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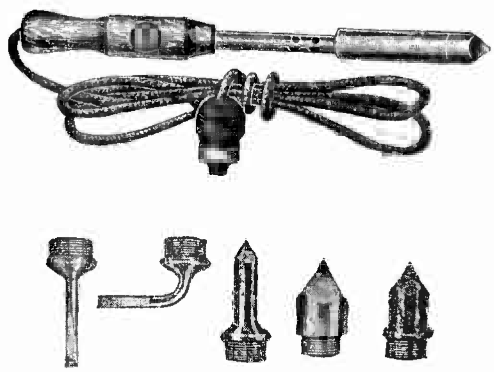

Electric Soldering Iron
With Changeable Tips

SOLDERING

ITS IMPORTANCE IN CIRCUIT WIRING

Vol.36#12 Dewey Classification R360

Some Standard Soldering Products
in Common Use

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SOLDERING

Its Importance in Circuit Wiring

The present day receiver is a highly developed, quality instrument in performance. However it is natural that some of its parts should fail to function under abnormal load conditions or abuse. The service technicians job is to locate these defective parts by test. The next step is to disconnect that part from the circuit and replace it with a new one. In many instances it is even necessary to disconnect some parts such as condensers and R.F. or audio transformers from the circuit in order to be able to subject them to a test individually. The parts of modern radio apparatus are in almost all cases connected together by means of wires which are soldered to the terminals of the respective parts. Hence every time we wish to remove some piece of apparatus from a radio receiver's circuits it is necessary that the wires connecting it to the other circuit parts be unsoldered.

Purpose of Using Solder. The repair of any radio receiver usually entails the making of a number of soldered connections, and it is essential that the radio service man should know how to solder the connections correctly, because the many connections in the wiring of a radio receiver must be so treated in order to eliminate losses arising from high-resistance joints. It is recommended that, after carefully studying this subject, you put into practice the instructions contained herein. An hour or so spent with a simple soldering kit and a few scraps of copper wire should enable you to acquire the knack of making a neat, well-soldered joint. Any joint in the wiring of a receiver, in order to be good, must possess low electrical resistance and high mechanical strength.

If the surfaces of two copper wires are scraped until clean and bright and then firmly twisted together, the joint thus formed will possess good mechanical strength and low electrical resistance when first made. But with the lapse of time, inevitable vibration of the wires will tend to loosen the joint and this undesirable loosening will be further aggravated by expansion and contraction of the metal with temperature changes. Furthermore, due to the action which the oxygen in the atmosphere has upon the metal, oxidization of the surface of the metal will take place and eventually this oxidation will penetrate to every crack and cranny of the joint. As the oxides thus formed are very poor conductors of electricity, it can be readily appreciated that the result will be troublesome. This oxidization of the metal takes place slowly, but as this action progresses, inevitably the resistance of the joint becomes higher and higher until its resistance in extreme cases may become of such a value as to be nearly non-conductive.

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Noisy and fluctuating reception volume is often due to poor joints. The amount of energy received by the antenna in the first place is very small and must be conserved to the greatest extent possible. There should be no waste of an appreciable amount of this energy which would be the result if it traversed high-resistance joints.

Solder, therefore, is applied to each and every joint in the wiring of a receiver for the purpose of enhancing the mechanical strength of the joints and to preserve their initial low resistance.

Although solder (an alloy of tin and lead) has greater resistance than copper, it is possible in the practical application to so form the joints that they will possess very low resistance. To accomplish this it is necessary to make joints, splices, and connections so that they will be mechanically secure and electrically conductive without the use of solder. Solder is then applied to preserve the stability of such joints both mechanically and electrically.

Action of Heat Applied to a Joint to be Soldered and Use of Soldering Flux. When soldering a connection it is necessary to heat the joint to a temperature at which the solder will melt and flow freely, and for this purpose the soldering iron is used. However, heated metal oxidizes rapidly and to prevent such oxidization, and to dissolve such oxides when they do form, a fluxing agent is applied to the joint to be soldered.

There are a number of fluxes available and the choice of the proper flux is of prime importance. The flux to be used in radio receivers, or in any delicate electrical work, must be both non-corrosive and non-conductive. Should corrosive flux be used, joints made by its use will eventually possess high-resistance due to such corrosion. Therefore, never use an acid flux.

