Rev 1

# INSTRUCTION MANUAL

## Models GW-BD/GW-BD-HT

## Big Dipper™

## Dip Solder Machine

SERIAL NO._____

Gold-Wave™

*The Finest in Equipment for the Electronics Industry*

**WARNING!**
Failure to read and follow the safety recommendations below may result in damage or serious injury.

-Never leave the unit unattended while in use.
-Always connect to appropriate power supply with the correct voltage and current rating.
-Always use a properly grounded receptacle.
-Always disconnect electrical power cord prior to performing any repair or maintenance.
-When in use, the solder, as well as other surfaces, are HOT! Avoid contact.
-Remember, the hot surfaces remain hot for a long time after use. Avoid contact!
-Never use the machine in any application for which it is not intended.
-Always use temperature resistant gloves, a fire retardant smock and protective eyewear to avoid risk of injury or burns.
-Never operate the unit with insufficient solder.
-Most fluxes are flammable. Use caution when handling near hot surfaces.
-An appropriate fire-extinguishing device should always be kept within reach of this unit.
-Never operate the unit if the thermocouple tube is not in its proper position or if it appears damaged.

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## 1.0 SYSTEM DESCRIPTION

### 1.1 Process description:

This machine is used to solder thru-hole circuit boards in low volumes. The machine contains a shallow flux container on the left side and a shallow solder pot on the right side. A trolley, on which a pallet rests, shuttles between the fluxer and solder pot. The shuttle slides to the left for fluxing and then to the right for preheating and/ or solder dipping. The pallet used is a universal pallet adjustable to accommodate differing board sizes. The trolley is designed so as to articulate the immersion and de-immersion of the board into the solder and flux pot appropriately.

### 1.2 Parts of the System: (See Figure 1)

The system consists of 8 assemblies:

Pallet
Trolley
Fluxing
Preheating
Solder Module
Exhaust Hood
Computer Controller
Electrical Circuit

### 1.3 System Specifications:

| | |
|---|---|
| Power: | 120 VAC, 60 Hz, 10A<br>optional 220 VAC, 50/60Hz, 10A |
| Max solder temperature (GW-BD): | 275 °C (527 °F) |
| Max solder temperature (GW-BD-HT): | 350 °C (662 °F) |
| Solder capacity: | approx. 50 lbs (23Kg) |
| Max board size: | 8” x 11.4” (203 x 290mm) |
| Dimensions: | 16.25 x 17.5 x 9” (413 x 445 x 230mm) |
| Warm-up time: | Approx. 50 min. |
| Weight: | 50 lbs empty (23Kg), 100 lbs (45Kg) w/solder |

## 1.4 System Operation:

### 1.4.1 Pallet:

Place an assembled PCB on pallet by gently pushing the board onto the titanium fingers. Paths can be moved closer together or further apart to accommodate various board widths. The maximum board size is 8 x 11.4 inches (200 mm x 290 mm).

### 1.4.2 Trolley:

The trolley accommodates the pallet in two positions. A lower position used for immersing the PCB into the flux or solder and an upper position used to elevate the PCB above the solder for preheating. The trolley can be slid to one of three positions. Sliding the trolley to the left articulates the pallet into the flux pot. Sliding to the right, articulates the pallet into the solder pot. The trolley track contains a detent that can maintain the trolley in a neutral or "home" position. Home position is used to load and unload pallets.

### 1.4.3 Fluxer:

The flux pot must be initially filled with flux to the appropriate level. To determine this level, simply slide an empty pallet into the fluxer. The flux should be high enough to just contact the tips of the titanium fingers (approximately 1/8 inch or 3mm from top edge of pot).

### 1.4.4 Preheater:

After having been fluxed, the PCB may be preheated. While the trolley is in home position, carefully lift the pallet onto the trolley elevator standoffs. Slide the trolley to the right. The PCB will now hover approximately 1/4 inch or 6 mm above the solder surface. Heat radiated from the solder dries and activates the flux by elevating the temperature of the PCB. After the designated preheat dwell time, return the trolley to home position and gently lower the pallet from the elevator standoffs.

