STANDARD OVERHAUL PRACTICES MANUAL

SOLDERING ELECTRICAL CONNECTIONS

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STANDARD OVERHAUL PRACTICES MANUAL

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To: All holders of SOLDERING ELECTRICAL CONNECTIONS 20-12-01.

Attached is the current revision to this STANDARD OVERHAUL PRACTICES MANUAL

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All revisions to this manual will be accompanied by transmittal sheet bearing the revision number. Enter the revision number in numerical order, together with the revision date, the date filed and the initials of the person filing.

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INTRODUCTION

1. General

A. The instructions in this manual tell how to do standard shop procedures during maintenance functions from simple checks and replacement to complete shop-type repair.

B. This manual is divided into separate sections:

(1) Title Page

(2) Transmittal Letter

(3) Highlights

(4) Effective Pages

(5) Contents

(6) Revision Record

(7) Record of Temporary Revisions

(8) Introduction

(9) Procedures

C. Refer to SOPM 20-00-00 for a definition of standard industry practices, vendor names and addresses, and an explanation of the True Position Dimensioning symbols used.

D. The data is general. It is not about all situations or specific installations. Use it as a guide to help you write minimum standards.

E. If the component overhaul instructions are different from the data in this subject, use the component overhaul instructions.

SOLDERING ELECTRICAL CONNECTIONS

1. INTRODUCTION

A. The data in this subject comes from Boeing Process Specifications BAC5242 (which supersedes BAC5044), BAC5065 (which supersedes BAC5046) and BAC5155. The airline has a copy of the Boeing Process Specification Manual.

B. The data is general. It is not about all situations or specific installations. Use this data as a guide to help you write minimum standards.

C. For soldering of surface mounted devices refer to SOPM 20-11-07.

D. Refer to SOPM 20-00-00 for a list of all the vendor names and addresses.

2. MATERIALS

NOTE: Specifications QQ-S-571 and MIL-F-14256 are now cancelled. Replacement specifications are not yet identified in BAC5242.

A. Solder alloys per QQ-S-571

(1) Tin/lead wire form with rosin flux – SN60WRP2 or 3, SN63WRP2 or 3

(2) Tin/lead wire form with mildly activated flux – SN60WRMAP2or 3, SN63WRMAP2 or 3

(3) Tin/silver wire form with mildly activated flux – SN96WRMAP2 or 3

B. Flux, Rosin Base

(1) Non activated – MIL-F-14256, Type R, Kester 135, V14597

(2) Mildly activated – MIL-F-14256, Type RMA, Kester 197, V14597, or Almit RF-35-RMA

C. Solvents

(1) Isopropyl Alcohol – TT-I-735

D. Abrasives

(1) Aluminum oxide cloth

(2) Emery cloth or paper, wet or dry, 320-400 grit

(3) Scotch-Brite pads, Type A, Very Fine, V78381

E. Hand Lotions

(1) North 212 Skin Conditioner, V11392

(2) I.C. Lotion, V0KDZ6

F. Tools to Heat Shrink Solder Sleeves

(1) Infrared Heat Guns

(a) Raychem IR500 with RG-2 reflector or 993709 tubing reflector, V06090

(b) Raychem IR550 Mark II with RG-2 reflector, V06090

(c) Raychem IR1000 or IR1003 Zap Gun, V06090

(d) Boeing ST2021C or ST2021J hand model or ST2021D bench model

(2) Hot air heat guns

(a) Raychem AA-400, V06090

(b) Raychem CV-5300 with MG-1 reflector, V06090

(c) Raychem CV-5700 Mini Gun 3 with MG-7 reflector, V06090

G. Resistance Soldering Equipment – Contact (V07015) Model H-101-CD-T-103

3. GENERAL

A. Solder in a room that is as clean as Class 1,500,000 of BAC5703, with 66-84°F air temperature and a maximum relative humidity of 65%. If the relative humidity goes below 30%, use the procedures for electrostatic discharge sensitive (ESDS) control per BAC5485 (Ref SOPM 20-12-02). A BAC5703 Class 1,500,000 controlled area has these properties:

(1) Persons are permitted to eat, drink or smoke only in specified areas away from the work stations or airplane components.

