The following information is compiled and rewritten from old books lying around for the benefit of learning and exchanging the secrets of good soldering techniques. As we continue our journey into the different types of sheet metal work and learn how to fabricate conductor heads and other ornate work, you’ll want to learn the basics on soldering.

To the readers, it is important to understand that this information on soldering is compiled and re-printed from material written as early as 1900. It does not express concern or standards such as that of ASTM standards nor do we discuss the acceptable amounts of lead and other chemicals allowed to date. ASTM International is a global forum for the development of consensus standards. ASTM dates back to 1898, however, standards do change. To learn more about ASTM, contact information is included at the end of this document.

We invite you to share your experience, tips and techniques with us. All of which will be posted as an update to this article. The only way one can learn is if we teach them. Manufactures too are welcome to submit any information that would benefit the industry. We will include a section online for links to articles of interest. If you know of any links, please let us know so we can share it with all of our visitors.
Soldering Part 1
(Reprinted E.A. Atkins 1908)

Every mechanic who is a worker in any kind of metals should at least be able to make a simple soldered or brazed joint; to acquire the knowledge of the operations is not at all difficult, a working acquaintance being readily obtained after a few hours of practice. The operations of soldering and brazing are not analogous to those of gluing, gumming or cementing, as it is not simply a question of inserting some adhesive substance in between the two surfaces of the joint, and thus sticking the metals together. When two edges or surfaces of metals are soldered or brazed together, the solder or spelter actually alloys with the metal to be soldered for some small distance beneath the surface; hence the solder or spelter penetrates into the pores of the metal, obtaining a firm grip. If a joint to be cut through and the surface examined under the microscope, no clear line of demarcation between the solder and the metal can be observed. For instance, if the metal soldered is copper, it will be noticed that the bottom layers are yellow, the solder having combined with the copper and formed a bronze. In a brazed joint the spelter will have alloyed with the copper and then formed a brass.

In making or choosing a solder the requirements of a good solder should be kept in mind. They are as follows:

1. The melting point must be below the melting point of the metal to be soldered.
2. The solder must flow readily.
3. The solder must firmly unite with the metals to be soldered.
4. The solder must be strong.

Let us consider the above requisite properties of a good solder or spelter. In the first place, it would manifestly be foolish to attempt to solder a metal with a solder whose melting temperature was higher than that of the metal to be soldered, as before the solder commenced to run the sheet itself would have a hole melted in it. So that, in soldering the softer metals such as block tin and pewter, care must be taken to choose the proper solder.

For the solder to properly permeate every part of the joint it is, of course, necessary that it become liquid or thin, so as to flow readily. To obtain this property all foreign substances must be kept out of the solder. Thus, to give an illustration, if a small quantity of zinc gets into a soft solder composed of lead and tin, it makes it become thick or pasty to use. From what has been said at the commencement it will be readily understood that the solder must be of such a nature as to alloy with the metals to be soldered, or else it will be impossible to make a firm joint.

From iron, copper or brass work that is to be subjected to pressure, it is essential that the joint be as strong as possible. Hence, in making joints for this kind of work a brazing spelter must be chosen that will give the best results. The following is a table of a few of the soft solders in ordinary use; -
It is interesting to notice the change of the melting points of the solders from that of the metals, which form them. For example, lead melts at 620 degrees Fahr. And Tin at 420 degrees Fahr. yet when these are alloyed together in equal proportions to form ordinary tinman’s solder, the melting point drops to 320 degrees Fahr. This is one of the advantages that is derived from the alloying of metals.

It is generally the best plan to make one’s own solder, as much of that which can be brought is unreliable. Besides which, without some guarantee that the solder contains the required proportions of lead and tin, there is no knowing whether or not there is more lead in the solder than has been bargained for. At which time tin had a cost of about ten times the cost of lead. (This being written in the early 1900’s I don’t believe is so true any longer. We have very reliable sources for solder) A rough test of the quantity of tin in solder is by listening to the characteristic “cry” of the tin when the solder is bent.

In making solders, the lead and tin are melted together, the metals properly mixed, and the scum or oxide skimmed off the surface. And before pouring it into the mould, it is a good plan to dust a little resin on the surface of the solder, and let it burn away. In lieu of a cast-iron mould, a bar of small angle iron can conveniently be used for running the sticks of solder.

