



How to Hand Solder an Electric Wire to a COB LED

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1. Overview

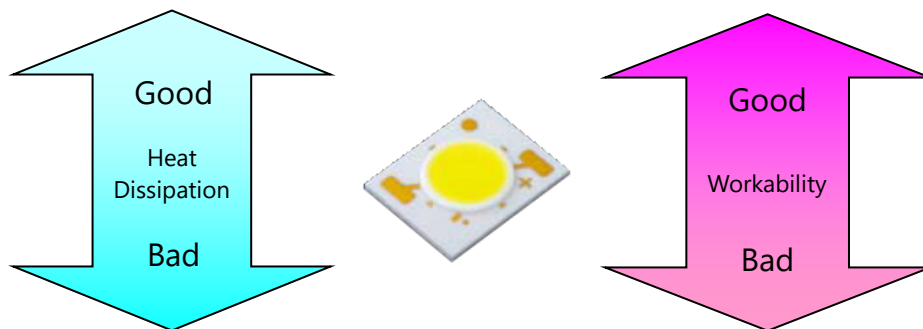
It is more difficult to solder an electric wire to a COB LED by hand than to solder a typical discrete LED to a PCB by hand; there are potential issues to consider when establishing an electrical connection between the COB LED and the housing/heat sink with an electric wire:

- COB LEDs have substrates with good heat dissipation; this can cause the substrate to absorb the heat of the soldering iron, preventing the solder from melting properly and leading to reduced workability.
- When soldering an electric wire to a COB LED, the process may reduce the dielectric strength of the COB LED depending on how it will be operated.
- During and/or after soldering an electric wire to the electrode, if tension is applied to the electric wire, it may cause the electrode to delaminate causing a catastrophic failure (i.e. the COB LED not to illuminate)

This application note provides information on how to solder an electric wire to a COB LED and cautions/suggestions for this process, considering the issues above.

Note:

Nichia recommends using specially designed holders to attach COB LEDs to the housings/heat sinks for the electrical connection to reduce the potential for reliability issues.



2. Necessary/Recommended Soldering Equipment

For successful soldering, it is important to use a soldering iron that ensures that the contact area between the iron and the metal to be joined (i.e. the COB LED's electrode) is maximized to conduct the heat efficiently. Ensure that the chosen soldering iron is appropriate for the electrodes of the LED. For general information on necessary equipment (i.e. soldering station) including soldering irons, refer to Figure 1 below.

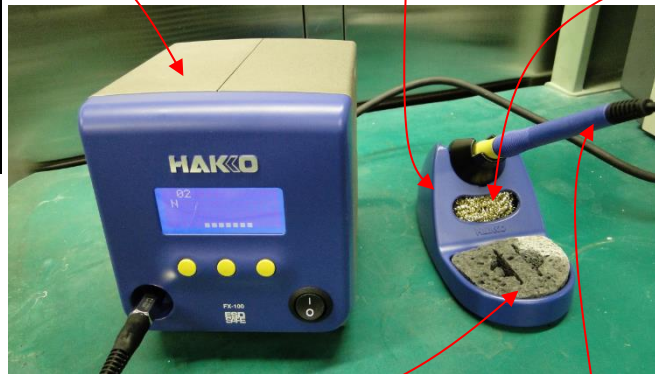
Light Emitting Diode

Temperature Controller

Recommended Hand Soldering Condition	
Temperature	380°C Max
Soldering Time	5sec Max

Soldering Iron Stand

Cleaning Wire



If the tip of the soldering iron becomes oxidized/blackened and will not come clean after wiping on a damp cleaning sponge, the cleaning wire can be used to remove the oxidation from the soldering tip.

Cleaning Sponge

If the soldering iron is turned on and left for a while, it will cause the tip to become very hot causing oxidation to occur on the working surface of the tip; this will cause the tip to discolor (i.e. blacken). If this occurs, the solder will not wet (i.e. melt) on the tip surface; the oxidized tip should be cleaned on the damp sponge.

Soldering Iron





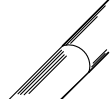
Ensure that the shape of the soldering iron tip is selected accordingly for its intended purpose. To solder electric wires to COB LEDs, tips with high heat capacities should be used. For more details on the types of tips that might be useful for this purpose, refer to Table 1.