(2) Work stations must be visually clean from a distance of 2-3 feet.

(3) The air pressure of the atmosphere inside must be kept higher than the areas outside.

(4) If shop coats are necessary, they must not be worn with the garment open or sleeves rolled-up to expose personal clothes.

(5) If finger cots or gloves are necessary, they must be removed when persons go out of the controlled area. Gloves must be replaced when visually dirty. Finger cots must be discarded after they are used.

B. Only the approved hand lotions can be used by soldering technicians during these procedures. Contamination from other hand lotions, perfumes and cosmetics, which could possibly not be seen during inspection, can cause hardware failure during environmental tests. Before you touch the hardware, wash all such materials from your hands and rinse with clean water. Then you can apply the approved hand lotions, if necessary.

C. White cotton or nylon gloves are recommended during soldering operations. Finger cots can be used if bare skin will not touch parts.

D. Keep the soldering tip tight in the heating element. Keep the tip clean and coated with a continuous layer of solder. A small amount of solder can be applied to the tip as necessary.

E. Soldering Iron Temperature Control – Usually, if the soldering iron is operated at the specified voltage, temperature control is not necessary. But if the iron is kept on at full heat a long time and not kept clean, oxides could occur on the tip and cause contamination and corrosion. This problem could be decreased if the temperature is decreased while the iron is not used, but you must make sure the iron is back at full heat before you start to solder again.

F. Preparation of Conductors and Terminals

(1) Remove a sufficient length of insulation from the wire to permit an inspection gap between the end of the insulation and the end of the solder on the bare conductor after the connection is soldered. As a minimum, the insulation must not be included in the solder. As a maximum, the gap must be the larger of 0.060 inch or 2 wire diameters (insulation included), but not that long that a short circuit with adjacent conductors could occur.

(2) Keep the wire stripper tools visually clean. Repair or replace tools that get mechanical damage.

(3) Some scraped wire strands are permitted if there is no bare metal. Bare metal is permitted on the cut ends of the wires. Broken strands are permitted, within the limits specified in BAC5044, unless the wire will be used at 6,000 volts or more.

(4) The insulation must not be burnt, frayed, split, punctured or crushed, when examined visually without magnification.

(5) Clean the wires, part leads and terminals (but not flatpacks) as necessary, to be sure the solder will make a good bond. Remove oxides, tarnish, and other contamination with rubber erasers, fiberglass rods, tinned copper shield braid, or abrasive material. Hold the part leads tightly between the body and the surface to be cleaned. Be careful not to bend or put stress on the joint between the wire and the body of the part. Then clean the surfaces with isopropyl alcohol.

(6) When you attach part leads to lugs or terminals or parts bonded to a circuit board, make a stress-relief bend in each lead. Only one of the two leads must be bent if the part will not be bonded, or not to be given a conformal coating. Hold the lead between the part body and the bend to prevent stress in the wire joint at the body. Start the bend no nearer than 0.03-inch from the part body.

4. SOLDERING

A. General

(1) Bend, install, or hold conductors and part leads to not let them move while the hot solder cools and becomes solid.

(2) If the component is identified as heat-sensitive, be sure to install a heat shunt between the body of the part and the location to be touched by the soldering iron tip (Figure 1). Heat shunts can also be used to give protection to insulation when you solder stranded conductors.

(3) Apply the soldering iron tip to the connection area to supply a maximum of heat to the metal surfaces to be soldered. But also make sure you give maximum protection to the parts that could be damaged by the heat.

(4) Wait until the metal surfaces get to the melting temperature of the solder. Then apply solder to the metal surfaces and let it flow into the joint. If possible, do not let the solder wire touch the soldering iron tip.