It will be noticed that pewterer’s solder melts some degrees below the boiling point of water; but it does not of necessity follow that boiling water will melt away the solder from the joint on the pewter vessel, as the solder, by virtue of alloying with the pewter, will, in this case, have its melting point raised.

The following table gives the composition of the ordinary hard solders or spelters:

<table>
<thead>
<tr>
<th>Lead</th>
<th>Tin</th>
<th>Melting-point</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>1</td>
<td>480 ° Fahr.</td>
</tr>
<tr>
<td>2</td>
<td>1</td>
<td>440 °</td>
</tr>
<tr>
<td>1</td>
<td>2</td>
<td>340 °</td>
</tr>
<tr>
<td>2</td>
<td>3</td>
<td>335 °</td>
</tr>
<tr>
<td>1</td>
<td>1</td>
<td>320 °</td>
</tr>
<tr>
<td></td>
<td>Bismuth 2</td>
<td>201 °</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Copper</th>
<th>Zinc</th>
<th>Silver</th>
</tr>
</thead>
<tbody>
<tr>
<td>Iron work</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Copper and thin iron work</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>Brass work</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Thin brass work</td>
<td>8</td>
<td>8</td>
</tr>
</tbody>
</table>

The term “spelter” should not be confused with the same name that is applied to ingot zinc, as a hard solder is essentially brass, whilst, of course, ingot zinc is almost pure zinc.
and is principally used in galvanizing. It will be seen that the first spelter has the same composition as ordinary brass, and it might be here said that sheet brass is often used, instead of brazing spelter, as it is sometimes found to be more convenient to put along the joints. In bent joints, such as that as the kettle spout, a strip of brass can be cut that will lie along the whole length of the joint.

In practice there is really very little need to trouble about the composition of brazing solders, as they're usually sold in grade form, numbers 1,2,3 etc., the course being used for iron and the finest for thin brass work. Silver solders, mostly composed of copper and silver, are used principally used in jeweler’s work, with which we are not here concerned. The fluxes used in soft soldering are “killed Spirits,” resin, resin and oil, tallow, and for pewter Gallipoli oil. Soldering fluids are sold readily made up, and these are probably composed of crude chloride of zinc with some sal ammoniac in solution. A lump of sal ammoniac is sometimes used for cleaning the point of the soldering bit, and powered sal ammoniac is used as a flux in various tinning operations. Borax is almost generally used as a flux for brazing. There are however, several advertised substitutes: but the principal ingredient in these is probably borax in some form or other. It may be known in passing that the object of using a flux is to assist the solder to flow, and to keep the part of the joint, which is being soldered from contact with the atmosphere. The air being kept from contact with the surface of the joint, no oxides can form, consequently the melted solder is free to unite with the heated metal. In many cases, too, the flux has a cleaning action, removing any thin film of oxide that may have formed on the surface of the sheet previous to soldering.

**Soldering Part two**
(Reprint from Broemel 1918)

The process of soldering consists of welding together pieces of metal by means of another metal of a lower melting point. Soft solder may be taken to mean the uniting of pieces of metal with fusible alloys of tin and lead.

In the operation of soldering, which is done by using soldering coppers for applying heat, the solder must be fused to the pieces that are being joined. This is done by raising the temperature of the solder and the parts to be soldered to the fusing point. The solder is applied and sweated in by holding a hot soldering copper in contact with the seam until the correct fusing temperature has been attained with the results that the metals fuse together in one homogeneous mass, making a perfect joint at every point.

The absolute necessity of heating the parts to be soldered and raising them to the correct temperature cannot be too strongly emphasized.
Fluxes. – When soldering two pieces of metal together, a perfect bond cannot be made unless oxide is kept out of the joint, a flux must be used to prevent oxidation while the soldering operation is going on. The basis of all good fluxes is zinc chloride. Many sheet Metal workers in the past prepared their own flux by “cutting” zinc in muriatic acid until the acid stops boiling and bubbles cease to rise. The acid eats away the zinc, liberating hydrogen during the process. This action continues until the acid is “cut” or “killed;” in other words until all the hydrogen in the acid has been all the zinc it will eat. What is left in the bottle is no longer muriatic acid, but is known as chloride of zinc. Muriatic acid is the commercial name for hydrochloric acid, and is often used in its raw state as a flux for soldering galvanized iron and zinc. Chloride of zinc, or “killed acid,” is used as a flux when soldering clean galvanized iron, zinc, copper, and brass. When the material to be soldered is tin plate, bright copper, or lead, rosin is used as a flux, and when melting has a tendency to penetrate into the lock or seam. There are several kinds of soldering salts and non-corrosive fluxes on the market, which are being used with good results by the sheet metal trade. A too strong flux will do harm to the work and to the soldering tools. Whatever flux is employed should be diluted with water to the weakest condition for the work on hand.

