Tip Style Selection

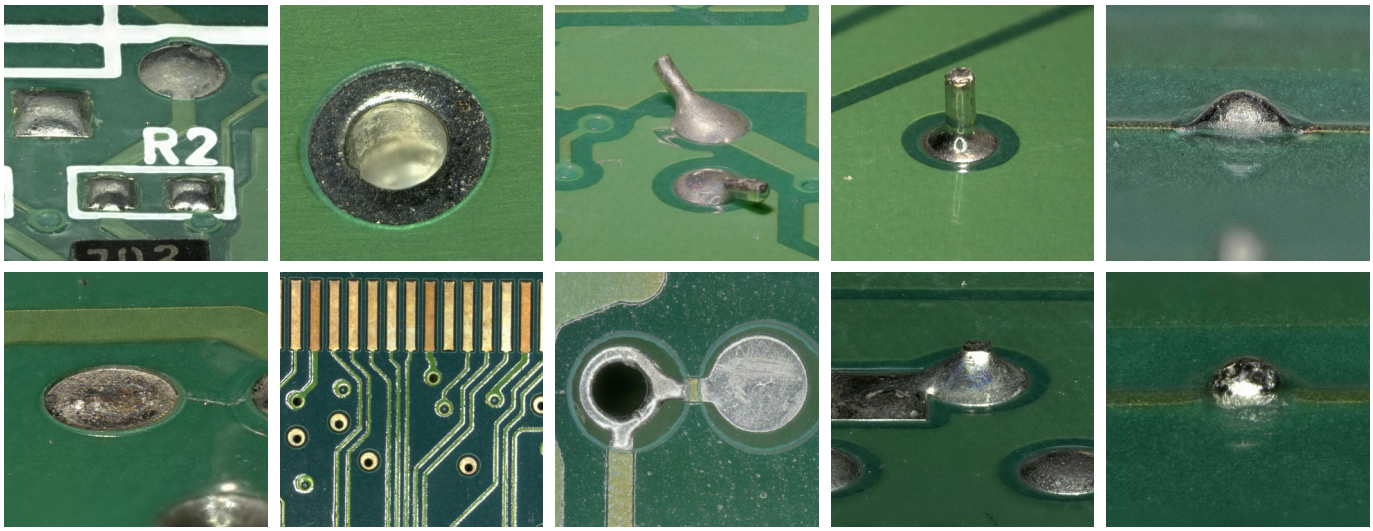
Printed Circuit Boards (PCB) are an essential part of the many electronic products we rely on every day. Both in-circuit and functional testing after manufacturing are critical steps to ensuring their dependability. QA Technology's test probes are an important part of this process, offering the best possible electrical contact with each board being tested.

While there are many probe factors that affect its ability to make reliable electrical contact, proper tip style selection is likely the most important one. Incorrect tip selection could cause false failures where no defects are found (NDF), lower your first pass yields (FPY), or in extreme cases, damage the unit under test (UUT). Selecting the right tip can reduce the overall cost of test by increasing the output of units being tested and extending the life of your test probes.

Test engineers often have very different experiences as to which is the best probe tip style to use for any given contact surface. QA offers a wide range of styles to support the various board test applications known in the industry. The following considerations will help you select the right tip style for many of today's common test targets.

Test Target Types

It is important to consider the size, shape and other features of the test targets. There are various PCB targets such as pads, vias, leads, posts, and solder bumps, which range in probe-ability from easy to difficult.



BOARD MANUFACTURING/PROCESSES

EASY

PCBs that are designed with a clean process and are produced with surface finishes such as immersion tin, silver, gold, or ENIG are generally considered easy to probe. Reliable electrical contact can be achieved by using many of the common probe tip styles.


Immersion Au (gold) **ENIG**


Immersion Ag (silver)


Immersion Au (gold)


Immersion Sn (tin)

MEDIUM

Test targets that are solder pasted using a no-clean process, or have other common finish types such as hot air solder leveling (HASL), are typically considered medium difficulty to probe. For these finishes, be sure you are using a no-clean paste that incorporates a pin-testable flux. The selection of probe tips to choose from for these applications is slightly more limited.


