

RESTORATION TOPICS

Soldering Litz and Tinsel Wire

COMPILED BY RAY BINTLIFF FROM RESPONSES OF:
Charles Ahr, Alan W. Dodge, Dick Mackiewicz and Dennis J. Winkelsas

The following article is a compilation of responses to William Ross' letter, which appeared in the November 1992 issue of *A.R.C.* Ross asked how to solder litz wire such as is found on older headphones, speakers, etc. (Editor)

The types of wire most commonly found in old radios have solid or stranded conductors. These conductors may be bare or covered with insulation. Insulating materials include enamel, fabrics (such as cotton, acetate and silk), and rubber. Some types of wire use these insulating materials in combination. For these wires, stripping the insulation and soldering are fairly simple operations. However, litz and tinsel wire are much more difficult to prepare and solder. Litz and tinsel are special purpose wires that have unique properties. Litz wire exhibits low losses at radio frequencies. Tinsel wire is very flexible and resists breakage.

WHAT IS LITZ WIRE?

Litz wire (an abbreviation of the German word "litzendraht") is composed of a number of fine wires or strands, each separately insulated and woven together so that each strand of wire successively takes up all possible positions in the cross section of the wire. Number 44 AWG is a typical individual wire size. This very small wire size can make working with litz wire very difficult. Litz wire usually consists of 3, 5, 7 or 9 individual insulated wires.

Figure 1 provides an example of litz wire composed of three enamel-covered conductors. These individual wires are spiral-wrapped and covered with cotton insulation.

At radio frequencies, electrical currents tend to flow most readily on the outer diameter of a conductor. This characteristic is known as the "skin effect," and it results in a higher electrical

The advice provided by the letter writers inspired Ray Bintliff to try soldering a rather decrepit headphone tinsel cord to a phone tip. The results were successful, and a satisfactory solder joint was obtained even though the tinsel conductors were corroded. During the tinning process, he found it necessary to apply solder to the wrapped tinsel wire until much of the cotton core was burned away.

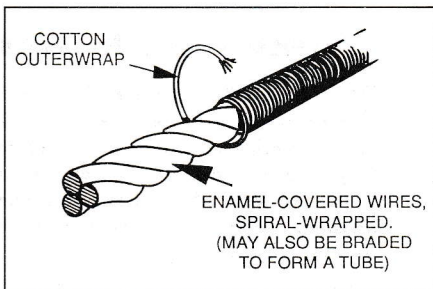


Figure 1. Greatly enlarged view of a length of Litz wire.

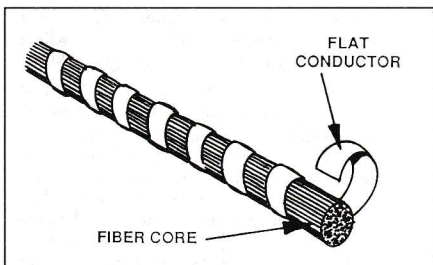


Figure 2. Greatly enlarged view of one of the many individual strands that make up tinsel wire.

resistance which can cause undesirable losses in a wire or a coil. Litz wire overcomes these losses by using a number of conductors which are insulated from each other, producing a larger effective wire size. Litz wire is most useful in the 300 kHz to 3 MHz frequency range and is usually employed in IF and RF coils.

SOLDERING LITZ WIRE

Because of small wire size, preparing and soldering litz wire can be challenging. The insulation can be removed by separating it from the conductors and cutting it off. But a simpler method was used by the old timers. They dipped the end of the Litz wire to be soldered into alcohol, and then set it aflame. After the cotton insulation was burned away and the flame extinguished, the end

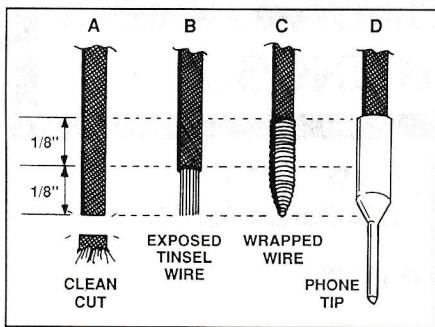


Figure 3. Preparation of tinsel wire for soldering.

of the wire was again dipped in alcohol, wiped clean and then tinned. After the insulation is removed, the conductors should be wrapped together and soldered. The same technique may also work on tinsel wire.