Of all the fluxes available rosin flux and "Nokorode", or equivalent, are the best for radio use. Each has its advantages and disadvantages, as set forth below, and as the methods of application differ slightly the use of each will be taken up separately.

Nokorode is the easier of the two to handle and its use enables one to easily and quickly make well-soldered connections. However, although it is non-corrosive, Nokorode, or equivalent, possesses the disadvantage of being partially conductive and this point should be borne in mind when using it about a radio receiver. Moreover, it creeps rapidly when melted by the heat of the soldering iron, and should it run between two or more terminals in the receiver it would create a leakage path between such terminals. Even a very thin film of this flux, so slight as to be scarcely noticeable, permits the possibility of current leakage with consequent detrimental effects upon the efficiency of the receiver. Also, as this flux is made in the form of a grease-like paste, it readily collects dust, which, when occurring between two terminals, does not add to the efficiency of the receiver. It is permissible to use Nokorode, or equivalent, on joints where there is no possibility of its creeping and forming a more or less high resistance leak between different portions of the circuit. If it should creep between terminals or conductors placed in close proximity to one another, it must be wiped off carefully with a clean cloth, preferably a cloth dipped in alcohol.

Rosin Flux and so-called "Rosin Joint". Rosin flux, although it is more difficult to handle than Nokorode, or equivalent, is the best flux for all soldering operations about a radio receiver. It is both non-corrosive and non-conductive; as a matter of fact, the insulating qualities of rosin are excellent. Hence, if residual rosin is allowed to remain between two or more terminals or conductors, no harm is done and when it hardens it presents a smooth, glazed surface which does not readily collect dust.

Because of the fact that rosin will not introduce leakage between circuits, as the case with paste flux, it is used almost exclusively today in the manufacture of radio receivers.

On the other hand, rosin flux improperly used is quite apt to result in what is termed a "rosin joint". The creation of a rosin joint is to be avoided, for the resistance of such a joint may be easily so high as to constitute an open circuit. However, by exercising reasonable care in applying the rosin flux, such joints will not occur.

The Soldering Iron is made with a Copper Tip and Should not be Allowed to Overheat. The soldering iron consists of an insulated handle, an enclosed heater resistance unit and a copper tip. There are many electric irons on the market at very low prices, but the purchase of such irons is not recommended. These cheap irons invariably are poorly made, with the result that they either draw an excessive amount of current, furnish an insufficient amount of heat, or fail to stand up under continued usage; i.e., the heating unit burns out, thus rendering the iron useless. It is economical to pay more in the first place for a well made iron. Such irons are not expensive.

The proper degree of heat of an electric soldering iron is predetermined by the design of its enclosed heating unit and will always be right when used on an electric lighting circuit of correct voltage. Thus, the user is saved the inconvenience of having to heat the iron repeatedly, as is the case when electricity is not available and a plain iron must be used. Plain irons, although they cost less than the electric variety, must be heated with a blow-torch or in a gas flame. If the iron is heated in a gas flame, care must be exercised to keep it cleaned of the soot that will be deposited upon it. The proper degree of heat of any soldering iron is that at which it will melt the solder as soon as it is applied. In an electric iron the correct soldering temperature is automatically provided for by the design of the heating element. Electric soldering irons are made in various sizes, and are rated according to their electrical power consumption. Standard sizes range from those consuming as little as 15 watts to those consuming 300 to 400 watts.

The choice of a soldering iron for radio receiver work, since there are so many sizes to choose from, should be determined by the following considerations:

The iron should be efficient in design, that is: For the electrical power consumed a large percentage of the heat developed in the heating unit should be conducted directly to the tip, and should not be radiated by the heating unit to where it does no useful work.

The iron should not be too hot. Irons with a high power consumption are usually large, having very large tips (sometimes as much as several inches in diameter). These are designed for heating and soldering very large pieces of metal. In radio receiver and amplifier tube circuits it is only necessary that an iron be able to heat joints between wires very seldom larger than #14 in size. If an iron of very high wattage rating is used for such small work its tip will become excessively hot and as a result will become badly oxidized. This oxide acts as a heat insulator preventing the conduction of heat from the tip of the iron to the metals to be soldered and to the solder. Such an iron would have to have its tip continually scraped free from oxide in order to be able to use it.