Hot Air Solder Leveling – HASL


Lead with wave solder/reflow

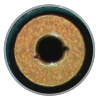
DIFFICULT

The most difficult to probe test targets typically fall into one of two categories. The first is one that is solder pasted using a flux that is NOT rated as pin-testable (PT). This type of flux leaves a residue that is more difficult to penetrate, making electrical contact less reliable. In this case, we recommend that you work with your process team to see if a probe-able flux can be used.

The second will have an organic solderability preservative (OSP) finish that is applied to a PCB to prevent oxidation on the copper surfaces. While an OSP finish generally has the benefit of a lower cost, it will likely increase the cost of test by lowering FPY and reducing probe life. In these situations, there is a very limited tip style selection. It is highly recommended to solder paste these test points prior to electrical testing.


Lead Free Solder Paste/Flux


Organic Solderability Preservative OSP


Unpasted OSP Via

Tip Materials

QA's tips are made from either beryllium copper (BeCu) or steel. Both are gold plated over nickel. The hardness of steel ranges between 58 and 60 on the Rockwell C scale, 38-42 for BeCu. As such, steel will have reduced wear and remain sharp longer.

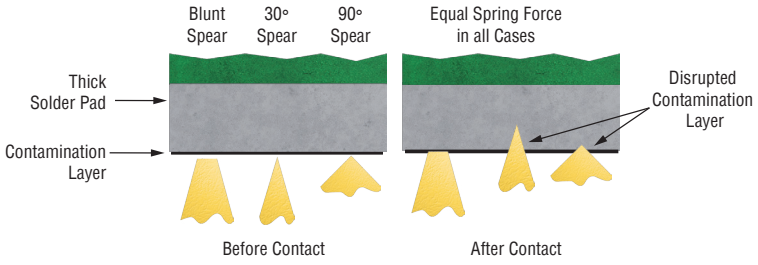
While there is a difference in the average resistance of less than 10 mOhms between the two base materials, it will not affect the vast majority of test applications.

Tip Geometry

QA offers many different tip styles, each with their unique geometry. The large number of headed or headless choices supports the wide variety of test applications.

Geometry and sharpness will determine the ability to penetrate contamination layers. A tip that is blunt or has dull edges will make contact over a larger area thus reducing its ability to penetrate contamination layers on the test targets.

A tip that has a sharp point or steep cutting edges applies a higher pressure against the solder causing it to yield. As the solder yields, any oxides or remaining flux residues are disrupted, allowing better electrical contact.

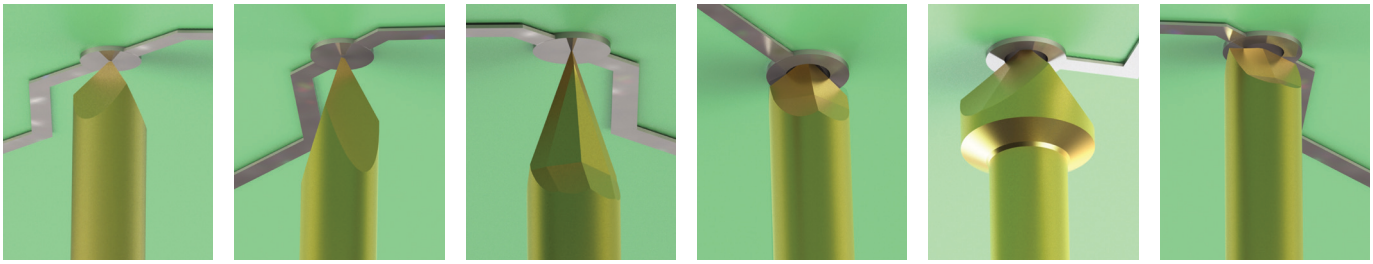


Recommended Tip Styles for Target Types

TEST PADS, VIAS AND THROUGH-HOLES

TEST PADS, VIAS and **THROUGH-HOLES** come in a wide range of sizes, surfaces, and shapes. They can be solder pasted, unpasted, concave, flat, or convex (dome).

