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Soldering Stainless Steel

Soldering is a common method for joining metal pans and preventing moisture infiltration into seams in metal roofing. To achieve a lasting, watertight seam, the solder must be fully sweated through all layers of metal.

When it comes to stainless steel, soldering can prove tricky for even the most experienced mechanic.

Contractors who are familiar and comfortable with soldering copper may find fully sweating solder through a seam a relatively straightforward task. When it comes to stainless steel, however, soldering can prove tricky for even the most experienced mechanic.

The major difference between the soldering of copper and stainless steel relates to thermal conductivity. Copper conducts heat very well, a characteristic that makes it a popular metal for cookware. The thermal conductivity of copper is 231 BTU/ (hr./ft./°F). Stainless steel, on the other hand, is a poor conductor of heat, at only 8.09 BTU/ (hr./ft./°F). This means that heat from the soldering iron is transferred across a piece of copper twenty-eight times faster than stainless steel. The rapid, uniform heating of copper helps the molten solder flow and draw through the seam. In comparison, stainless steel heats up slowly, retains heat around the point of contact of the soldering iron, and does not dispel heat as quickly after the iron is removed. Using a cooler soldering iron (around 400°F) with a large head will help distribute the heat and prevent buckling due to excess heat, but the metal will still take a little longer to heat up than copper.

Another reason stainless steel can be difficult to solder has to do with its tenacious oxide coating. The chromium contained in stainless steel reacts with oxygen to produce an invisible oxide film. This oxide coating protects the metal from corrosion (this is what makes it

Solder not fully sweated through this twenty-two-gauge stainless steel lapped, riveted, and soldered seam. The rivets are too long as well.

Top surface (top) and cross section (bottom) of a twenty-two-gauge stainless steel lapped, riveted, and soldered seam with solder fully sweated all the way through. Soldering was performed using the methods described on the reverse.

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"stainless"), but also prevents solder from wetting and adhering to its surface. The key to removing the oxide film and preventing its renewal during soldering is the use of flux. Hydrochloric acid fluxes are commonly used for soldering copper, and while they are effective with stainless steel, they will induce rapid corrosion of the metal if the residue is not neutralized and completely removed after soldering. Phosphoric acid fluxes are compatible with stainless steel and typically yield good results, though the finished soldered seam should still be cleaned to remove flux residue. In addition, cleaning the metal to remove dirt and oil, roughening the surface with a stainless steel wire wheel to achieve a bright, metallic surface, and pre-tinning (i.e. applying a thin layer of solder to the mating surfaces) prior to forming the seam will all help increase the wetting ability of the solder.

Using an appropriate solder is also important. Solder made up of fifty percent tin and fifty percent lead works ideally for soldering copper. 50/50 solder will also work with stainless steel, though a higher tin content will help increase the wetting ability of the solder. Solder containing sixty percent tin and forty percent lead usually works quite well. Tin-silver alloy solders can also be used with stainless steel; however, given the cost, these solders may be impractical for roofing work.

One roofing contractor's experiments with stainless steel lapped, riveted, and soldered seams have produced good results using the following techniques and adjustments:

- Pre-tin both pieces of metal being joined.
- Decrease the lap from the standard 1-½" to 1-¼".
- Place rivets 1/4" from each edge of the seam rather than 1/2" to help prevent distortion of the seam.
- Solder 2" of the seam, then skip 2". Continue in this alternating pattern for the full length of the seam, then go back and fill in the unsoldered portions.

Fully sweated soldered seams in stainless steel can be difficult to achieve due to the low thermal conductivity of the metal and its rapidly forming oxide coating. Using a cooler iron and being patient in allowing the metal to heat up slowly—using an appropriate flux, pre-tinning, and adjusting the layout of the seam—can help improve the flow of solder through a stainless steel seam. Preparing sample soldered seams prior to the start of a project is a good way to figure out what procedures will be necessary to obtain the best results. Cutting the sample seams in half transversely to view the cross section will reveal if full sweating has been achieved.

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