Solder. – Practically all solders used by the sheet metal worker are combinations of tin and lead. The quality of the solder must not be overlooked. Solder should be purchased from a reliable dealer who will furnish a good article, having the correct proportions of lead and tin. The solder generally used is composed of half tin and half lead, commonly called half and half or 50-50. It melts about 370 degrees Fahrenheit. A better flowing solder, one having more resistance to stress, is composed to 60 percent tin and 40 percent lead. It melts about 340 degrees Fahrenheit. The latter is the best possible combination, with the objection, however, that it is very costly.
Soldering Furnaces. – Furnaces for heating soldering coppers are made to burn gasoline, gas, oil, and charcoal. The firepot shown in Figure 126 is well adapted for burning charcoal, gas furnaces, as shown in figures 128, 129 are most generally used; their point of superiority being the continuous supply of fuel. Soldering coppers of different sizes, suitable for different kinds of work (fig.130, 133) should be included in every shop and can be obtained in various weights.

A small copper should not be used on heavy work, as it cannot contain enough heat to allow the solder to flow and sweat into the joint, as it should. When the small copper is applied to the metal, it becomes cool quickly with the result that the workman waste much time in trying to keep the copper hot, or soldering with relatively cold coppers, which means poor work. After selecting coppers of suitable weight for the work at hand, the next point to consider is the required shape.

Fig. 129. - Double Gas Furnace

Fig. 130. - Square Point Soldering Copper

Fig. 131. - Roofing Copper

Fig. 132. - Bottom Copper

Fig. 133. - Hatchet Copper
Forging and Tinning Coppers. – Soldering coppers are forged to any by placing the copper in the furnace and heating it to a dark cherry color. The dross and scale is removed by means of a coarse file; the copper is then forged to the required shape on an anvil or block of iron by means of a heavy hammer. Copper can be forged very easily if the metal is annealed or softened. The annealing operation for copper consist of heating the metal to a dull red heat. It can be allowed to cool out slowly in the air or by immersing in water.

The soldering copper shown in figure 157 (a) is forged to a pointed shape. It is well adapted for soldering seams in tin ware or any other bench work and generally weighs three to four pounds a pair. The bottom copper shown in figure 157 (b) is wedge shape in form and is used for soldering the bottom seams of sheet metal articles on the inside. For soldering flat seams, coppers shaped as shown in Figure 131 are best adapted, being especially suitable for flat seam roofing and should weigh from 6 to 10 pounds a pair.

Fig. 157. - a, Soldering Copper for tinware, applied to vertical seam. b, Bottom Copper

Tinning Points of Coppers. – When tinning pointed coppers, they should be heated, then filed bright on four sides, not higher than about ¾ inch from the point. This gives a bright smooth surface, ready for tinning. The coppers are again placed in the furnace and heated sufficiently to melt solder. The point of the copper is then rubbed lightly on a small block of sal ammoniac, which cleans the surface. A small portion of solder is now melted upon the sal ammoniac and by lightly rubbing the copper back and forth upon the solder and sal ammoniac, it will become tinned and ready to use.

Soldering coppers can be tinned with rosin instead of sal ammoniac. This is usually done by placing a piece of solder and some rosin upon a board or soft brick. The copper is filed
in the usual manner, then heated just hot enough to melt solder. It is next taken and rubbed on the solder and rosin until the solder adheres to the copper. This method is of tinning is generally used when soldering tin, and if rosin is being used as a flux. Keeping the point of the copper bright and clean at all times is of vital importance. Never allow an oxide or scale to form on the points, for copper oxide is almost a non-conductor of heat and an oxide soldering copper gives up its heat so poorly as to be practically useless. If a scale is allowed to form on its point, it flakes off and causes serious trouble in the soldering. A copper can never remain in good condition if it is overheated. When a copper is allowed to become red-hot its usefulness is gone until it has been retinned.

