Revere Copper Products, Inc.

Soldering FreedomGray®

The "keys" to successful soldering of Revere ***FreedomGray®*** zinc/tin alloy coated copper. are the same as those for soldering plain copper – adhesion of solder to the metal's surface and "draw" of the solder into the seam. Both of these are affected by the surface condition of the metal, "wetting agent's" (flux's) ability to draw the molten solder, solder used, and application of heat.

- **Metal surface –** it is imperative that metal to receive solder be dry, clean, and free of oxides, dirt, oils, etc. Solder will not adhere to such foreign materials.

  Any oxidation on ***FreedomGray must*** **be removed** from all surfaces to receive solder. Oxidation may be removed with light abrasion with products like as scotch brite. It is not suggested or recommended that the zinc / tin coating be removed.

  DO NOT remove the tin/zinc alloy! It is not required that the alloy coating be removed. Removal of the alloy coating may result in aesthetic and/or corrosion problems and will void Revere's warranty.

- **Solder –** Revere recommends only lead-free solders be used with ***FreedomGray*****. The alloy formed by adding lead to the Zinc/Tin may have a much lower melting point and may decrease the viscosity of the molten solder. The addition of lead may also provide inadequate strength and incomplete seam fill.**

  Based on testing of various lead-free solder alloys, Revere suggests consideration of Johnson #497 *SuperFlo*™ by Johnson Manufacturing Company, Princeton, Iowa for use with *FreedomGray*.

  Other lead-free solders may be equally suitable for soldering *FreedomGray*. However, Johnson #497 *SuperFlo* consistently provided the strongest soldered seams in the Revere test program.

- **Flux –** is an "*accessory*" to soldering but it is important because flux:
  - Removes oxides and/or other surface films from the metal. (Oxide formation is one of the greatest obstacles to soldering.)
  - Prevents re-oxidation of the base metal and solder during soldering
  - Lowers the surface tension between the solder and base metal so the solder can flow and spread rapidly.

  Fluxing will **NOT** remove heavy oxides

  Lead-free solders do not "draw" into seams as easily as lead-bearing solders (50-50 or 60-40). To overcome this problem, Revere suggests the use of "tin-loaded" fluxes such as Johnson's E-127 Flux-'N-Solder with Pure Tin for soldering ***FreedomGray***.

  Revere does **NOT** recommend or endorse the use of fluxes that contain free acids – muriatic/hydrochloric acid (HCl), phosphoric acid (H_3PO_4), etc. – with ***FreedomGray***.

- **Pre-tinning –** to insure "draw" of solder into locks, surfaces to receive solder must be tinned (pre-tinned) prior to soldering.

  Tinning may be done by:
  - Dipping into a bath of molten solder after fluxing

CORPORATE HEADQUARTERS · ONE REVERE PARK · ROME, N.Y. 13440-5661 · (315) 338-2022 · FAX: (315) 338-2105
E-Mail: archcopper@reverecopper.com

- Flowing on a smooth even layer of solder with a soldering copper
- "In-situ" fluxing through use of a "tin-loaded" (tinning) flux.

  For "in-situ" tinning, tin-loaded flux should be applied liberally to all surfaces to be joined. When the seam is heated the tin melts and "attracts" the solder and draws it into the seam.

- **Joint design –** locks to be soldered should be three-quarter inch (¾") wide – deep. All surfaces to receive solder should be pre-tinned and fluxed before the locks are engaged. Locks are then "dressed" with a mallet and block of wood. (When possible locks should be formed on a "bar folder" to provide parallel "legs".)

- **Heat source –** must be sufficient to raise the temperature of the *entire* seam to the point at which solder flows freely.

  Soldering coppers (irons) are the preferred heat source – Revere does **not** endorse soldering architectural copper work with a "direct flame" (plumbers torch). In addition to a very real fire hazard, open flames can cause to metal to warp due to spot heating and there is not enough pressure applied to the seam (from the soldering copper) to maintain alignment and hold it together.

  Size, shape, and weight of coppers must be sufficient so that all thicknesses of metal in the lock or seam are heated to a temperature above the melting point of the solder.