When heating a soldering iron with a blow-torch or gas flame, be careful not to overheat the iron, and under no circumstances allow it to become red hot. The proper degree of heat is indicated by the appearance of a green flame about the iron.

The iron should be no larger than is necessary and should be of a size with a tip surface large enough and a heating element large enough to maintain the tip at a temperature slightly above that at which it will melt solder under continuous use.

The iron should be small in diameter, not more than ¾". This includes heating element as well as tip and should preferably be smaller in order that it be possible to get the iron into remote places where there is very little clearance between wiring and parts.

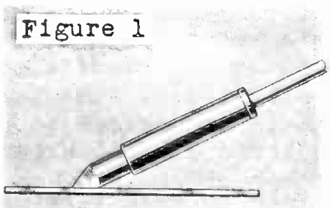


Figure 1

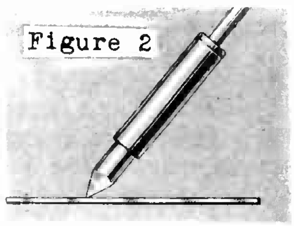
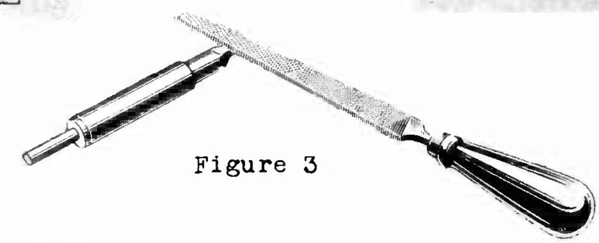


Figure 2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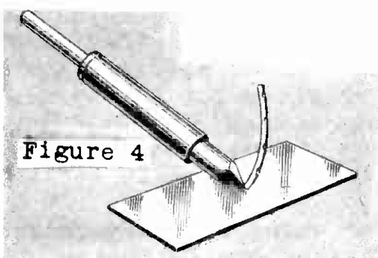
Figure 4

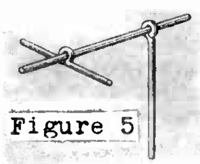
Figure 5

The iron if it has the above qualities will heat quickly and cool quickly (within 2 to 4 minutes). If the iron is of efficient design an iron of about 40 watts and not more than 60 watts rating, is sufficiently large enough for receiver circuit work. Inefficiently designed irons in order to meet the above requirements have a rating of from 75 to 100 watts.

When soldering wires larger than #14 and thin sheet metal and for heavier work irons having a rating of from 75 to 150 watts should be used because the smaller size irons would quickly cool to a temperature below that at which solder melts.

The point of the soldering iron should be properly shaped. Figure 1 illustrates a well shaped point. By the use of such a point, with its working surface held parallel to the work as shown, heat conduction from iron to joint is expedited, resulting in quick and efficient heating of the joint to proper temperature.

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Figure 2 shows a poorly shaped point. To hold the working surface of such a point parallel to the work will often necessitate an awkward positioning of the iron. Where the nature of the layout of the receiver will not permit of a correct positioning, only a limited part of the iron's working surface can be brought into contact with the work. Result: Slow and limited heating of the joint and consequent possibility of producing a poorly soldered connection.

How to tin the Soldering Iron and Preparation of Joint for Soldering. Before soldering can be accomplished properly the iron must be "tinned". To tin the iron it is first heated and the working surfaces filed until the copper shows clean and bright, Figure 3. Do not bear down heavily upon the file for it is only necessary to remove such dirt and oxide as may have collected upon the surface of the copper. A daub of flux is now placed upon the surface of a piece of clean, bright tin, the heated iron is applied thereto