**Dipping Solutions.** – When using charcoal, gasoline, or gas for heating, the point of the copper becomes discolored. Using an earthen fruit jar, mix a solution composed of ½ ounce of powered sal ammoniac and one quart of water. After the sal ammoniac has been dissolved the solution is ready for use. The point of the heated copper, when taken from the furnace is dipped quickly into this solution. This facilitates the soldering operation by making the tinned surface bright and clean.

**Methods of Soldering**

**Soldering Flat Seams.** - In Fig. 158 is shown the method of soldering a flat seam having ½ inch to ¾ inch lap. In this case two pieces of galvanized iron, about 2 ½ by 8 inches, are used as shown by a and b. Muriatic acid is employed as the flux and care must be taken that the flux is allowed to enter the seam the width if the lap, and not merely brushed over the edge of the seam without allowing the acid to penetrate. The seam is now tacked with solder shown at x. The seam is then soldered its entire length by placing the copper directly upon the seam and soldering from tack to tack, being careful always to let the solder cool before soldering from one tack to another. In placing the copper directly
upon the seam at c, Figure 158, the solder is drawn into the seam, as shown at a, Figure 159. Having applied the flux properly, the heated copper draws the solder into the seam, fusing the various metals and making a compact mass, shown at b. An improper way of placing the copper on the seam is shown at c; the soldering copper c, resting the edge of the seam, allows but little solder to sweat into the joint as shown at d, resulting in a poorly soldered seam.

When soldering a grooved seam on the inside of sheet metal articles, a mistake is often made by workman and students in placing the copper on the seam in the position shown at e, Figure 159. When placed in this position, the copper is held the wrong side of the seam, drawing the solder away from instead of into the seam. The copper should be held directly upon the seam, heating it thoroughly and drawing the solder into the joint.

**Soldering Vertical Seams.** - Upright seams in roof flashing, cornice gutters, and other work, whether lapped or locked, are more difficult to solder than flat seams. The ordinary lapped vertical seam is shown at a, Figure 157. When upright seams are to be soldered, no matter what metal is used, the soldering copper should be forged wedge shaped, being about ¾ inch wide and ¼ inch thick at the point when completed. The end and the topside only are tinned as shown by the shaded portion in b, Figure 157. When the end and the upper face only are tinned, the solder can easily be controlled when applied to the seam. If all four sides of the copper were tinned, much of the solder would run to the underside and away from the seam, and a result in a waste of time and material. When soldering vertical seams, the handle must be higher than the copper to allow the solder to flow forward until the required amount has been transferred to the seam and sweated to the joint. This is done by moving the copper to the right and the left on the seam, heating it thoroughly and drawing the solder into the seam, as shown at d, Figure 158.
Repair Work. – When soldering old work and repairing sheet metal articles the surface must be free from dirt or any substance, which will prevent the solder from adhering to the metal. The parts to be soldered must be perfectly bright by scraping or filing. Scraping is the best method and usually done by means of a knife blade or tinner’s scraper, shown in Figure 135. Regardless of what method is used, the surface must be cleaned and made perfectly bright or good soldering cannot be done. When soldering old tin ware, after the metal has been scraped, use chloride of zinc or “killed Acid” as a flux instead of rosin.

Soldering Bench Work. – When soldering flat seams, ornaments on cornice work, bottom seams of tinware, and other small work at the bench, the work is often discolored by the hot copper burning the bench underneath and leaving a dark spot on the surface of the metal. This can be overcome by using a piece of black sheet iron, thick glass or marble slab, upon which the work to be soldered can be placed. The glass or marble slab should be \( \frac{1}{2} \) to \( \frac{3}{4} \)-inch thick. It can be easily cleaned and also serves as a level plate while soldering.
Equipment

Good equipment for soldering is shown above. This includes a gas furnace, acid cup, jar for dipping solution, small block of sal ammoniac, pointed soldering coppers and a marble slab 14 inches square by \(\frac{3}{4}\) inches thick. When soldering small articles, the solder should be applied to the copper, instead of directly to the work. A bar of solder is placed on the bench, one end being raised by resting it on the edge of the marble slab, or by placing some small tool under it. The end of the bar of solder is touched with the point of the copper, and if it has been properly tinned, a small portion of solder will melt and adhere to the copper, which is then applied to the parts being soldered.
Questions & Answers (Compiled By Bud Goodman 2003)

Here is a list of some question and answers from the compiled work above. Basically the same story, just a different way of looking at it.

