td>
<td>51 / .0020</td>
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<tr>
<td>270 / .0106</td>
<td>51 / .0020</td>
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<tr>
<td>300 / .0118</td>
<td>64 / .0025</td>
</tr>
<tr>
<td>330 / .0130</td>
<td>64 / .0025</td>
</tr>
<tr>
<td>360 / .0142</td>
<td>75 / .0030</td>
</tr>
</tbody>
</table>

Table 2
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.

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.

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.

<table>
<thead>
<tr>
<th>Capillary</th>
<th>Displacement @ transducer (in mm)</th>
<th>Displacement @ tip point (in mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>SQ</td>
<td>175</td>
<td>287</td>
</tr>
<tr>
<td>Typical</td>
<td>180</td>
<td>476</td>
</tr>
</tbody>
</table>

Less displacement at the tip applying same power setting
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.

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.
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.
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 60µm, where smaller tip diameter design is needed.

**Physical and Mechanical Properties of AZ**

<table>
<thead>
<tr>
<th>Property</th>
<th>AZ</th>
</tr>
</thead>
<tbody>
<tr>
<td>Color</td>
<td>White</td>
</tr>
<tr>
<td>Hardness (HV1)</td>
<td>2000</td>
</tr>
<tr>
<td>Grain size µm</td>
<td>&lt;0.9</td>
</tr>
<tr>
<td>Density g/cm³</td>
<td>4.25</td>
</tr>
<tr>
<td>Composition</td>
<td>$\text{Al}_2\text{O}_3 + \text{ZrO}_2$</td>
</tr>
</tbody>
</table>

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.
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

<table>
<thead>
<tr>
<th>Property</th>
<th>AZR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Color</td>
<td>Pink</td>
</tr>
<tr>
<td>Hardness (HV1)</td>
<td>2050</td>
</tr>
<tr>
<td>Grain size µm</td>
<td>&lt;0.9</td>
</tr>
<tr>
<td>Density g/cm³</td>
<td>4.25</td>
</tr>
<tr>
<td>Composition</td>
<td>Al₂O₃ + ZrO₂ + Cr₂O₃</td>
</tr>
</tbody>
</table>

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**

**Capillary Sample Selection**

<table>
<thead>
<tr>
<th>Wire Type</th>
<th>Copper 20µm</th>
<th>Gold 20µm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Application Requirement:</td>
<td>QFN (Ni-Pd PP L/F)</td>
<td>BGA (Laminate Au Plated)</td>
</tr>
<tr>
<td>- Package Type</td>
<td>60µm</td>
<td>45µm</td>
</tr>
<tr>
<td>- Bond Pad Pitch</td>
<td>55µm</td>
<td>40µm</td>
</tr>
<tr>
<td>- Bond Pad Opening</td>
<td>42+/-2µm</td>
<td>35+/-2µm</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Shank Selection</th>
<th>SQ</th>
<th>DOP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Capillary Finish</td>
<td>SU</td>
<td>Polished</td>
</tr>
<tr>
<td>Capillary Material</td>
<td>AZR</td>
<td>AZ</td>
</tr>
</tbody>
</table>

| Recommended Capillary Part Number | SQ - 25080 - 325E - RU39TS | DOP - 25058 - 291F - ZP34TP |
HOW TO ORDER - NON FINE PITCH SERIES