(5) On printed circuit boards, keep to a minimum the time and pressure of the soldering iron to prevent damage to the boards, adjacent components, insulation and parts. Do not apply the iron longer than 3 seconds.

(6) If a soldered joint must be heated again, let it cool approximately 30 seconds before you apply the heat again.

CAUTION: DO NOT VAPOR DEGREASE, PUT INTO SOLVENT, OR CLEAN WITH WATER UNSEALED COMPONENTS, ENCAPSULATED OR POTTED ASSEMBLIES OR UNSEALED ELECTROLYTIC CAPACITORS.

(7) Clean off the flux from the soldered areas and adjacent areas. For rosin flux (Type R) use isopropyl alcohol (BAC5225 Type 1, Class 1, 2, or 6). For activated flux (Type RMA), use isopropyl alcohol (BAC5225 Type 1, Class 1, 2, or 6) and then the Axarel 32/ECD batch washing system (BAC5225 Type 4, Class 1). Start to clean the areas within 1 hour, and complete the cleaning in 8 hours, after the solder is cool and solid.

B. Hand Tinning Procedure

(1) You can use a soldering iron or resistance soldering electrodes to apply heat. If you use the soldering iron, be sure to keep the tip clean and coated with a continuous layer of solder. If you use the electrodes, do not apply or remove them while the power is on.

(2) Heat shunts are necessary on all but connectors, wire, terminals, pins or contacts. Keep the jaw faces of the shunts clean of contamination and corrosion. Do not set the iron temperature higher then 700°F.

(3) Heat the area to be tinned. Then apply flux-cored solder to make a smooth, continuous shiny surface. Do not let the iron stay on the surface more than a total of 5 seconds during the operation.

(4) If necessary, you can do Paragraph 4.B.(3) again, but not more than two more times.

(5) Remove flux residues per Paragraph 4.A.(7) above.

C. Soldering to Terminals and Lugs

(1) The source data, such as BAC5043, BAC5242, BAC5065, tells how to make connections when the components are built at the factory. For overhaul operations, use the original configurations as a guide. Refer to SOPM 20-11-01 for instructions about how to bend and install the wires and component leads if you cannot tell how to make the connections from the original details. Some details are given in the steps below.

(2) Wrap the wires around the terminals a minimum of 180-degrees unless these are forked terminals or one wire goes through a series of terminals. Do not overlap wraps or wires.

(3) One continuous wire can be used to connect a series of connectors. At the first and last terminal, attach the wire to the terminal as if this was the only terminal. For the terminals in between, send the wire straight through, and make sure you solder the wire to a minimum of two surfaces of each of these terminals.

(4) For stress relief, make a bend in the leads of parts attached to or between terminals, as shown in SOPM 20-11-01. When you make the bend, be sure to hold the lead at a point between the part body and the location of the bend.

(5) If the distance between two terminals is 0.75-inch or less, you can use solid wire of the same size, as an alternative to stranded wire, but only if the specified wire size is 22-gage or thinner.

(6) If the terminal or connection will have more than one conductor attached, it is best to solder all of the conductors at the same time.

D. Soldering to Solder Cups (Figure 2)

NOTE: Resistance heating is preferred, but you can use a soldering iron with or without resistance heating equipment.

(1) Attach resistance electrodes to the outside surface of the solder cup near the bottom while the power to the electrodes is off.

(2) Energize the resistance electrodes, or use the soldering iron, to apply heat to the outside of the solder cup.

(3) When the cup becomes as hot as the melting point of the solder, melt a sufficient quantity of flux-cored solder in the cup to make a satisfactory fillet after the wires are installed, within the limits shown.

(4) Strip and cut the wire to let it fit into the cup to the bottom, as shown. Install the wire as shown. Make sure the melted solder fills the inspection hole, wets the complete circumference of the bottom of the cup interior, and does not overflow the hole. A thin layer on the outside surface of the cup is permitted.