Vias and through-holes in a PCB are typically used to pass a signal from one layer to another. When these are to be used as test points, it is necessary that they are not solder-masked so that they can be easily probed.



EASY

For gold plated pads use a **SPHERICAL** or **FLAT** tip to minimize marking.

40 30 10

For open or solder pasted holes/vias use a **BLADE, CHISEL, SPEAR,** or **STAR** tip. Reduced contact area will generate higher contact pressure.

61 51 43 03 23 01 06

For flat pads or solder domes, reduced **CROWN** tips may be considered to prevent sliding off the target.

74 54

MEDIUM

For contacting flat pads and vias pasted with pin-testable solder, **CHISEL, BLADE,** or **STAR** tips can be good choices.

43 03 23 61 51 N6

The **CHISEL TRIAD** tip is a good choice for contacting open holes/vias where flux is present. The **SPEAR** tip is used when the rim of the hole must remain free of marks.

18 38 41

DIFFICULT

RAZOR tips are made with two sharp cutting edges to increase contact reliability on a wide variety of pasted pads and vias. Although QA does not recommend testing on unpasted vias, the 6R **RAZOR** may be the best choice.

6R 8R 9R

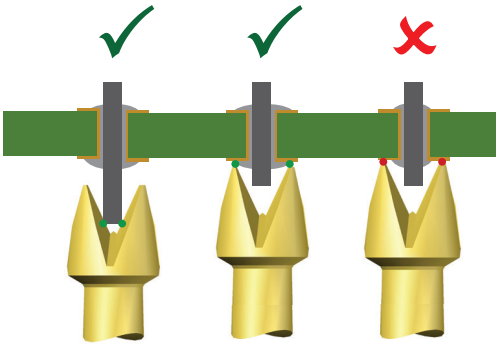
A steeper angled tip such as **SHARP CHISEL, SHARP NEEDLE,** or **TRIAD** can provide the highest penetrating pressure for reliable testing on flat or domed test pads.

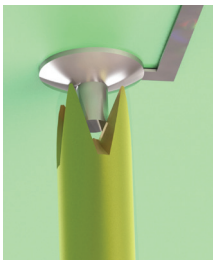
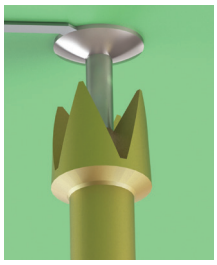
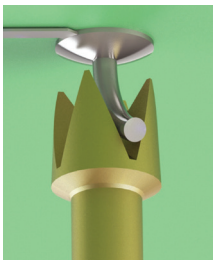
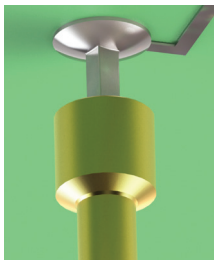
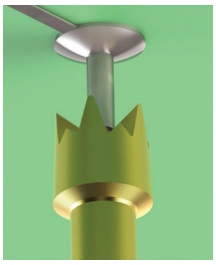
53 63 31 08

LEADS AND POSTS

A lead is a terminal on a component. They could be different lengths, straight or bent. Smaller leads will require tip styles with closely spaced cutting edges to trap the leads. A post is larger in diameter and more rigid than leads.

Multi-point tips are designed to capture a target, such as a lead or a post. Some styles have steeper valleys between the tips, creating a self-cleaning feature where it allows contamination to escape.



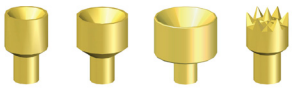






EASY

For stability on a lead or post and to minimize side-loading, the **SERRATED** tip style is the best choice, but has a limited ability to penetrate contamination.

64 09 29

For extremely long leads, **CUP** or **TORCH** tip styles can be used, but are likely to require more maintenance.