1. **What are three of the most common types of soldering coppers?**
   - A. Square Point Soldering Copper
   - B. Roofing Coppers
   - C. Bottom Coppers

2. **What form of copper is universally used?**
   - A. Square Point Soldering Copper.

3. **What would you do to a new copper?**
   - A. New coppers would need to be properly tinned.

4. **Is the copper hammered cold?**
   - A. No. Solder coppers are forged to any desired shape by placing the copper in the furnace and heating it to a dark cherry color. Once the dross and scale is removed, the copper is then forged to the required shape on an anvil or block of iron by means of a heavy hammer.

5. **Why is the copper heated before hammering?**
   - A. Heating the copper anneals or softens the copper and may then easily be forged to the desired shape.

6. **What is annealing?**
   - A. To subject to great heat and then cooled slowly for the purpose to render it less brittle.
   - B. It is the repeated process of heating and hammering the material to produce the desired shape.

7. **Is the copper forged directly after heating?**
   - A. No.

8. **What must be removed from the copper before forging?**
   - A. First the copper is heated to remove any burnt tinning and pits known as dross and scale, and then it is reheated to a bright red and shaped on a heavy anvil or heavy iron plate with a large hammer.

9. **Why is this important?**
   - A. If this is not done, dirt will be forged into the copper and eventually split it.

10. **What is the method used for removing the dross and the scale?**
    - A. Dross and scale is removed by means of a course file.
11. What is the technical term for dross?
   A. The scum formed by oxidation at the surface of molten metals.

12. Can a copper be tinned without removing the dross?
   A. NO! A copper cannot be tinned unless first made absolutely clean and free from oxide. Which is the technical name for dross.

13. Does forging the copper place it in immediate condition for use?
   A. No

14. What would you do to a copper after forging?
   A. Allow the copper to cool out after forging

15. Why is the head of a soldering iron always made of copper?
   A. Although many call it a soldering “iron”, the head or bit, as some know it by, is always made of copper. Two main and very essential qualities are that the head has the capacity to hold the heat need for the particular work to be done and that it has the ability to rapidly transfer heat to the job when it comes in contact with the other metal.

16. What operation frees the copper from dirt or oxide?
   A. Tinning the copper

17. On how many sides and how high from the point should the pointed copper be filed for tinning?
   A. When tinning pointed coppers, they should be heated, then filed bright on four sides, not higher than about ¾ inch from the point.

18. What temperature of heat must be attained for tinning the copper?
   A. The temperature must be hot enough to melt the solder.

19. How would you go about tinning a copper with sal ammoniac?
   A. The point of the copper is rubbed lightly on a small block of sal ammoniac, which cleans the surface. A small portion of solder is now melted upon the sal ammoniac and by lightly rubbing the copper back and forth upon the solder and sal ammoniac; it will be tinned and ready for use.

20. Can a copper be tinned other than using sal ammoniac?
   A. Yes, A copper can be tinned with rosin.
21. How would you tin a copper with rosin?
   A. This is usually done by placing a piece of solder and some rosin upon a board or soft brick. The copper is filed in the usual manner, and then heated just hot enough to melt the solder. It is next taken and rubbed on the solder and rosin until the solder adheres to the copper.

22. When would this method of tinning a copper with rosin be used?
   A. This method of tinning is generally used when soldering tin and if rosin is being used as a flux.

23. What is chloride of zinc?
   A. Chloride of zinc, or “killed Acid,” is used as a flux.

24. What materials would it solder well?
   A. Clean galvanized iron, copper, and brass.

25. Would you use an iron dish as a satisfactory container for mixing acid solutions?
   A. No. Iron dish should never be used.

26. What is the best kind of jar to use?
   A. Use a clean glass jar as used for canning fruit. A one to two-quart Mason jar is satisfactory.

27. What are the important safety precautions to exercise in mixing and using acid solutions?
   A. Place the jar in a dish as a safety precaution in the event that the jar should crack during the process of mixing the solution.
   B. Wear safety glasses at all time when mixing solutions.
   C. Wear a good pair of sung gloves to avoid contact with acid and skin.
   D. Avoid fumes.