(5) Remove the soldering iron, or turn off the power to the resistance electrodes. Do not remove the electrodes from the cup until the solder cools and becomes solid.

(6) Remove flux as necessary per Paragraph 4.A.(7).

(7) For good heat, keep the electrodes and ground connectors tight and clean. Clean the electrode tips as necessary with abrasive of 325-grit or finer and then wipe them with isopropyl alcohol.

E. Printed Circuit Boards

(1) Mechanically install the electronic parts on the board per SOPM 20-11-01 and the overhaul instructions. If the unit is identified as electrostatic discharge sensitive (ESDS), refer to SOPM 20-12-02 for special instructions.

(2) The soldered connection must not have a frosty, ridged, fluted or grainy finish, unless one or more of these conditions is applicable:

(a) The solder cooled slowly because the component was an unusually large mass of metal.

(b) The conductor was untinned gold.

(c) The joint was exposed to vapor phase reflow.

(d) The joint was made with high-temperature solder.

(3) Flux stains of solder surfaces on the component side of the circuit board are acceptable.

(4) These solder joint conditions are not acceptable:

(a) Cold solder joint

(b) Too much solder

(c) Flux residue

(d) Unwanted matter or contamination in the solder

(e) Broken solder joint

(f) Insufficient or no solder

(g) Rosin, not solder, makes the joint

(h) Voids

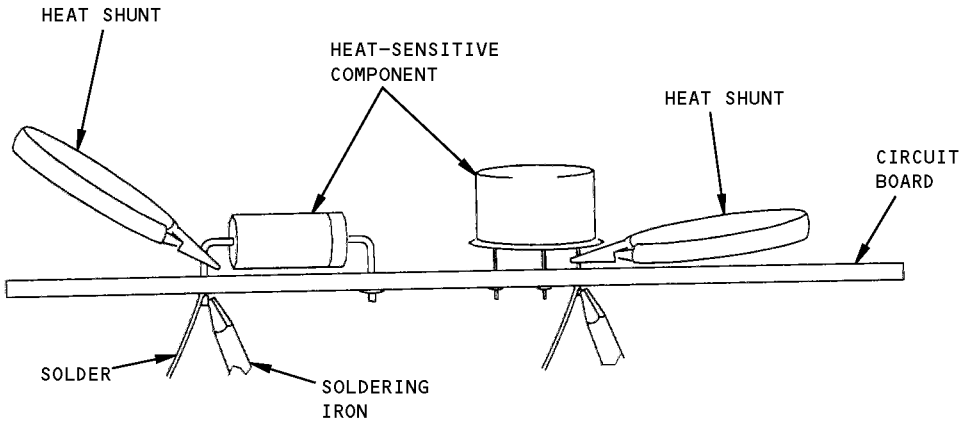
(i) Disturbed solder joint

(j) Too much heat

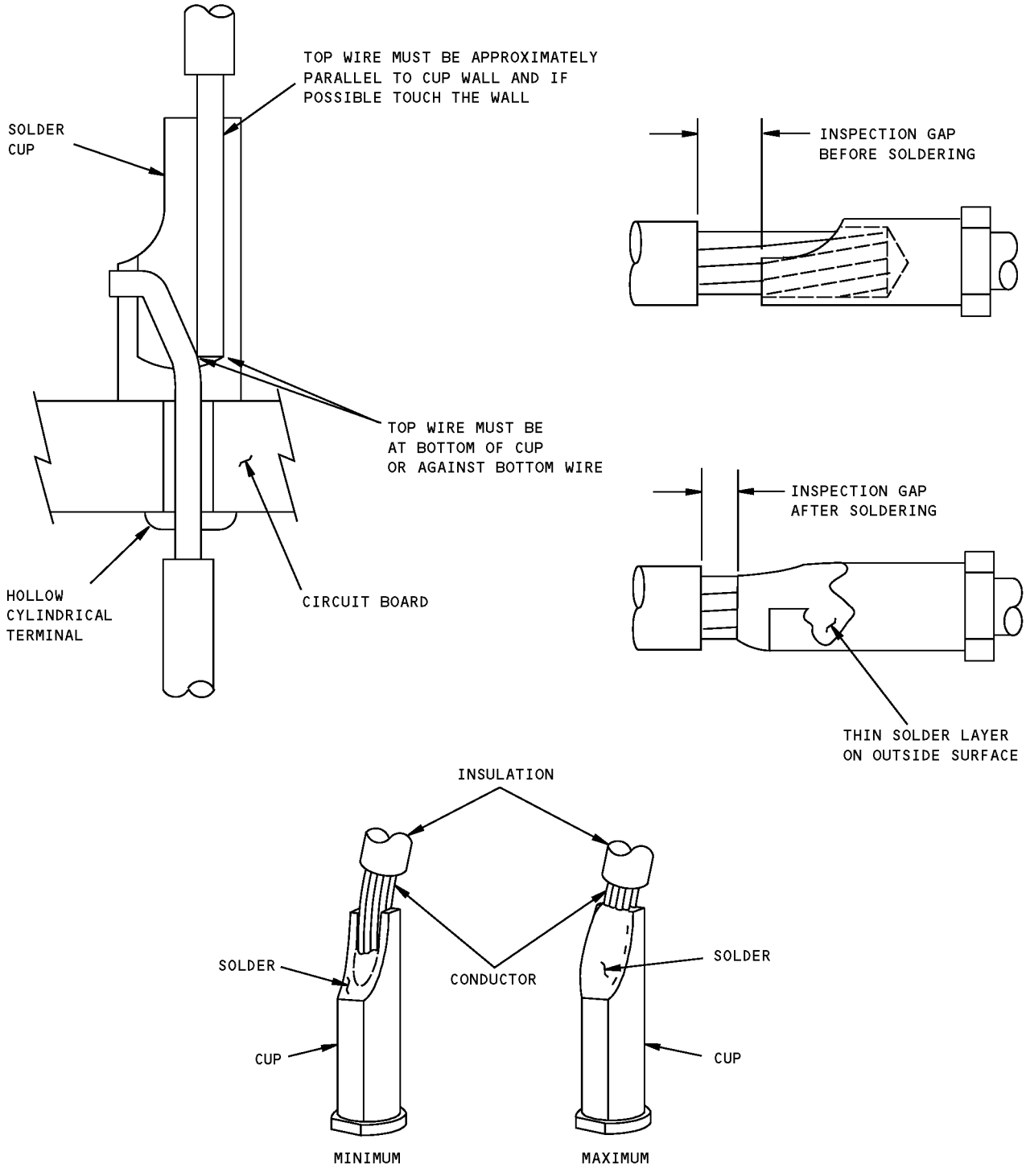
(5) Bare copper or copper alloys on the lead ends are permitted.

(6) Solder can go into the bend radius of a horizontally-installed axial-lead component (such as a resistor) at one or both ends if the solder does not extend outside of the pad diameter.

(7) Plated-through holes that contain wires or leads must be filled with solder. A depression on one or both sides is acceptable, but cannot be deeper than 25% of the board thickness.



Heat Shunt Examples
Figure 1



Acceptable Solder Cup Joints
Figure 2

5. IN-PROCESS CORRECTION

A. Solder joints can be touched up or soldered again as necessary. This includes such conditions as too much solder, not sufficient solder, peaks, points (icicles), bridges, spatter, pits, scars, holes and voids.

B. Solder connections can be touched up again and again if the results agree with the quality controls of BAC5242. But keep to a minimum the number of times you do this to joints on circuit boards, to prevent damage.

C. Heat the soldered area and correct the problem as quickly as possible after the solder melts. Add more solder or flux as necessary.