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**

<table>
<thead>
<tr>
<th>Hole Size</th>
<th>Tip Diameter (µm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>25 µm (.0010&quot;)</td>
<td>W = 70 µm (.0028&quot;)</td>
</tr>
<tr>
<td>28 µm (.0011&quot;)</td>
<td>Y = 75 µm (.0030&quot;)</td>
</tr>
<tr>
<td>30 µm (.0012&quot;)</td>
<td>Z = 80 µm (.0032&quot;)</td>
</tr>
<tr>
<td>33 µm (.0013&quot;)</td>
<td>A = 90 µm (.0035&quot;)</td>
</tr>
<tr>
<td>35 µm (.0014&quot;)</td>
<td>B = 100 µm (.0039&quot;)</td>
</tr>
<tr>
<td>38 µm (.0015&quot;)</td>
<td>C = 110 µm (.0043&quot;)</td>
</tr>
<tr>
<td>41 µm (.0016&quot;)</td>
<td>D = 120 µm (.0047&quot;)</td>
</tr>
<tr>
<td>43 µm (.0017&quot;)</td>
<td>E = 130 µm (.0051&quot;)</td>
</tr>
<tr>
<td>46 µm (.0018&quot;)</td>
<td>F = 140 µm (.0055&quot;)</td>
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<tr>
<td>51 µm (.0020&quot;)</td>
<td>G = 150 µm (.0059&quot;)</td>
</tr>
<tr>
<td>56 µm (.0022&quot;)</td>
<td>H = 165 µm (.0065&quot;)</td>
</tr>
<tr>
<td>64 µm (.0025&quot;)</td>
<td>I = 180 µm (.0071&quot;)</td>
</tr>
<tr>
<td>68 µm (.0027&quot;)</td>
<td>J = 200 µm (.0079&quot;)</td>
</tr>
<tr>
<td>75 µm (.0030&quot;)</td>
<td>K = 225 µm (.0089&quot;)</td>
</tr>
<tr>
<td>84 µm (.0033&quot;)</td>
<td>L = 250 µm (.0098&quot;)</td>
</tr>
<tr>
<td>90 µm (.0035&quot;)</td>
<td>M = 300 µm (.0118&quot;)</td>
</tr>
<tr>
<td>100 µm (.0039&quot;)</td>
<td>N = 190 µm (.0075&quot;)</td>
</tr>
<tr>
<td>127 µm (.0050&quot;)</td>
<td>P = 270 µm (.0106&quot;)</td>
</tr>
<tr>
<td>178 µm (.0070&quot;)</td>
<td>Q = 330 µm (.0130&quot;)</td>
</tr>
<tr>
<td></td>
<td>R = 360 µm (.0142&quot;)</td>
</tr>
<tr>
<td></td>
<td>S = 410 µm (.0161&quot;)</td>
</tr>
<tr>
<td></td>
<td>T = 420 µm (.0165&quot;)</td>
</tr>
<tr>
<td></td>
<td>U = 430 µm (.0169&quot;)</td>
</tr>
<tr>
<td></td>
<td>V = 710 µm (.0279&quot;)</td>
</tr>
</tbody>
</table>