  Historically, coppers were used in pairs that were heated in charcoal or gas fired pots. (One copper heated while the other was used.) So long as the coppers are changed and re-heated sufficiently often, there is nothing wrong with this method.

  To avoid re-heating and changing coppers, many (most) contractors use continuously heated coppers (torches).

  Normally, Revere has suggested acetylene / MAP gas be used with continuously heated coppers. (Acetylene "burns hotter" than propane and makes soldering quicker and easier by maintaining the copper at a constant temperature).

  However, most metals, including copper, will dissolve in molten tin. As a result, lead-free solders "attack" soldering coppers – especially when they are over-heated. The service life of coppers can be prolonged by maintaining the minimum temperature required to completely sweat a joint or seam. (The result is a juggling act of supplying sufficient heat to fully sweat a seam without "burning-up" the soldering copper.)

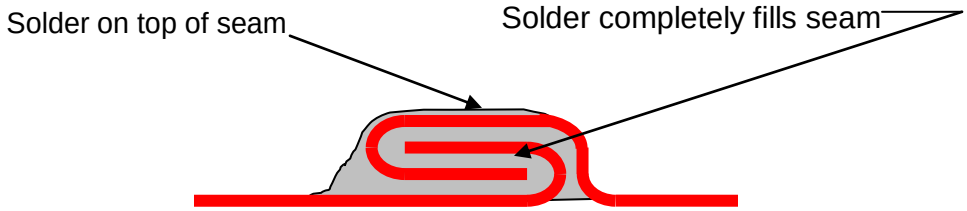
- **Placement/Location of heat –** to insure that solder is drawn completely through the lock, the soldering copper must be placed on top of the seam. Further, the copper should be at least as wide as the seam – preferably wider.

- **Timing –** all locks and seams **MUST** be completely soldered within four-hours (4-hours) of being installed / exposed to the elements! Upon exposure to the atmosphere metals begin to oxidize. These oxides act as insulation - they inhibit the flow and bonding of solder which results in weak seams.

  The rate of oxidation will vary with weather conditions but, seams that have been exposed to the elements for over four-hours should be opened, cleaned, and re-fluxed before soldering. In no case should seams be left exposed to the elements overnight. Moisture from dewfalls can sufficiently oxidize the metals to prevent proper soldering.

Inspection of Soldered Seams – Well made soldered seams can often be identified by their appearance. As shown in the sketch below, there should be a band of solder on *top of* the seam and

additional solder along the edge of the seam.



Section Through Properly Soldered Seam

Solder on top of the seam is the result of the soldering copper being placed over the multiple thicknesses of copper. The absence of solder the full width of the seam *may* be an indication of insufficient heat to fully sweat the seam.

The solder on top of and adjacent to the seam should be relatively smooth with low ridges perpendicular to the seam. These ridges are the result of "pulling" the heated soldering copper along the seam. The absence of such ridges is not "proof positive" of a poorly made seam but may be reason for further investigation.

Little or no solder on top of the seam accompanied by a large amount of rough solder adjacent the seam is often a poorly made seam.

The outer edge of the solder should be tightly adhered to the copper. There should be no gap, line, or space between the solder and the copper. Likewise, there should be no "hair-line" splits or cracks in the solder. Solder is not elastic – it will not crack on its surface while maintaining its integrity within the seam.

The above is based on tests and field experience of Revere Copper Products, Inc. and others. It is presented for reference only. While it represents our best suggestions for soldering ***FreedomGray***, it is recommended that all parties consult the appropriate manufacturer's MSDS for proper procedures, safety, and care when handling and/or working with any chemical (including flux), metal (including solders), or heat source.

In the event of a difference between the above and a manufacturer's MSDS, information in the MSDS must be followed.

Further, all aspects of soldering should be done in a manner in accordance with local, state, and federal – including OSHA – health, safety, and building codes.

For additional information regarding any of Revere's architectural coppers please contact the Architectural Services Department at (800) 448-1776, extension 2554 or e-mail archcopper@reverecopper.com.

For information regarding Johnson's fluxes and solders contact Johnson Manufacturing Company, 114 Lost Grove Road, Princeton, IA 52768; phone – (563) 289-5123, fax (563) 289-3825, or e-mail johnsonmfg@aol.com.