28. Is water or acid poured in the jar first?
   A. Acid. Never put water in the jar first and pour in the acid afterwards.

29. What will happen if water is poured in the jar before the acid?
   A. Very strong acid coming in contact with water is liable to cause action.

30. What is used for stirring the solution?
   A. Stir the solution with a piece of zinc or wooden stick.

31. What is meant by “Killed” or “Cut” Acid?
   A. You can prepare your own flux by “cutting” zinc in muriatic acid?
32. How is the “cutting” process done?
   A. This is done by putting pieces of zinc into a bottle of muriatic acid until
      the acid stops boiling and the bubbles cease to rise.

33. What is muriatic acid?
   A. Muriatic acid is the commercial name for hydrochloric acid and is often
      used in its raw state as a flux for soldering galvanized iron and zinc.

34. In cutting the muriatic acid would you drop a large piece if zinc in the acid?
   A. No.

35. What would happen if the zinc is not dropped into the solution in small
   pieces?
   A. Small pieces are added piece by piece to avoid sudden boiling and to
      prevent overflowing.

36. How long should the zinc remain in the solution?
   A. Allow zinc to remain in the solution until no further sign of any action
      between the zinc and acid is evident.

37. If a flux is made to strong, what action does it have on the working tools?
   A. To strong of flux will do harm to the work and to the soldering tools.
      Whatever flux is employed should be diluted with water to the weakest
      condition for the work on hand.

38. On what materials is rosin used as a flux?
   A. When the material is tin plate, bright copper or lead, the rosin is used as a
      flux.

39. When is muriatic acid in its raw state better?
   A. Muriatic acid is often used in its raw state as a flux for soldering
      galvanized iron and zinc.

40. On what materials is borax used for soldering?
   A. Brass

41. Soldering vertical seams called?
   A. Upright soldering

42. What precaution is used soldering from one tack to another?
   A. Being careful to allow the solder to cool before soldering from one tack to
      another.
43. How is solder applied to the seam?
   A. When soldering vertical seams, the handle must be higher than the copper to allow the solder to flow forward until the required amount has been transferred to the seam and sweated into the joint. This is done by moving the copper to the right and to the left on the seam, heating it thoroughly and drawing the solder into the seam.

44. What is the position of the soldering copper when soldering flat-lock seams?
   A. The copper should be directly upon the seam.

45. How is solder applied to grooved seams on the inside of sheet metal articles?
   A. When soldering a grooved seam on the inside of sheet metal articles, the copper should be held directly upon the seam as in fig 159.

46. If the soldering copper requires retinning, how is it done?
   A. When tinning pointed coppers, they should be heated, then filed bright on four sides, not higher than about ¾ inch from the point. This gives it a bright smooth surface ready for tinning. The coppers are again placed in the furnace and heated sufficiently to melt solder. The point of the copper is then rubbed lightly on a small block of sal ammoniac, which cleans the surface. A small portion of solder is now melted upon the sal ammoniac and by lightly rubbing the copper back and forth upon the solder and sal ammoniac, it will become tinned and ready to use.

47. With want fluid are seams brushed before applying solder?
   A. Brush the seams with soldering fluid; Fluxes, diluted acid.

48. How would you brush a seam and what would you brush it with?
   A. Care must be taken that the flux is allowed to enter the whole width of the seam and not merely brushed over the edge of the seam without allowing the acid to penetrate.

49. What necessary equipment should be on the bench?
   A. Gas furnace, acid cup, jar for dipping solution, small block of sal ammoniac, pointed solder coppers, and a marble slab 14 inches square by ¾ inch thick.

50. What is the marble slab used for?
   A. When soldering flat seams, ornaments on cornice work, bottom seams of tinware, and other small work on the bench, the work is often discolored by the hot copper burning the bench underneath and leaving a dark spot on the surface of the metal. This can be overcome by using a marble slab, upon which the work to be soldered can be placed.
51. Can any other material be used for the same purpose of isolating the work from the bench?
   A. Yes, you can use a piece of black sheet iron or thick pieces of glass.

52. What position are acids and dipping solutions supposed to have on the bench?
   A. Keep the acid and dipping solutions from in under your nose.