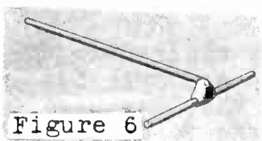
Figure 6

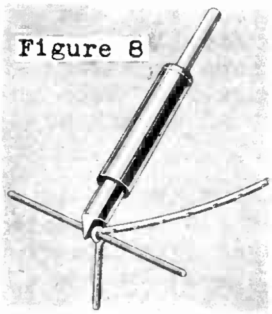
Figure 8

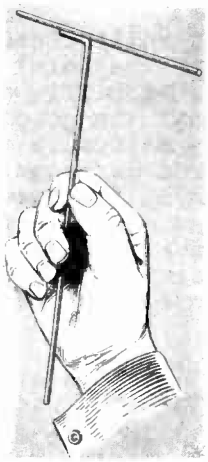
Figure 7

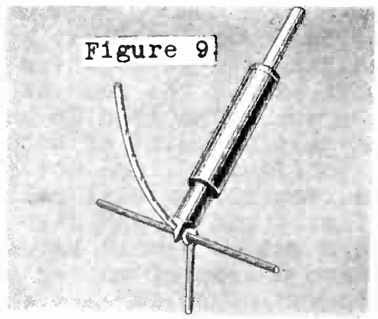
Figure 9

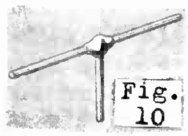
Fig. 10

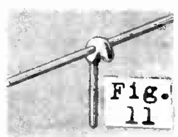
Fig. 11

and at the same time solder is melted by contact with the iron, Figure 4. The iron is now worked back and forth in this molten solder until its working surfaces are uniformly coated. The iron is now tinned and ready for use.

Soldering the Joint. Before a properly soldered connection can be made the surface of the wires must be scraped or sandpapered until clean and bright--THIS IS IMPORTANT. The joint is then made mechanically secure as shown in Figure 5. A loop is formed in the wire by means of a pair of long-nosed pliers. This loop is then slipped over the wire to which connection is to be made and pinched into place, resulting in a secure, self-supporting joint.

Compare the connections in Figure 5 with Figures 6 and 7 wherein are shown what are known as "abutted joints". The making of such joints should be avoided as they are insecure and very apt to possess poor electrical conductivity. To attempt to hold the wire of an abutted joint in position while soldering is certain to result in an unsatisfactory joint, for it is a physical impossibility to hold the wire absolutely steady for the length of time necessary for the solder to solidify. The slightest tremor of the hand at this critical stage will result in a fracture of the solder and, although this fracture may be so slight as to quite unnoticeable,

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it nevertheless detracts from the strength and conductivity of the joint. Another objection to the making of abutted joints arises from the necessity, often encountered, of making two or more connections close to one another. While soldering one connection the heat will be conducted by the metal to the other connection and should this other connection be an abutted one, it will promptly fall apart. Having made the joint mechanically secure, the next step is the application of the flux. Of the two fluxing agents already mentioned as being suitable for radio and other delicate electrical work, namely Nokorode, or equivalent, and rosin, we will consider the use of Nokorode first.

Nokorode, or equivalent, can be applied to the joint either before or after it has been heated, but to apply to the joint before it has been heated is perhaps preferable. Assuming that the service man is soldering a joint as shown in figure 5, Nokorode flux is first applied to the joint. This paste should be used very sparingly, only enough to cover the joint with a thin film. If an excess of this flux is used it will creep rapidly as it melts, and this is highly undesirable for reasons already stated.

The soldering iron, properly heated and well-tinned, is now applied to the joint, melting the paste which runs into the joint where it accomplishes its purpose; i.e., the removal of any slight film of oxide that may have formed thereon. The iron is held against the joint until the joint is heated to the melting point of solder. The solder is then applied to the joint, as shown in Figure 8, and not to the iron as shown in Figure 9. When properly done, the solder will melt as soon as it comes in contact with the joint and will run in and over the joint making a neat, workmanlike job. Only enough solder should be used to cover the joint, as shown in Figure 10; do not leave a lump of solder on the joint as shown in Figure 11. Such unsightly "gobs" of solder are wholly unnecessary and present an unworkmanlike appearance.

If any of the flux remains on the joint or adjacent insulation, which it usually does, it should be carefully wiped off with a clean cloth. Special care should be exercised in this respect in case the residual flux has crept between two or more wires or terminals. In any case, it is best to use a clean cloth that has been dipped in alcohol. The alcohol materially aids the thorough cleansing of the joint and adjacent insulation by dissolving the left-over flux.

