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White Paper: Soldering Electrical Connectors to Automotive Glass

Disclaimer: These are general guidelines to help facilitate the soldering of PC Systems glass connectors to a Silver based substrate screened on to Automotive glass based on knowledge gained from working with past customers. Since we do not actually solder any of our connectors to glass, we encourage you to work with individuals within your organization to develop the most effective parameters for your particular application, or call our Engineering department for more help.

Background Information

Glass connectors are used to link the vehicle wire harness to a screened Silver paste on automotive windshields for multiple purposes, primarily defrosting. Typically, the goal is solder a Tin plated Copper "footprint" to the very thin layer of Silver paste.

Different Footprints:

This whitepaper will focus on what we refer to as reflow tabs and preform on braid. Other footprints include foil or flex connectors, solder clad clips, and tinned wires.

Flux:

Assuming you are using a Tin plated footprint, No-Clean fluxes are usually used regardless of solder alloy. Unless we are asked not to, we ship our connectors pre-fluxed so that all you need to do is add heat.

Solder Alloys:

As of 04/07/11, alloys containing Lead are still allowed on automotive glass. That will likely change in 2012. Typical alloys are:

- 27%Sn69.65%Pb3%Ag0.35%Sb
- 25%Sn62%Pb3%Ag10%Bi
- 96.5%Sn3.0%Ag0.5%Cu
- 52%In48%Sn

Methods:

Two methods of soldering are typically used when attaching electrical connectors to glass, which are solder iron and resistance soldering. For PC Systems product, the best method is to use a solder iron, but resistance soldering can be used as well. Other methods are available, but they are less effective or cost prohibitive.

Special points of interest:

- Multiple alloys are available for soldering to glass, including Lead Free options.
- Different alloys require different tip temperatures. Manipulating the temperature will allow you to manipulate your cycle time.
- A table of temperatures for popular alloys is on page 2.
- If you have any questions, please contact our Engineering Department.

What temperature should my solder iron be?

Do you have a relatively accurate method of measuring your solder iron temperature? If so, you are already a couple steps ahead in the game. There are multiple ways of measuring solder iron temperature, and conveniently, for this application it does not need to be incredibly accurate. If your temperature can be controlled on the soldering unit with a setting, that is probably enough. If you need to measure the temperature, you can use a variety of methods that all have some drawback. Using an IR gun, you can focus on the tip, but it is best if the tip isn't shiny and you read your manual to understand where to place the gun. You can also use a thermocouple to measure the temperature. You will likely see some offset due to stem effect, but it should be negligible.

If you talk to solder industry insiders, they are likely to tell you that you want to keep your iron temperature about 25-50°C higher than the liquidus temperature for your alloy. This will ensure that you don't "burn" the flux and still give you a decent cycle time. Assuming most of you are in Production, you know that the faster the cycle time the better. Also, there is some concern that holding a hot iron on the glass for an extended period of time could possibly damage the substrate.

Here are a couple of guidelines for the four mentioned alloys from above, along with some considerations that are alloy and temperature specific.

27%Sn69.65%Pb3%Ag0.35%Sb

This alloy is typically known as "Tri-alloy" and sometimes the Antimony is not noted in the formulation. With a 253°C liquidus temperature, this solder has the highest processing temperature requirement of the four alloys we will look at. Tip temperatures can be anywhere from 300°C to 420°C and the tradeoff is the amount of thermal shock to the glass vs. cycle time.

25%Sn62%Pb3%Ag10%Bi

This alloy is typically known as "Quad-alloy". Tip temperatures can be anywhere from 200°C to 420°C and the tradeoff is the amount of thermal shock to the glass vs. cycle time.

TEMP continued on Page 2…

	Solidus (°C)	Liquidus (°C)	Tip Temperature (°C)
Tri Alloy	179	253	420
Quad Alloy	164	166	420
SAC305	217	220	275
In52Sn48	118	118	150

Table 1 – A table showing the Tip Temperatures for common solder alloys used on Automotive glass.

…TEMP from Page 1

96.5%Sn3.0%Ag0.5%Cu

This alloy is known as SAC305 and is very common in the electronics industry. Many variations of this formulation are available. It is important to control your tip temperature when using this alloy to avoid Ag dissolution which will weaken your solder joint. Ag dissolution is a function of time and temperature; therefore it would be advisable to run trials to determine the ideal tip temperature. For most applications, a tip temperature between 250 and 300°C is ideal.

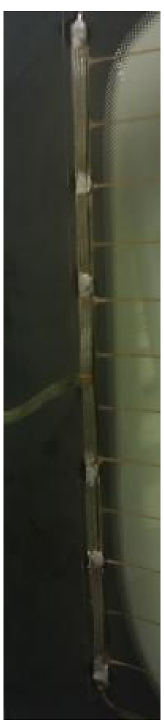
52%In48%Sn

This is the eutectic alloy for Indium and Tin. The very low melting temperature provides a production friendly system, but also requires more consideration regarding the maximum temperature of the application. You won't want to use this if you expect that your application may see 110-120°C temperatures due to potential for reflow. There are many other formulations available that use Indium as the main constituent, but the high cost of Indium typically makes these alloys cost prohibitive. If using the 52%In48%Sn formulation, a tip temperature of 150°C can be used.

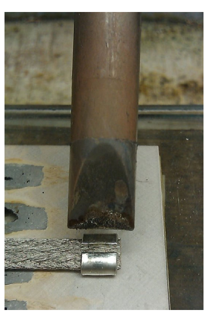
Others

As stated earlier, it typically is advisable to define the liquidus temperature of the alloy and then add about 50°C for a tip temperature. You will need to balance the need for shorter cycle times with the capability of your iron to reach temperature and recover following a soldering cycle.

Table 1 shows the important temperatures for the alloys discussed here.



Helpful Techniques



In the first photo (left to right) you'll see that the chisel edge of the solder iron is being placed in parallel with the seam of the preform. You'll also notice that the solder iron tip is slightly larger than the footprint of the preform.

In the second photo, you will see a "hold down" fixture has been added to keep the braid in place after the heat is removed. This is useful in reducing the chance for cold solder joints, which is very important.

In the third photo, you will see a reflow tab rather than preform on braid. The techniques used are the same.

Finally, in the last photo, you'll see a reflowed preform. It is important to note that a flux "halo" is visible around the joint, which is a good indication that an adequate amount of flux was present in the preform before soldering.