

Solder Preform Basics

Paul Socha, Indium Corporation

Paul A. Socha, Indium Corporation, reviews the types of solder preforms and their uses. He offers 10 basic steps to determining if an assembly needs preforms. Solder preforms can be used on a mixed SMT and through-hole PCB or to fortify solder paste on a difficult joint. Most solder preforms can be flux coated. When incorporating preforms, be sure to consider possible effects on [reflow](#), [cleaning](#), and RoHS compliance.

[Solder paste](#) is the most recognized form of solder used in [electronics assembly](#) today. A surface mount application depends on solder paste to attach the components to the circuit board. However, solder paste may not be the only solution. This is especially true when working with through-hole components or very large devices that require more solder than can be supplied by printed solder paste. In fact, quite often a PCB involves [mixed technology](#) that requires more than one form of solder. Solder paste is used for the surface mount components and solder preforms are utilized to attach the leads on through-hole components, avoiding wave or selective soldering.

[Solder preforms](#) are formed shapes of solder that are extremely uniform. Each preform consistently delivers the same volume of solder to the joint. Solder preforms can be formed into a variety of shapes and sizes to fit specific requirements. Some of the more common shapes are washers, discs, squares, rectangles, and frames. Sizes can range from extremely small to quite large, depending on the solder volume needed to complete the joint. In crucial applications, tight tolerances can be held on the preform shapes; however, this should not be specified if it is not needed, as it can increase the cost of the solder preform.

These shapes can also be connected with narrow strands of solder for use when multiple preforms are being applied in a specific pattern. The strands are designed to break apart at the moment of reflow and wick back to the solder mass. This process allows for faster and more accurate placement.

Solder Fortification

Solder preforms can also be used in conjunction with solder paste to fortify a solder joint. In some cases, solder paste may not provide enough solder volume to meet the joint's strength and coverage requirements. This could be due to [limits of the stencil thickness](#) and to the fact that only about 50% of the volume of solder paste is alloy powder. If solder preforms are needed to fortify the solder joint, the solder paste should first be applied to the board surface. Solder preforms can be placed on top of the solder paste or inserted onto the component pins and then inserted into the printed circuit board. Solder preforms can also be placed on the bottom side of the board to deliver additional solder

where needed. This might be needed for pads around through-holes for components with pins or pads for surface mount components, among other situations.

It is important to make sure that the same alloy is used for the solder paste and preform. An undesirable mixture could affect the joint and cause it to react unexpectedly. When solder preforms are used with solder paste, no additional flux is needed on the solder preform because the flux in the solder paste provides adequate fluxing action.

Preforms are available in the same alloys that are currently utilized in solder paste. SAC, Sn63, Sn62, indium-contained, and gold-contained alloys are most common. The same specifications that govern the solder paste alloys also apply to solder preforms; i.e. J-STD.

Flux-coated Preforms

In most cases, if solder preforms are used without solder paste, a flux should be used to remove the oxides from the metallizations being joined. To save time in production, most solder preforms can be flux coated. This flux coating is activated when the alloy is heated, removing the oxides. The flux coating on the solder preforms can range from mild to strong, depending on the metallizations being joined. No-clean and solvent-clean varieties are available. If solder preforms are used on the same board as solder paste and cleaning is required, the flux type for both should be the same.

Generally, flux is added to the preforms up to 3% by weight; however, much lower amounts of flux coating (even down to 0.5%) can be adequate to remove the oxides and promote excellent wetting. The more flux that is used to make the joint, the more residue is either left on the board in a no-clean application or has to be removed if cleaning is required.

To avoid mixing alloys (i.e. high- vs. low-temperature or Pb-free vs. Pb-containing) in a work area, or to help differentiate solder preforms of similar size and shape, a colorant can be added to the flux coating.

If the PCB assembly involves mixed technologies and the same alloy is used for both the solder paste and solder preform, the same method of reflow with the same temperature profile can be used. When using solder preforms for through-hole components, reflowing them at the same time as the solder paste eliminates the need for [selective soldering](#) and/or [hand soldering](#).

Packaging

Solder preforms can be packaged to suit each customers' needs. For jobs where many people are working together in a group, rigid solder preforms can be packaged in jars so they can be spread out at a work station and applied by hand using tweezers or a suction pickup tool. Some preforms are more fragile and must be packaged so they are kept flat

to avoid damage during shipping. Fragile solder preforms should be handled with a suction pickup tool or supported with a spatula to prevent deformation.

For high-volume applications, solder preforms can be packaged in tape-and-reel so they can be robotically placed with little human intervention. Matrix trays (waffle packs) are also commonly used. Solder preforms can be removed from the trays by hand or via an automated pick-and-place process.

Regardless of the packaging method, solder preforms should always be handled with gloved hands or finger cots to avoid contamination from surface organics, which can lead to voiding and poor wetting.

Storage and Handling

When solder preforms are received by the end user, they should be stored in their original unopened container in a nitrogen dry box to prevent unnecessary oxidation. Packages should be opened just prior to use. Most solder preforms are packed in argon and vacuum sealed. When not in use, the solder preforms should be returned to the nitrogen dry box with the lid removed so the nitrogen can purge any oxygen from the container. This also applies to other forms of packaging, such as a bag containing a partially used roll of solder preforms in tape & reel.

Solder preforms generally have a shelf life of two years from the date of manufacture. If the solder preforms are used beyond this time, their quality should be certified by the end user to make sure no time-related degradation will compromise the joint being soldered. If all quality criteria are met, the end user must make the final decision whether to use them or not.

10 Basic Steps to Choose Preforms

Here are some basic steps to help determine if solder preforms are right for your applications:

- 1.** Make sure you have a thorough understanding of what is required for your application.
- 2.** Consult with your solder supplier for help with form, alloy, and metallization compatibility. The metallizations involved in the solder joint, as well as the operational temperature of the device once in service, are crucial when determining the best alloy for your application.
- 3.** Review the application to determine what form of solder is best. If a solder preform is warranted, you will need to consider the shape, dimensions, and tolerances.
- 4.** Don't over-specify the preform with regard to solder purity or size tolerances as this will have an effect on its pricing.

5. If possible, prepare a drawing for your solder supplier to review.
6. Is a flux needed? If so, the solder preform can be coated with flux to save a step during manufacturing. A tacky flux can also be used to provide the fluxing action and to hold the preform in place during reflow. You need to determine if the flux residue will be removed and, if so, what cleaning solvent will ensure a clean joint.
7. The method of placement is important to determine the type of packaging needed — rigid vs. fragile and low-volume vs. high-volume production.
8. Consider method of reflow. The reflow temperature should be 20°–50°C above the liquidus temperature of the alloy. Excessive temperature may char the flux or damage temperature-sensitive devices in the assembly.
9. Determine the correct volume of solder. If you are using solder preforms with solder paste, identify the ratio of solder paste to solder preforms. Plan on 10–20% extra solder to ensure a good fillet.
10. Solder preforms can be used in many applications not related to surface mount. These include: mechanical attach, vacuum seals, cryogenic seals, hard-to-reach areas requiring solder, clad preforms for reinforcement, and [die attach](#). Solder preforms are used in aerospace, medical, military, energy, automotive, communications, security, and many more industries. Discuss with your solder supplier if solder preforms are right for your application.

Paul A. Socha, Americas technical manager, Indium Corporation, may be contacted at psocha@indium.com.