WHITE PAPER

CORED SOLDER WIRE FOR LED LUMINAIRE SOLDERING (Part 1)

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The LED industry has unique needs in terms of cored wire solder assembly. Joints soldered with cored wire are consumed in abundance for many different lighting applications. Most commonly, these spools of solder are used to connect the LED engine array board to the control and power driver board, to provide board to board connections for linear lighting and to solder the endcap of the Edison base, which serves as electrical gateway for typical A-lamps as shown in Figure 1.

Figure 1. Uses of Cored Solder Wire in an LED Luminaire

Aesthetics play a unique role in LED assemblies this is due to solder joints being physically exposed to consumers in a variety of lamps/luminaires that incorporate Edison based caps as shown in Figure 1. In general, manufactures and assemblers will clean the end caps to ensure an aesthetically pleasing solder joint.

Additionally, a significant percentage of LED manufacturers use reflective white solder masks to maximize light output from the lamp or luminaire. Increased levels of flux residue (caused by spattering) and the browning of such residue on a white solder mask can absorb light, thus potentially affecting the brightness of the luminare.

In effect, specific needs include:
1) Aesthetically pleasing “shiny” solder joints
2) Low residue and spatter
3) Solder spreadability
4) Low odor

Alpha has developed and tested a new cored wire alloy-flux combination (Telecore HF850 with SnCu alloy), that provides superior performance relative to the above needs.

Solder spreadability and spatter (commonly known as “spitting”) are phenomena that are common to traditional electronic assemblies which can be typically quantified by an IPC or JIS standard.

However, the shininess/aesthetics of solder joints are seldom quantified.

Traditionally, the electronics industry prefers to have "shiny solder joints", which is typically done by visual examination. The aesthetics plays even a greater role in LED assemblies where a retrofit end cap is used because the solder on the endcap is visually exposed to consumers. In addition, the browning and volume levels of flux drives certain LED manufactures to actually clean the end caps.

Aesthetics tend to be subjective in nature. Thus, Alpha® has developed a novel technique to quantify the shininess of cored solder wire joints using reflectivity as a primary metric in study which was calibrated against a standard mirror with a reflectivity of 87-93%. Additionally, the solder aesthetics of a widely used reference cored wire which falls under the same range of flux percentage and alloy type was also quantified against HF850. Images of these endcap joints are shown in Figure 2.

Figure 2. Images of randomly selected assembled end caps using reference cored wire and Alpha® HF850 SnCu

Figure 3 shows the results from the reflectivity measurements of endcap joints produced with Alpha® Telecore HF850 SnCu compared to those produced with reference wire.

Alpha® HF850 SnCu cored wire produced 180% higher reflectivity when compared to the reference cored solder wire under 3 solder iron tip temperatures. Furthermore, the increasing tip temperatures resulted in a drop in reflectivity for the reference wire which is mostly explained by the burning/browning of the flux at higher temperatures where as HF850 produced consistent levels of >20% reflectivity at increasing iron tip temperatures.

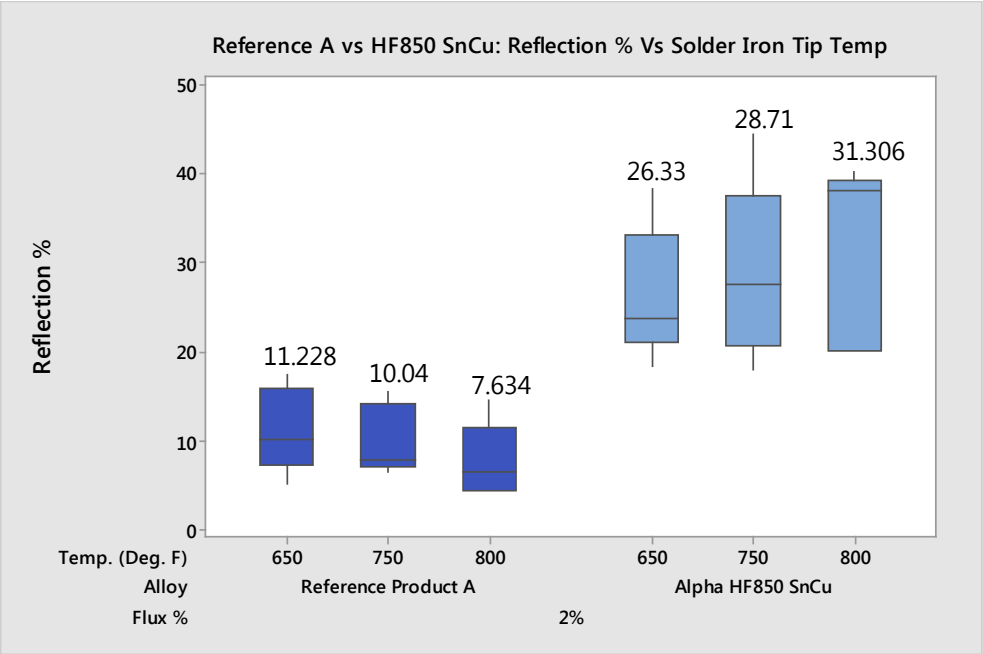

Figure 3 – Reflectivity Results of HF850 vs Reference Cored Wire

Alpha® has developed a novel technique to quantify “shininess” of solder joints, using reflectivity as a metric. This technique allows us to quantitatively benchmark various cored wire alloy-flux combinations as well as process parameters, to ultimately select alloy-flux-process combinations that yield desirable joint characteristics.

From the results it is clear that ultra-low residue endcap joints can be produced with Alpha® Telecore HF850 SnCu. In the process the cleaning step for flux residues on the endcap joint, is not required, providing significant value to users of the Alpha® Telecore HF850 wire.

Subsequent white papers will provide details regarding the significant value created by Alpha® Telecore HF850 SnCu wire in providing ultra low spatter, excellent spreading and low odor.