### 1.4.5 Solder Module:

Use the dedrossing tool provided to skim and remove the superficial dross (oxide) layer that forms on top of the solder. Now slide the trolley toward the solder pot until the PCB is fully articulated into the pot. The bottom side of the PCB should now be in full contact with the molten solder, yet no solder should overflow to the top side of the PCB. While in this position, the trolley can be gently moved from left to right

approximately 1/4 inch or 6mm. This gentle movement or "rocking" accelerates solder joint formation.

### 1.4.6 Computer Controller:

The controller stores important parameters of the process into a menu or profile. Up to 12 profiles may be stored for later retrieval.

The following lists the controlled parameters:

- b) Solder pot temperature
- c) Preheat dwell time
- d) Solder dwell time
- g) Program storage menu (#0-12)

The parameters are preset to desired values, and can easily be altered for optimal performance.

### 1.4.7 Exhaust:

Flux fumes which collect in the machine are extracted through the exhaust header.

A 4 in. (100 mm) duct may be connected to the exhaust port to remove fumes from work area. Use a 400 CFM (150 m3/h) capacity exhaust fan to remove fumes beyond working area.

# 2.0 OPERATION AND MAINTENANCE

## 2.1 Installation

### 2.1.1 Placement:

The Big Dipper system must be placed on a stable bench-top. Using a horizontal bubble level, adjust the four jacking feet until the machine is properly leveled.

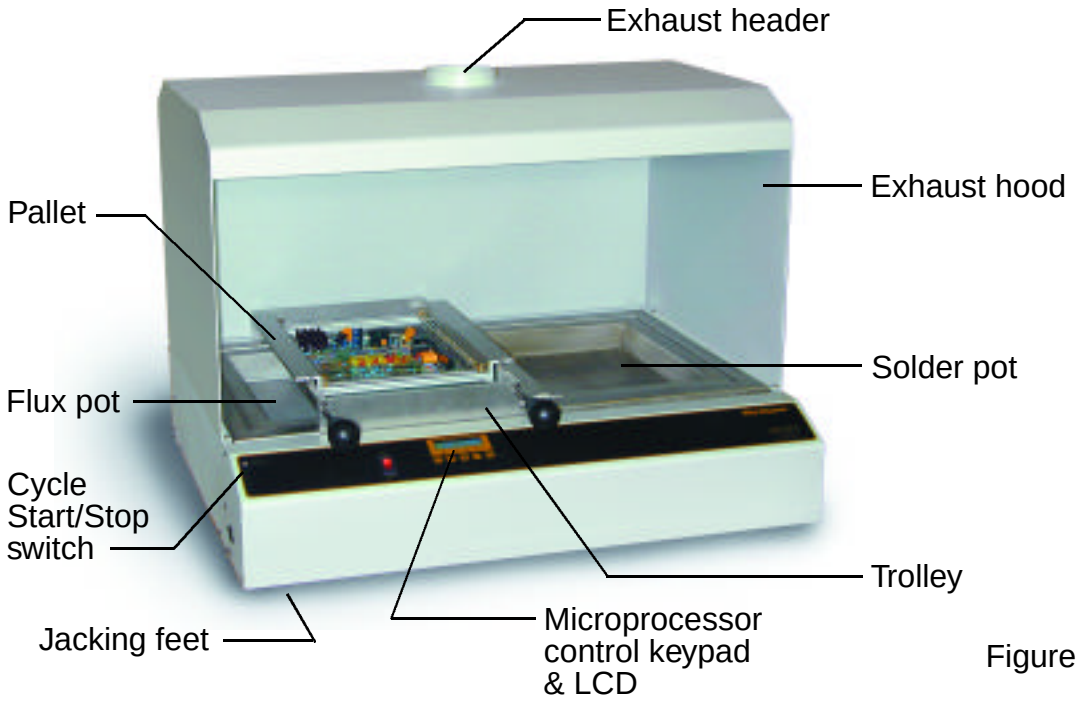


Figure 1.

### 2.1.2 Connecting to Power:

Connect the line cord plug into an appropriate 115 volt, 20 amp receptacle. For 220/240 volt units, connect to appropriate 10 amp supply.

**C A U T I O N !**

Do not turn on solder heater until solder pot is filled with solder. Refer to 2.6.1.

2.1.3 Attach exhaust hood by engaging the four keyholes to the machine and secure the two eccentric washers behind the hood using the knurled knobs provided.