Incidentally, the handiest and most practical forms of solder for radio use are ribbon and wire solder. Wire solder is made with a core of rosin flux, a very convenient arrangement, for by its use flux and solder are applied to the joint in one operation.

When using rosin-core solder a somewhat different procedure is in order insofar as the flux is applied to the joint after it has been heated. First, apply the iron to the joint until the joint is well heated; then apply the rosin-core solder. Be careful to apply the solder to the joint, as shown in Figure 8. The rosin flux in the core of the solder will at once melt and run upon the joint, fluxing it. The solder will also melt rapidly and follow the flux to the joint, resulting in a neat, well soldered connection.

Even as the use of Nokorode, or equivalent, has one pronounced disadvantage; namely, the likelihood of current leakage due to the presence of residual flux; so has rosin flux one pronounced disadvantage, and that is the possibility of producing a "rosin joint". A rosin joint is the result of burned rosin collecting on the joint and is due to the improper manipulation of the soldering iron and solder. The solder will often flow over such a joint giving the appearance of a well soldered connection, when, in reality, the burned rosin in the joint results in a high-resistance connection and in severe cases even an open circuit. To avoid the making of rosin joints the rosin-core solder must be applied to the heated joint, not to the iron. If the rosin-core solder is applied to the iron, as shown in Figure 9, a rosin joint will very likely be made for the following reason. The melted rosin flowing upon the iron will result in the active ingredients of the rosin flux literally "going up in smoke," while the useless burned residue will flow down onto the joint. As that active ingredient in the flux which accomplishes the proper fluxing of the joint has been evaporated by the heat of the iron, the burned rosin remaining is of no use as a fluxing agent and only serves to obstruct the soldering operation. Therefore, care should always be exercised in the use of rosin-core solder. When handled correctly, however, rosin-core solder is really excellent for radio use. If an iron is used which is of a temperature just slightly higher than that at which solder will melt, it will not burn the rosin and as a result the forming of rosin joints is avoided. You can therefore readily see that the selection of a soldering iron of the proper type and rating is important in order that high resistance joints be avoided and much waste time and money saved.

It is often necessary in the wiring of a radio receiver to carry the solder to the joint on the soldering iron. This is greatly facilitated by notching the iron with a file, as shown in Figure 12; this notch serves to hold a bubble of molten solder while the iron is brought to the joint. When a bubble of solder is brought into contact with the joint it will heat the joint very quickly and, provided the joint has been properly fluxed, the solder will flow readily to it.

Practical Application of Solder to Metal Units or Parts of Receiver, Wiring, Terminals, Lugs, etc. It is impossible to solder to nickel plated surfaces when using these fluxes permissible in radio work. Therefore, when solder-to an instrument or terminal which is nickel plated, it is necessary first to scrape the plating from that part of the instrument or terminal which is to be soldered until the base metal, usually brass, is exposed. Soldering is then accomplished in the usual manner.

It is always best to solder connections, but when soldering wires to certain apparatus it is sometimes necessary to modify this rule. When it is inadvisable to solder a connection directly to the binding post terminal of an instrument, the wire should be soldered to a connecting lug and this lug should be then clamped tightly beneath the nut of the binding post. Bear in mind, however, that such a connection does not constitute a soldered joint. The actual connection between lug and binding post terminal of the instrument is a mechanical one and every care should be exercised that it be not only good but permanent; i.e., the contact surfaces of lug and terminal should be scraped, or sandpapered, until clean and bright, and the lug then clamped tightly beneath the nut of the binding post.

Figure 13 illustrates a commonly used type of connecting lug. These lugs are usually made with a small hole in the shank and through this hole the wire is slipped and pinched securely into place by means of pliers. Solder is then applied to this joint to insure the preservation of its mechanical strength and electrical conductivity. If the lug has a small trough, as in B, Figure 13, the wire is clamped into place in this trough and solder then run into it.

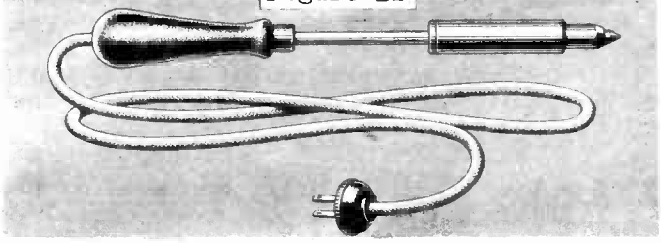
Instruments to which it may be inadvisable to solder directly are a. f. transformers, small fixed condensers, grid leaks, and fixed and variable high resistance units.