5. **Chamfer Diameter**

<table>
<thead>
<tr>
<th>Chamfer Diameter</th>
<th>Tip Diameter (µm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A = 35 µm (.0014&quot;)</td>
<td>W = 70 µm (.0028&quot;)</td>
</tr>
<tr>
<td>B = 41 µm (.0016&quot;)</td>
<td>Y = 75 µm (.0030&quot;)</td>
</tr>
<tr>
<td>C = 46 µm (.0018&quot;)</td>
<td>Z = 80 µm (.0032&quot;)</td>
</tr>
<tr>
<td>D = 51 µm (.0020&quot;)</td>
<td>A = 90 µm (.0035&quot;)</td>
</tr>
<tr>
<td>E = 58 µm (.0023&quot;)</td>
<td>B = 100 µm (.0039&quot;)</td>
</tr>
<tr>
<td>F = 64 µm (.0025&quot;)</td>
<td>C = 110 µm (.0043&quot;)</td>
</tr>
<tr>
<td>G = 68 µm (.0027&quot;)</td>
<td>D = 120 µm (.0047&quot;)</td>
</tr>
<tr>
<td>H = 74 µm (.0029&quot;)</td>
<td>E = 130 µm (.0051&quot;)</td>
</tr>
<tr>
<td>I = 78 µm (.0031&quot;)</td>
<td>F = 140 µm (.0055&quot;)</td>
</tr>
<tr>
<td>J = 86 µm (.0034&quot;)</td>
<td>G = 150 µm (.0059&quot;)</td>
</tr>
<tr>
<td>K = 92 µm (.0036&quot;)</td>
<td>H = 165 µm (.0065&quot;)</td>
</tr>
<tr>
<td>L = 100 µm (.0039&quot;)</td>
<td>I = 180 µm (.0071&quot;)</td>
</tr>
<tr>
<td>M = 114 µm (.0045&quot;)</td>
<td>J = 200 µm (.0079&quot;)</td>
</tr>
<tr>
<td>N = 127 µm (.0050&quot;)</td>
<td>K = 225 µm (.0089&quot;)</td>
</tr>
<tr>
<td>P = 137 µm (.0054&quot;)</td>
<td>L = 250 µm (.0098&quot;)</td>
</tr>
<tr>
<td>Q = 156 µm (.0061&quot;)</td>
<td>M = 300 µm (.0118&quot;)</td>
</tr>
<tr>
<td>R = 175 µm (.0069&quot;)</td>
<td>N = 190 µm (.0075&quot;)</td>
</tr>
<tr>
<td>S = 194 µm (.0078&quot;)</td>
<td>P = 270 µm (.0106&quot;)</td>
</tr>
<tr>
<td>T = 213 µm (.0084&quot;)</td>
<td>Q = 330 µm (.0130&quot;)</td>
</tr>
<tr>
<td>U = 232 µm (.0092&quot;)</td>
<td>R = 360 µm (.0142&quot;)</td>
</tr>
<tr>
<td>V = 251 µm (.0100&quot;)</td>
<td>S = 410 µm (.0161&quot;)</td>
</tr>
</tbody>
</table>

6. **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")
- XL = 11.10 mm (.437")
- XXL = 12.0 mm (.470")

11. **Main Taper Angle (MTA)**

- UT series - Standard 30° (No need to specify)
- Others - 20° (Must be specified)
With continuous die size shrinkage and finer bond pad pitches of less than 60um, 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.

<table>
<thead>
<tr>
<th>Bond Pad Pitch µm</th>
<th>Useable Wire Diameter µm</th>
<th>H µm</th>
<th>CD µm</th>
<th>FA °</th>
<th>T µm</th>
<th>Recommended SPT Part Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>100</td>
<td>30</td>
<td>35</td>
<td>55</td>
<td>0</td>
<td>130</td>
<td>SBB-35130-558A-ZP34</td>
</tr>
<tr>
<td>90</td>
<td>25</td>
<td>30</td>
<td>53</td>
<td>0</td>
<td>110</td>
<td>SBB-30110-538A-ZP34</td>
</tr>
<tr>
<td>80</td>
<td>25</td>
<td>30</td>
<td>51</td>
<td>0</td>
<td>100</td>
<td>SBB-30100-518A-ZP34</td>
</tr>
<tr>
<td>70</td>
<td>25</td>
<td>30</td>
<td>48</td>
<td>0</td>
<td>90</td>
<td>SBB-30090-488A-ZP34</td>
</tr>
</tbody>
</table>
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](image1.png)  ![Deep access wire bonding](image2.png)

