Aluminum Soldering - Product Guide

Aluminum Soldering Considerations
Aluminum is a metal that it is hard to solder due to the high surface tension difference between it and molten solder alloy. This occurs because aluminum rapidly forms a tenacious oxide layer whenever it is exposed to oxygen in the air. The oxide layer is responsible for the high surface tension difference between the aluminum and the solder and impedes the solder from spreading evenly on an aluminum surface. There are hundreds of aluminum alloys available in the marketplace; it is important to identify the form of aluminum one is soldering. Once this is done, an appropriate soldering technique can be chosen for soldering the specific aluminum alloy under consideration.

Aluminum Flux
Aluminum flux can be used with certain solders to directly solder aluminum. Solder alloys that work well for soldering aluminum include tin-zinc, tin-silver, tin-lead-silver, and tin-copper. The fluxes listed below are active for soldering aluminum from 180°C – 315°C. The solder alloys used for soldering commonly are usually soldered in the 240°C – 290°C range.

Superior 1260 – Original, high activity, organic-based, chloride-free, viscous aluminum soldering flux. For aluminum, copper, nickel, brass, and mild steel soldering.

Superior 1261 – High activity, organic-based, chloride-free, more fluid aluminum soldering flux. Gives smooth, even hot dip solder coating on 1350 aluminum wire using 99.3Sn/0.7Cu and SN100C solder.

Superior 1265 – Version of the aluminum soldering flux in a unique paste form for applications requiring dispensing of flux to a particular area.

Aluminum Cleaner
The cleaner prepares the aluminum surface by removing surface oxides and is used for cleaning aluminum surfaces after soldering.

Superior Aluminum Cleaner is a non-hazardous, slightly acidic solution used for removing tenacious aluminum surface oxides from aluminum alloys immediately prior to applying soldering flux. Can also be used as a cleaner to remove post-flux soldering residues.
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Aluminum Flux Cored Solder
Solder wire can be cored with a specialty aluminum flux formula to make a cored solder wire capable of soldering a wide range of aluminum alloys.

*Superior AFCW* is a zinc-free, cored wire solder designed for direct aluminum soldering applications. It permits soldering to aluminum surfaces without using expensive plating techniques to prepare the aluminum surface. Available as 0.020 inch (0.508 millimeter), 0.062 inch (1.575 millimeter) and 0.125 inch (3.175 millimeter) diameters. Active in the range 280° - 380°C.

Direct Aluminum Solderpaste
Aluminum soldering can also be accomplished by using solderpaste, which is solder alloy and flux held together by a binder. The paste is applied followed by reflow soldering. There are many combinations possible; three common ones are listed below.

*Superior AL26-33-75* – Water-soluble formulation designed for direct aluminum to copper soldering. The presence of silver in the solder alloy creates a true intermetallic bond between solder and aluminum. Active in the range 240° - 290°C.

*Superior AL261-143-75* – Two-part water-soluble solderpaste with a specialty alloy for low temperature soldering of aluminum to copper. Active range 180° - 240°C.

*Superior AL273-103-63* – Water-soluble formulation for direct aluminum soldering. Most active solderpaste of this series, especially useful for aluminum to aluminum or aluminum to stainless steel soldering. Active in the range 280° - 380°C.
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Superior Flux has worked with many chemistries and platforms to give the user a wide range of solutions when it comes to soldering aluminum. The most important issue to consider is what aluminum alloys are to be soldered. Soldering to copper metals is fairly easy because elemental tin (present in many solders) readily forms an intermetallic bond with copper. Tin, however, will not make a metallurgical bond to aluminum. Other elements, especially zinc or silver, have to be added to the solder, which then can create an intermetallic bond between themselves and the aluminum once the aluminum oxides have been removed. Using the Superior Aluminum Cleaner greatly improves the chance that a given aluminum alloy can be evenly soldered. Finally, the choice of fluxing vehicle is largely dependent on the aluminum alloy being soldered and the heating method used.

Fluxing Methodology by Aluminum Alloy and Heating Method

<table>
<thead>
<tr>
<th>Heating Method</th>
<th>Super 1260 or 1261 Flux**; 91/9 Tin-Zinc or 96.5/3.5 Tin-Silver (240° – 290°C)</th>
<th>Superior 1265 Dispensable Flux Paste; 91/9 Tin-Zinc or 96.5/3.5 Tin-Silver (240° – 290°C)</th>
<th>Direct Aluminum Solder Paste AL26-33-75 with 96.5/3.5 Tin-Silver** (240° – 290°C)</th>
<th>AFCW Flux-Cored Solder Wire or Rods 96.5/3.5 Tin-Silver or 99.3/0.7 Tin Copper (280° – 380°C)</th>
<th>Pre-Tinning with Superior 1261 Flux** in Molten SN100C Solder Bath*** (300-320°C)</th>
<th>Direct Aluminum Solder Paste AL273-103-63 with SN100C Solder (280° – 380°C)</th>
<th>Pre-Tinning with Direct Aluminum Solder Paste AL26-103-25 with SN100C Solder (240° – 290°C)</th>
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</table>

*Depends on the ultimate concentration of trace elements in each individual alloy; some 8XXX and 9XXX alloy aluminum can contain elements that may hinder or block soldering.

**The Superior 1261 is a more fluid form of Superior 1260 and can be used in all applications that Superior 1260 is used.

***The Superior Direct Aluminum Soldering Paste is also available as a low temperature solder paste (Superior AL261-143-75) that can solder aluminum at 180-240°C.

****In soldering aluminum to aluminum these products are not recommended; however, soldering copper to aluminum these products can work because of the ease of soldering to the copper, giving the joining a “base” to work from. Using the Superior Aluminum Cleaner immediately prior to soldering greatly improves the solderability of many aluminum alloys.

*****SN100C (tin-copper with nickel and germanium) works best for this operation, however tin-copper, tin-zinc, and tin-silver can also be used.