Many makes of audio-frequency transformers are equipped with binding post terminals, and it is not good policy to solder directly to these. Solder the wire to a lug and clamp the lug tightly beneath the binding post nut. The wires leading from the windings of the transformer are usually soldered to the shanks of the binding posts inside the casing.

An attempt to solder directly to such terminals will possibly cause the connections with the case to become unsoldered, resulting in an open-circuited transformer. However, many of the later types of audio-frequency transformers are provided with lug terminals. It is quite safe to solder to these as the manufacturer has anticipated, and provided against, the loosening of the interior connections during the soldering operation.

Some types of small fixed condensers are made with plates of flimsy tinfoil. Do not solder connections directly to such condensers, as the heat of the iron is likely to damage the plates. Connection should be made by slipping a small (8/32) brass machine screw through the hole usually provided for such a purpose and clamping a lug, to which the connecting wire has been soldered, beneath the nut of the machine screw. However, connections may be soldered,

Figure 12



without fear of damage to those types of condensers having plates of sturdy copper foil, or thin strip brass, and solidly moulded in a protective casing of bakelite.

Grid leaks and other tubular high resistance units are almost invariably mounted by slipping them between two metal clips which serve to hold them firmly in place and make contact with their terminals. As a rule, the amount of heat necessary to solder connections to grid leaks and tubular high resistance units will damage the resistance thereof or will loosen, or entirely detach, the small metal end-caps which serve as the terminal of such devices.

When the grid leak or high resistance unit is a solid rod or such material as carborundum or graphite, or if it is a resistance unit of wire, it is not safe to make soldered connections to such devices unless the manufacturer specifically states that soldering will not damage his product. Instead, make a firm, secure, mechanical connection by means of the terminal provided for this purpose.

A method of splicing comparatively coarse wires, such as are used for the antenna, lead-in and ground wires, is shown in Figure 14. The wires are twisted once, as shown at point A, then bound tightly one about the other, as shown at points B and C. A slight space is left between these adjacent turns of the wire to allow the flux and solder to penetrate to the innermost crevices of the joint.

The foregoing instruction upon soldering may be summarized in a few simple rules, as follows:

1. The joint to be soldered must be clean, mechanically secure and electrically conductive.
2. The soldering iron must be clean, well tinned and heated to the proper temperature. (Use an electric iron, it is by far the best.)
3. Never use an acid flux.
4. Use the right flux, such as Nokorode, or equivalent, or rosin, and use it sparingly, keeping in mind the limitations of each.
5. Flow just enough solder on the joint to cover it.
6. If a paste flux such as Nokorode, or equivalent, is used, wipe away the residual flux with a clean cloth, preferably a cloth dipped in alcohol. Preferably use rosin core solder.

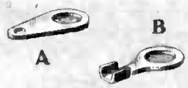


Figure 13

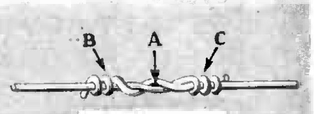


Figure 14

EXAMINATION QUESTIONS

1. What are the primary requirements of a good joint?

2. What is meant by "tinning" the iron?

3. State briefly the advantages and disadvantages of:-
   (a) paste fluxes.
   (b) rosin fluxes.

4. Why is solder used in making joints?

5. What precautions should be observed when using paste flux?

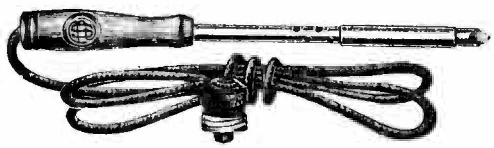
6. What is an abutted joint? Is the making of abutted joints considered good practice?

7. How much solder is necessary to make a good joint?

8. What precautions should be observed when using rosin flux?

9. What happens when a joint is left unsoldered?

10. Is the use of acid flux permissible in radio work? State why.



Electric Soldering Iron