Figure 1. Example of a Soldering Iron (Manufactured by HAKKO)

3. How to Choose the Optimal Soldering Iron Tip

Ensure that a tip size/shape is selected that is optimal for soldering the electric wire to the COB LED. In terms of ease of use, the optimal tip shape/size may vary depending on the operation; in terms of workability, as the area of contact between the tip and the metal to be joined (e.g. COB LED's electrode) increases the workability improves. For more information (e.g. types of tip shapes, cautions/suggestions for selecting sizes), refer to Table 1 below.

Table 1. Uses for Different Types of Soldering Iron Tips

Tip Shape	Tip Characteristics	Cautions/Suggestions
Type B 	Conical tips are capable of being used from any direction with easy handling. While the pointed tip helps conduct heat to small areas more efficiently, it also can be used for large areas.	Slightly thick and rounded tips are recommended when soldering electric wires to COB LEDs as they are easy to use.
Type BC 	Slightly thick and rounded tips are recommended when soldering electric wires to COB LEDs as they are easy to use.	Ensure that when soldering an electric wire to a COB LED with this type of tip, the size of the beveled edge is appropriate for the electrode size of the COB LED.
Type C 	Conical tips with beveled edges. The size of the beveled edges can be chosen that best fits the size of the metal to be joined.	-
Type D 	Flat screwdriver type tip. Depending on how the flat pointed tip is applied it can be used three ways: as a point, a line, or to an area.	-
Type K 	Tips with edges that resemble a knife. This type of tip also can be used for points, lines, or areas. It is also useful for narrow pitches or to fix soldering errors (e.g. removing solder bridges).	-

4. Cautions/Suggestions for Stripping the Wire

When soldering an electric wire to a COB LED ensure that it provides a necessary creepage distance and does not reduce the dielectric strength of the COB LED. Refer to Figure 2 below for more details on how to remove the insulating material from the wire.