22 32 82 07

MEDIUM

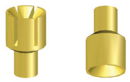
When using a pin-testable flux, a self-cleaning **CROWN** or other multi-point tip with valleys will help prevent contamination from building up.

74 84 N4 44 56

Tip styles with close points, such as **CHISEL TRIAD,** or **TORCH**, are best used on short leads.

38 05

A **SLOTTED CUP** tip is self-cleaning, while a traditional **CUP** can easily collect dust and contamination from the UUT. A traditional **CUP** is best used in a horizontal or downward-pointing orientation.



52 22

DIFFICULT

When a more difficult to test process is being used, consider using an aggressive self-cleaning **CROWN** tip design that features deeper cuts.

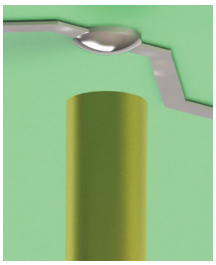
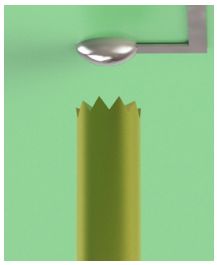
34 24 58

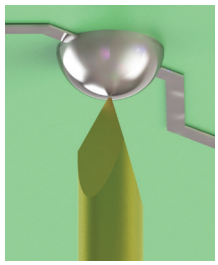
Small diameter leads require a self-cleaning tip geometry such as a **CROWN** or **TORCH** tip to prevent the lead from slipping through the valleys.

55 17

SOLDER BEAD/BUMP/DOME

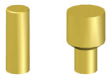
Technology provides test point accessibility, using a probe to contact a variety of solder beads or bumps that are placed on a trace where the solder mask has been removed. In addition, by placing an excessive amount of solder on vias or test pads, a round dome of solder may also need to be probed.

EASY

For clean processes where a minimal witness mark is desired, our **FLAT** tip is the best choice.



20 **10**

When light flux residues are present, a **MICRO SERRATED** tip is suggested.

B9 **79** **59**

MEDIUM

For no-clean flux targets, our moderately aggressive **FLAT STAR** tip has deep radial groves extending from the center, offering a self-cleaning benefit where contaminates or oxides tend to adhere to other tip styles.

36 **46** **16**

DIFFICULT

The most aggressive tip for this target type is our **CENTER POINT STAR**. Their sharp radial cutting edges, along with a sharp center point, make these ideal when difficult no-clean flux processes are being used.

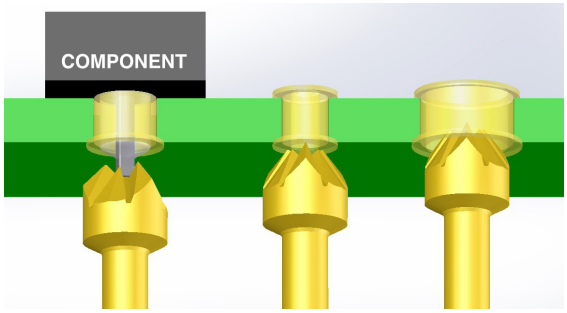
76 **26**

For larger solder domes on traces and pads, a **SHARP CHISEL** or **9R RAZOR** tip may be considered. It is critical to have extremely good pointing accuracy for reliability. QA recommends a guided plate fixture design.

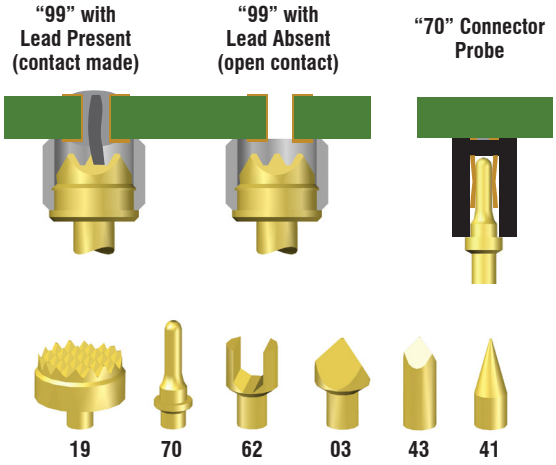
53 **63** **9R**

In addition, QA offers many specialty tip styles for other important, but less common applications.