53. What is the difference between dipping solution and soldering fluid?
   A. A flux (soldering fluid) must be used to prevent oxidation while the soldering operation is going on; this is brushed on the seams allowing the acid to penetrate the seam. Whereas the dipping solution is also an acid which once the soldering copper is taken from the furnace, it must quickly dipped into this dipping solution to facilitate soldering and making the tinned surface bright and clean.

54. What is the dipping solution used for?
   A. The point of the heated copper when taken from the furnace is dipped quickly into this solution. This facilitates the soldering operation by making the tinned surface bright and clean.

55. What is another name for soldering fluid?
   A. Flux.

56. What are 4 important principles to be remembered by one who attempts to solder?
   1. The soldering copper must be kept clean and well tinned.
   2. A good soldering flux must be used, and one which is suited to the metal.
   3. The metals to be soldered must be cleaned.
   4. The joint to be soldered must be heated above the melting point of the solder.

57. How would you mix a dipping solution?
   A. Using an earthen fruit jar, mix a solution composed of ½ powered sal ammoniac and one quart of water. After the sal ammoniac has been dissolved the solution is ready for use.

58. What would you do with a soldering copper directly after heating and before soldering?
   A. Tin the soldering copper.
59. What operation is used in soldering practice for keeping the tinned surface of the soldering copper bright and clean?
   A. Once tinned, the coppers are again heated sufficiently to melt solder, and the point of the copper is then rubbed lightly on a small block of sal ammoniac, which cleans the surface. A small portion of solder is now melted upon the sal ammoniac and by lightly rubbing the copper back and forth upon the solder and sal ammoniac; it will become tinned and ready for use again.

60. What is a swab?
   A. A tool for brushing seams with flux.

61. If you had to make your own swab, how would you make it?
   A. With bright tin and cow tail. Never us copper!

62. What is the definition of soldering?
   A. Means of joining, uniting or welding together pieces of metal with fusible alloys of tin and lead.

63. How many common flukes can you name?
   A. Rosen, is used as a flux for soldering tin plate
   B. Chloride of zinc (killed acid) is made by cutting zinc with muriatic acid, used generally for soldering clean galvanized iron, zinc, copper and brass.
   C. Raw Muriatic acid, also called hydrochloric acid, is used in its raw state diluted with water or zinc and also for galvanized iron.
   D. Borax, in powered or dissolved form is used for brass.

64. What kind of seam is shown in fig.157 (a)?
   A. Vertical Seam (one of the more difficult seams to solder)

65. What kind of soldering copper is used for soldering vertical seams?
   A. Bottom copper.

66. What are the forging dimensions of the bottom copper?
   A. The bottom copper is forged to a wedge shape, being about ¾ inch wide and ¼ thick at the point when completed.

67. How would you tin a bottom copper?
   A. The end and topside only are tinned.

68. Why? (To question 67)
   A. When the end and the upper face only are tinned, the solder can be easily controlled when applied to the seam. If all four sides of the copper were tinned, much of the solder would run to the under side and away from the seam.
69. When soldering vertical seams, how is the handle held in relation to the copper?
   A. The handle must be held higher than the copper to allow the solder to flow forward until the required amount has been transferred to the seam and sweated into the joint.

70. What is the movement of the copper on the seam?
   A. When soldering vertical seams you would move the copper back and forth from right to left.

71. In what work is vertical seam more often used?
   A. Roof flashings and cornice gutters.

72. Will solder adhere to unclean surfaces?
   A. No. Good soldering cannot be done before the surface is clean and made free from dirt and other substances.

73. How are the surfaces of old work prepared for soldering?
   A. When soldering old work and repairing sheet metal articles, the surface must be free from dirt or any substance which will prevent the solder from adhering to the metal.

74. What is a good flux for old work?
   A. Use Chloride of zinc or “killed acid.”

75. Can rosin be used for flux on tinware?
   A. Use Chloride of zinc or “killed acid” as a flux instead of rosin.

76. What is the best flux for old tinware?
   A. When soldering old tinwork, after the metal has been scraped, use chloride of zinc or “killed acid” as a flux, instead of rosin.

77. Can the surface of old work be scraped clean with any other tool besides the scraper?
   A. Yes. Files. Besides a tinner’s scraper, many times knives are used.

Let us help you answer your questions on Soldering. Write them down (please print) and send them to the address below. We’ll post them on our website in search for your answer.

Questions and Answers
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