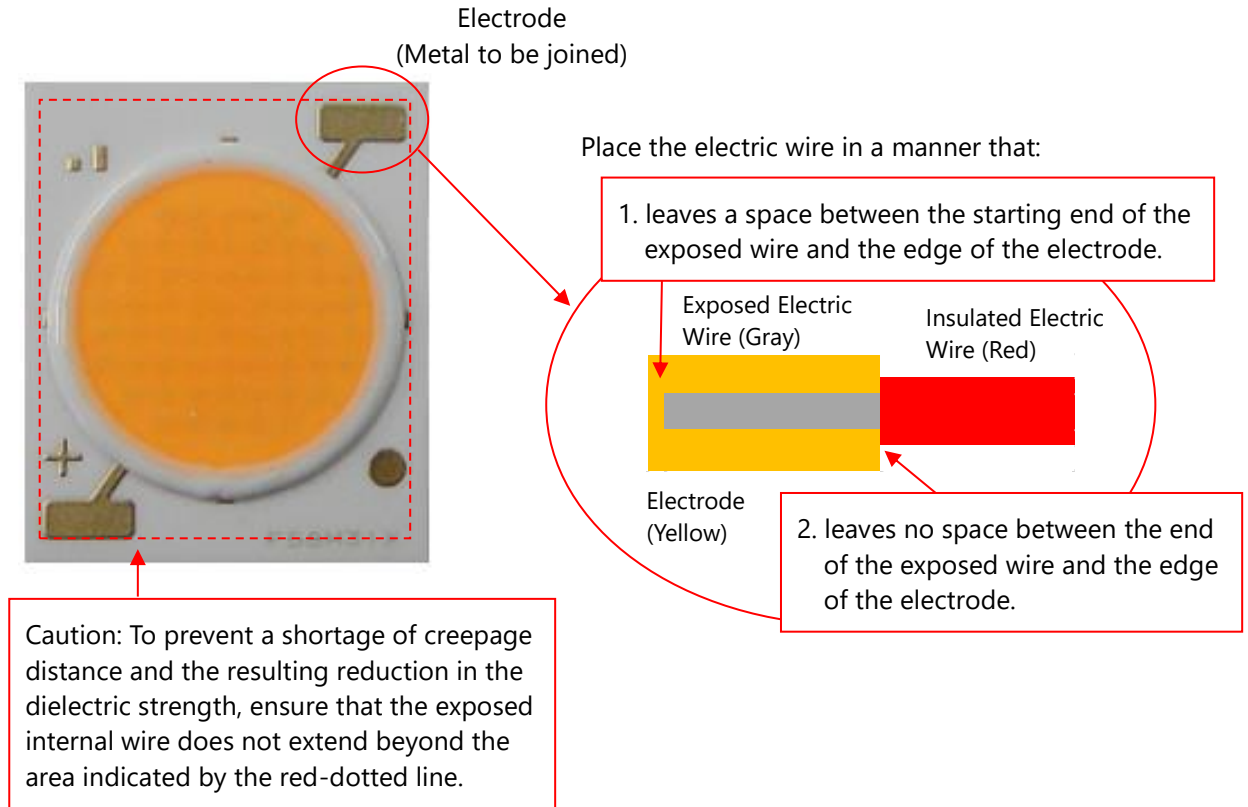


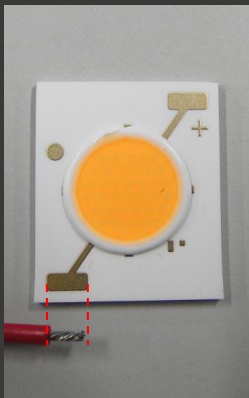
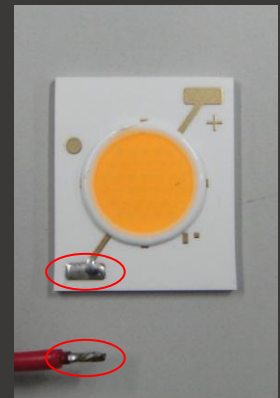

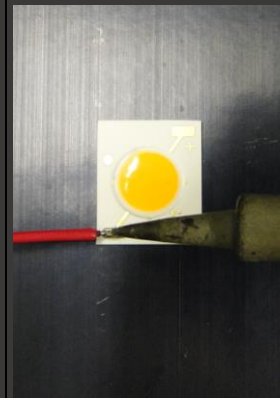
Figure 2. Schematic diagram of how to strip the wire

5. Procedure for Soldering an Electric Wire to a COB LED

Refer to Table 2 below for the details of how to solder an electric wire to the electrode of a COB LED. Ensure that when performing the soldering operations (i.e. Step 2: Pre-plating and Step 4: Soldering the Electrical Connection), the total operation time of these soldering operations combined is no longer than 5 seconds.

Note that this is an example provided for reference purposes only.

Table 2. How to Solder an Electric Wire to the COB LED's Electrode (Example)

1. Stripping the Wire	2. Pre-plating	3. Attaching the COB LED to the heat sink	4. Soldering the Electrical Connection
			
<p>Adjust the length of the exposed internal wire to suit the size of the electrode.</p>	<p>Apply appropriate amounts of solder to both the electrode surface and the exposed portion of the electric wire (i.e. pre-plating).</p>	<p>Before soldering: attach the COB LED to the heat sink, then decide the positions of the electric wires on the electrodes and clamp the electric wires to the heatsink away from the electrodes.</p>	<p>Heat the electrode with a soldering iron to melt the pre-plating solder. When the solder begins to melt, attach the electrical wire to the electrode.</p>

Note: Ensure that the electric wires are clamped on the heat sink away from the electrodes before soldering them to the electrodes. Otherwise, it may cause damage to the electrode (e.g. electrode delamination) when the electric wire is pulled.

6. Potential Issues after Soldering Electric Wires to COB LEDs

Electrode delamination is a commonly reported issue for cases where electric wires are used with COB LEDs for the electrical connection. This issue can occur when excessive force is applied to the electric wire after soldering it to the COB LED.

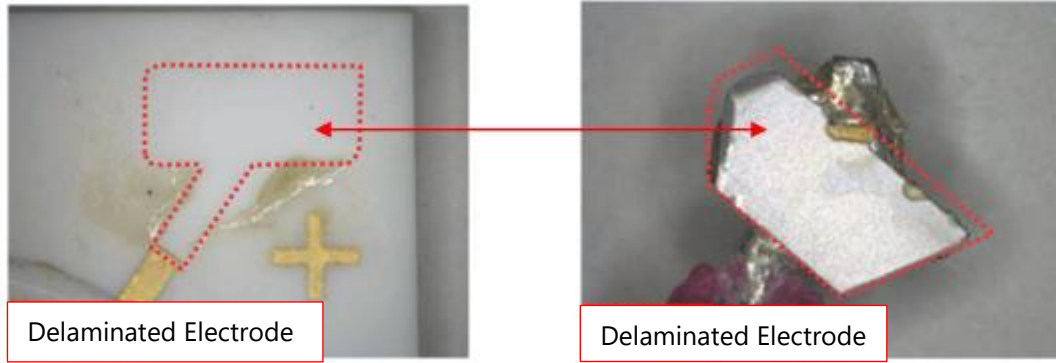


Figure 3. Electrode Delamination (Example of a Reported Failure)