WHAT IS TINSEL WIRE?

As its name implies, an individual strand of tinsel wire is composed of a flat ribbon-shaped conductor which is wrapped in spiral fashion around a fibre thread commonly made of cotton. The conductor, as shown in Figure 2, is usually made of copper or bronze. The finished wire consists of a number of strands which are twisted together, just like stranded hookup wire, and covered with insulation. Again, cotton is the typical outside insulating material.

The use of fourteen strands is common in tinsel wire. Unlike litz wire, the individual strands of tinsel wire are not insulated from each other. The thread, or core material, in combination with the spiral-wrapped conductor produces a very flexible wire. Tinsel wire is used widely in headphone and speaker cords because of its flexibility and ability to withstand bending, kinking and twisting.

FITTING PHONE TIPS AND TERMINAL LUGS TO TINSEL WIRE

As with litz wire, working with tinsel wire can also be challenging. The combination of a flexible fiber core and the wire configuration can make repairs very difficult. Soldering is a particularly difficult operation. However, the procedures described below will simplify the soldering process and produce dependable connections to tinsel wire.

As shown in Figure 3A, the initial step is to cut a small length from the end of the tinsel wire so that you have a clean square cut at the wire's end. Then pull back the outer insulation to expose about $\frac{1}{8}$ inch of tinsel wire as shown in Figure 3B. Then wrap a 6-inch length of small-

CAUTION: Excess solder may be squeezed out when the wire is inserted in the phone tip, and precautions should be taken to avoid burns from hot solder splashes.

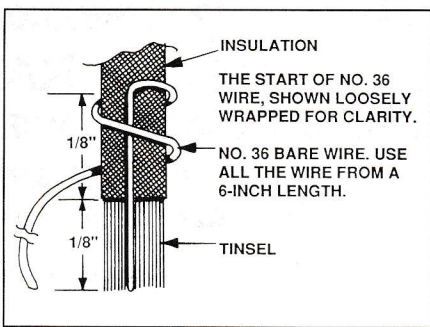


Figure 4. Enlarged view showing bare wire wrapped around the tinsel wire.

diameter copper wire (tinned wire is preferred) around the tinsel wire as depicted in the enlarged view of Figure 4.

The writers recommended wire sizes that ranged from numbers 28 to 36. The exact wire size is not critical, and any wire size that falls within the recommended range may be used. Whatever wire size is used, it should be close-wound, as depicted in Figure 3C.

Start by winding the small-diameter wire around the outer insulation and then down to the end of the tinsel. If a suitable small-diameter wire is not available, a single strand may be removed from some stranded hookup wire or test lead wire. The finished wrapped wire, shown in Figure 3C, is then tinned using rosin core solder and a low-wattage soldering iron. Excessive heat should be avoided; otherwise, the relatively fragile tinsel wire may be damaged.

Next, clamp the phone tip securely in a vise. Since the metal jaws of a vise will conduct heat from the phone tip and make soldering more difficult, it is a good idea to insert wooden blocks between the jaws of the vise and the phone tip. Apply heat to the side of the phone tip and fill the hollow portion of the tip with solder. With a soldering iron placed on the side of the phone tip, insert the tinned wire into the phone tip, and allow sufficient time for a good solder joint to be formed. Next, the soldering iron should be removed and the joint allowed to cool. Most likely, rosin flux will accumulate on the phone tip when the tinsel wire is soldered to it. The flux can be removed easily with isopropyl alcohol after the phone tip cools. The finished phone tip appears as Figure 3D.

Connecting tinsel wire to a crimp lug is similar to the procedure for attaching a phone tip except that the wrapped and tinned tinsel wire is crimped to the lug rather than soldered to the phone tip.

Most of the writers offered the recommendation that you should first practice on some scraps of litz and tinsel wire before attempting soldering on a collectible radio or accessory. With a little practice, you should be able to make repairs with confidence.

(Ray Bintliff, 2 Powder Horn Ln., Acton, MA 01720)