### ONE SIDE RELIEF (OSR)
Specify VR and SR

### DOUBLE SIDE RELIEF (DSR)
Specify VR and DR

### 90° DOUBLE SIDE RELIEF (90 DSR)
Specify VR and SR

### VERTICAL BOTTLENECK STYLE (VBN)
Specify BNH and MD

<table>
<thead>
<tr>
<th>Bond Pad Pitch (µm)</th>
<th>Useable Wire Diameter (µm)</th>
<th>H (µm)</th>
<th>CD (µm)</th>
<th>FA (°)</th>
<th>T (µm)</th>
<th>Recommended SPT Part Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt; 140</td>
<td>30</td>
<td>43</td>
<td>74</td>
<td>8</td>
<td>200</td>
<td>UTS-43JH-AZ-1/16-XL</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>VBN BNH=1.50mm MD=0.800mm</td>
</tr>
<tr>
<td>&gt; 140</td>
<td>30</td>
<td>38</td>
<td>58</td>
<td>8</td>
<td>150</td>
<td>UTS-38GE-AZ-1/16-XL</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>BNH=1780µm VBN MD= 450µm</td>
</tr>
<tr>
<td>80</td>
<td>30</td>
<td>38</td>
<td>58</td>
<td>8</td>
<td>100</td>
<td>SBNS-38BE-AZ-1/16-XL</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>OSR BNH=400µm SR=280µm VR=2000µm</td>
</tr>
</tbody>
</table>
OTHER ACCESSORIES FOR WIRE BONDING PROCESS

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)

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Face Width</th>
</tr>
</thead>
<tbody>
<tr>
<td>BST-0.050</td>
<td>50µm</td>
</tr>
<tr>
<td>BST-0.060</td>
<td>60µm</td>
</tr>
<tr>
<td>BST-0.080</td>
<td>80µm</td>
</tr>
<tr>
<td>BST-0.100</td>
<td>100µm</td>
</tr>
<tr>
<td>BST-0.150</td>
<td>150µm</td>
</tr>
</tbody>
</table>

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.

Style CUP

How To Order

<table>
<thead>
<tr>
<th>CUP - 25PB - L = .750 (standard length)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CUP - 25PB - L = 1.00 (optional length)</td>
</tr>
</tbody>
</table>

* 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:

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Capillary Hole Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>CUW-15</td>
<td>15-23µm</td>
</tr>
<tr>
<td>CUW-25</td>
<td>25-33µm</td>
</tr>
<tr>
<td>CUW-35</td>
<td>35-45µm</td>
</tr>
<tr>
<td>CUW-45</td>
<td>45-55µm</td>
</tr>
</tbody>
</table>
ACCESSORIES FOR WIRE BONDING PROCESS

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.

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.

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

KAJO

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

DELVOTEC

DEL6200 For Bonder 6200 6210
RHMBW01 For Bonder ZWBC1
KEC180B For Bonder KWB2100
TOS0943 For Bonder HN943

RHOM

KEC

TOSHIBA

BACK TO CONTENT
ACCESSORIES FOR WIRE BONDING PROCESS

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 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 drawback 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 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.

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 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

<table>
<thead>
<tr>
<th>SHINKAWA BONDER</th>
<th>KNS BONDER</th>
<th>ESEC BONDER</th>
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<tbody>
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<td><img src="https://via.placeholder.com/150" alt="Image" /></td>
<td><img src="https://via.placeholder.com/150" alt="Image" /></td>
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<table>
<thead>
<tr>
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<th>SHINKAWA SDW 35 BONDER</th>
<th>KAIJO BONDER</th>
</tr>
</thead>
<tbody>
<tr>
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<td><img src="https://via.placeholder.com/150" alt="Image" /></td>
<td><img src="https://via.placeholder.com/150" alt="Image" /></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>OE 360 BONDER FINGER CLAMP</th>
<th>OE 360 BONDER ANVIL BLOCK</th>
<th>OE7200 BONDER FINGER</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="https://via.placeholder.com/150" alt="Image" /></td>
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<thead>
<tr>
<th>CANON / NEC DIE BONDER</th>
<th>ASM 896 DIE BONDER</th>
<th>ASM 8930 DIE BONDER</th>
</tr>
</thead>
<tbody>
<tr>
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<td><img src="https://via.placeholder.com/150" alt="Image" /></td>
</tr>
</tbody>
</table>

### 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

**Customer:**

**Department:**

**Company:**

**Date:** / / 

**Contact No:**

**Extn:**

**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:**

---

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**SPT Japan Co. Ltd**  
(Japan)  
E-mail: info-jp@spt.net  
Fax: +81 45 470 6755
EFO WAND REQUIREMENT CHECKLIST

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**

| **Customer:** | _______________________________ | **Date:** / / |
| **Department:** | _______________________________ | **Contact No:** _______ **Ext:** __________ |
| **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.:** _______________________________

---

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