During and/or after soldering an electric wire to the electrode, ensure that tension is not applied to the electric wire. This may cause the electrode to be damaged and/or reduce the adhesive strength of the electrode to the package. In order to prevent tension from occurring on the lead, using a mechanism to clamp the lead (e.g. cable/cord clips, clamps, etc.) on the housing side is recommended.

As mentioned earlier in this section, electrode delamination may occur when excessive tension is applied to the electric wire. In addition, solder paste components (e.g. halogens) may cause the adhesive strength between the COB LED's electrode and substrate to decrease, leading to electrode delamination. Ensure that sufficient verification is performed to determine the effect of the chosen solder paste on the adhesive strength.

Refer to Figure 4 below for empirical data showing how the difference in solder paste affects the adhesive strength over time.

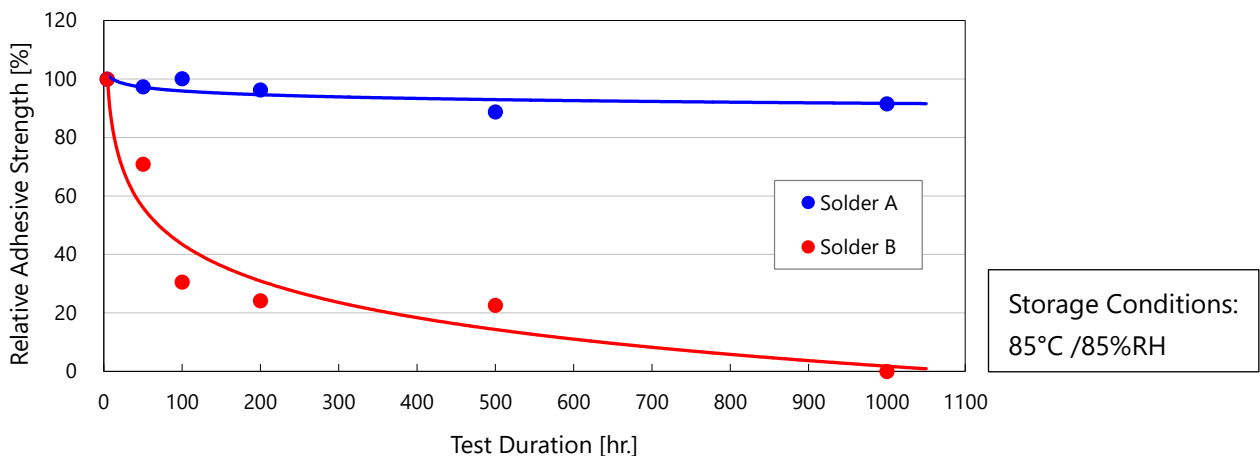


Figure 4. Reduction in the Adhesive Strength between the Electrode and Substrate over Time (Example)

7. Cautions/Suggestions for Replacing Soldering Iron Tips

Lead-free solders are higher in tin content than lead solders; tin can erode the tip plating causing the tip to wear out. This will affect the workability significantly. Ensure that if a lead-free solder is used, regular checks are made to determine when to replace the tips.

8. Summary

This application note has provided information on:

- Example of how to solder an electric wire to a COB LED by hand
- Potential issues associated with this connection method (e.g. electrode delamination due to excessive tension applied to the electric wire and the type of solder used)
- Alternative solution on how to secure/connect a COB LED (i.e. specially-designed COB LED holder)

The optimal soldering equipment/conditions for attaching an electric wire to a COB LED may vary depending on a range of factors. Those that better fit the chosen application should be determined by performing multiple runs using different conditions. Additionally, ensure that sufficient verification is performed with the type of solder being used to ensure that there are no issues (e.g. electrode delamination).

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