- Our **CHISEL TRIAD "38"** tip style is designed specifically to be a multi-purpose solution for boards that may or may not have leads present during testing. When a component is present, the 6 peaks aggressively capture the lead within the cutting edges. When the component is absent, the point of contact varies based on the diameter of the through-hole. With smaller holes, the three sharp points will hit the face of the via ring. When contacting a larger through-hole, the three sharp cutting edges will contact the inside of the hole, giving optimal electrical points of contact.

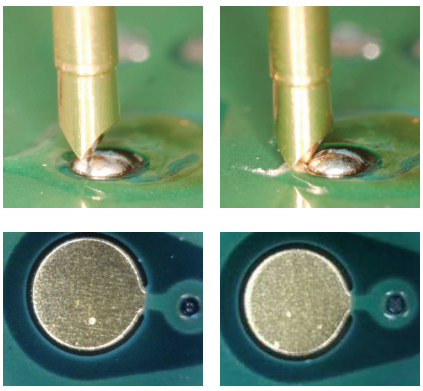


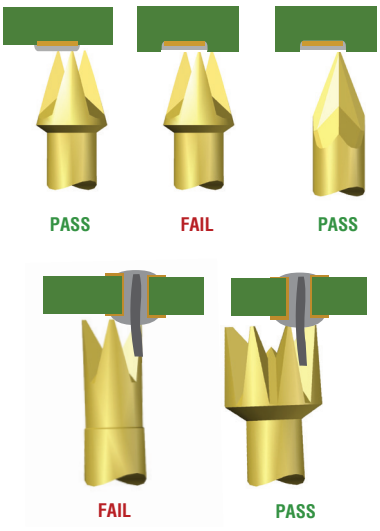
- Our **INSULATOR "89"** and **"99"** tip styles are used to test the presence or absence of a component on a PCB. An insulating sleeve around the probe keeps the probe electrically isolated from a flat contact surface, but allows the probe to make electrical contact with a lead or post.
- Our **CONNECTOR "70"** tip style is used to test a female pin connector where the rounded tip makes contact with the inner beams. A shoulder of the tip acts as a stop to prevent the tip from sliding completely through.
- QA offers the various tip styles for probes used in tester systems known throughout the industry. In our catalog and website, QA provides complete probe details that match tester manufacturers' series.



Other Considerations

- When new fixtures are built, we recommend verification of the selected tip styles once all board elements are identified. Initial processes and solder types can vary from the prototype PCB design to the production boards. In preparation for the launch of production UUT's, tip styles may need to be changed to a different geometry or a more aggressive style based on the cleanliness of the board.
- If the tip style recommendations do not generate good electrical contact, look closely at the witness mark that the probe tip should have made on the test target. Poor pointing accuracy, TIR of the probe assembly, as well as the diameter of the target can be attributed to missing the intended target. While certain tip styles may work well on flat or concave vias, when a dome is present, and pointing accuracy is not good, they may glance off the target and hit the solder mask.
- If your board process causes the solder mask to be below the test point, a multi-point tip may work even if you do not have good pointing accuracy. If your solder mask is higher than your target, one or more of these multipoint tips could prevent the others from making electrical contact. In this scenario, change to a single point probe to hit the target.
- In cases where you cannot improve the pointing accuracy on leads or posts, select a larger diameter tip style to maximize the ability to hit the test target reliably.





In summary, it is critical to select a tip style with the right number of points of contact, the correct angles, and sharpness. Improving the electrical contact to your test targets will help increase probe life and improve your FPY. Higher yields mean less time troubleshooting false failures, faster through-put, and ultimately, lower overall cost of test.

OTHER RELATED INFORMATION

Pointing Accuracy
www.qatech.com/en/resources-performance/pointing-accuracy.html