D. Unwanted solder can be soaked up with wicking material (Paragraph 5.E.) or a tool that melts the solder and removes it with vacuum (Paragraph 5.F.).

E. To use wicking material, use shield braid from coaxial cable, a vendor product such as Soder Wick (V34605) or a stranded wire with the insulation removed.

(1) Apply liquid flux to the shield braid or the stranded conductor. Soder Wick comes with flux in it.

(2) Put the wicking material or stranded conductor on the soldered connection and apply the hot tip of a soldering iron on top.

(3) Let the heated wick soak up the solder as necessary. Then remove the wick and the iron from the joint.

F. To use a vacuum solder removal tool, apply the heat source to the area, operate the tool to remove the solder as necessary, then remove the tool and the heat source.

6. HEAT SHRINKING OF SOLDER SLEEVES

A. General

WARNING: DO NOT USE INFRARED OR HOT AIR DEVICES IN AREAS WHERE THERE COULD BE FLAMMABLE LIQUIDS, VAPORS, OR GASES.

(1) The solder sleeve must be in the center of the splice.

(2) Conductor strands must lie flat and not go through the solder sleeve.

(3) The solder ring must be completely melted and flowed onto the adjacent surfaces.

(4) The solder joint must be resistant to a tensile test of 20 pounds or, as a minimum, be as strong as the tensile strength of the wire or braid.

(5) Use Method A, B, C or D as follows:

(a) For the BACS13BH (Raychem D144) series of solder sleeves, use Method A, C, or D.

(b) For the M83519/1 series of solder sleeves, use Method A, B, C or D.

(c) For the obsolete NAS1745 (Raychem D100) series of solder sleeves, use Method B.

(d) For the obsolete NAS1746-2,-3, or -4 solder sleeves, use Method A or B.

(6) Do not use solder sleeves on wires with a temperature rating less than 150°C (302°F) or if the conductors are nickel plated. Do not use solder sleeves in high-temperature applications (higher than 150°C (302°F) because the heat could melt the solder sleeve again.

B. Method A (Infrared)

(1) Put the solder sleeve in the center of the reflector of the IR500, IR550, or IR1759 gun.

(2) Push the switch to operate the gun. Look at the solder sleeve during the shrinking operation.

(3) When you see that the sleeve is melted and flowed, release the switch and remove the sleeve from the reflector.

C. Method B (Hot Air)

(1) Turn on the AA-400, CV-5300 or CV-5700 gun.

(2) Put the solder sleeve in the center of the reflector gun. Look at the solder sleeve during the shrinking operation.

(3) When you see that the sleeve is melted and flowed, remove the sleeve from the reflector.

D. Method C (Infrared)

(1) Fully open the nose cone of the IR1000 or IR1003 zap gun.

(2) Put the solder sleeve and wires within the reflector opening with the wire against the back shields and the solder sleeve in the space between the back shields.

(3) Close the nose cone, and make sure the fingers clamp the wires against the back shields. Then push the actuator switch to start the heat cycle.

(4) Remove the solder sleeve assembly 2 to 3 seconds after the lamp goes off.

(5) Examine the solder joint. If the timer is correctly set, the solder ring will be completely melted, the adjacent surfaces will be wet with the solder, and the solder surface will be bright and shiny. Decrease the time in 1/4-second increments if too much solder drained from the joint or if the sleeve is burned. Increase the time in 1/4-second increments if the solder is a dull gray color with a grainy surface, or if the solder ring is not completely melted.

(6) Make a check of the strength of the connection. Hold each wire between your thumb and forefinger and pull slowly until your thumb and forefinger slip on the wire.

E. Method D (Infrared)

(1) Put the solder sleeve in the ST2021C, ST2021D, or ST2021J heat unit and turn on the infrared lamps.

(2) After the solder ring is melted and flowed, remove the sleeve from the heat unit.