2.2 Pallets:

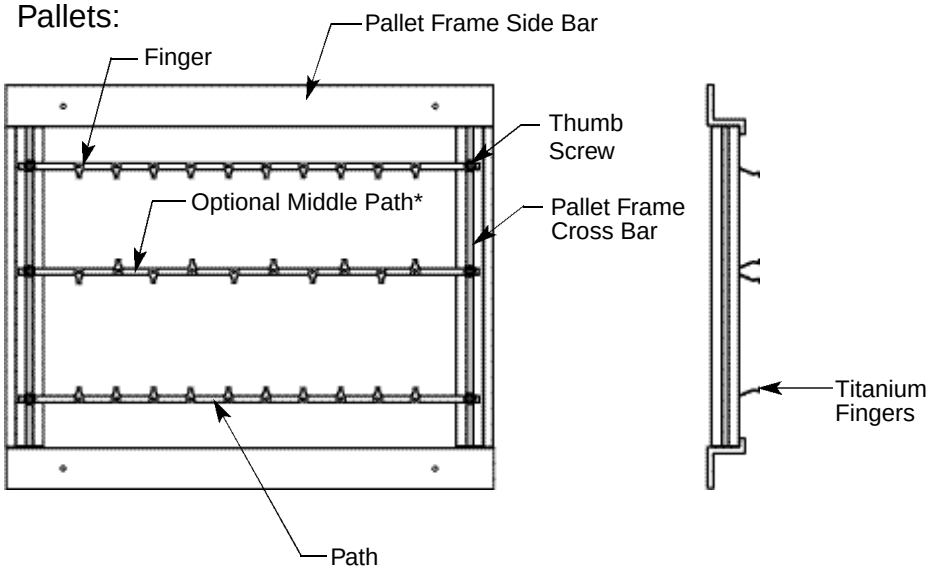


FIGURE 2. PALLET

*Note: For smaller PCBs, optional Middle Paths are available.

Pallet Maintenance:

The pallet is constructed of aluminum and titanium. Thus, solder will not bond. However, flux may adhere. Clean any flux build-up on fingers to avoid solder sticking to it.

Pallets should not be bent or skewed. Set pallet on a flat surface and check that all four corners sit level, without any play. If not level, gently press on corners to correct any minor skew in frame.

2.3 Trolley:

Before running any loaded pallets on trolley, run an empty pallet through to make sure it moves smoothly throughout its travel.

Trolley Maintenance:

a. Remove any foreign material such as a solder drop on the trolley rails.

b. Clean the conveyor rails with thinner or suitable solvent to remove flux splatter on rails.

2.4 Fluxer:

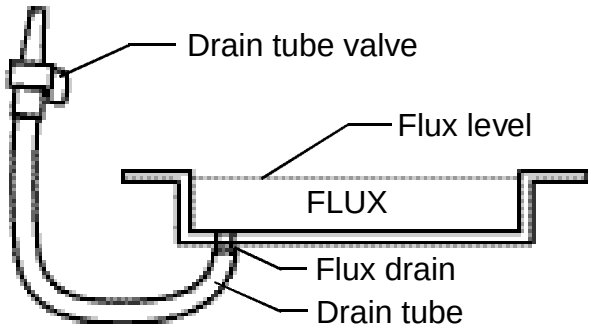


FIGURE: 3. FLUXER

During operation, the flux tank should be kept full at all times. The level should be such that the bottom surface of a PCB in a pallet contacts the flux fully.

To empty flux from the pot, remove the drain tube from the clamp, open the drain valve, and lower it into a suitable container. The flux will drain out by gravitational force.

**C A U T I O N !**

Whenever maintenance is performed on the fluxer, it should be done with machine switched off and the solder cooled down.

Fluxer Maintenance:

Check the specific gravity density of the flux daily before starting the machine and periodically during operation. Consult your flux manufacturer for the recommended specific gravity. To adjust the specific gravity, add a suitable amount of the thinner. Empty the flux tank every day after using the machine. If desired, the entire fluxer may be removed from the machine.

2.5 Preheat

The preheat consists of hovering the PCB above the solder. This allows the heat from the molten solder to dry and activate the flux and protects the PCB assembly from thermal shock when it enters the solder.

Preheat time setting on the control panel will vary depending on desired profile. In general, however, if component/board density is high, longer preheat dwell time should be set and shorter dwell time for less dense boards.

## 2.6 Soldering Module:

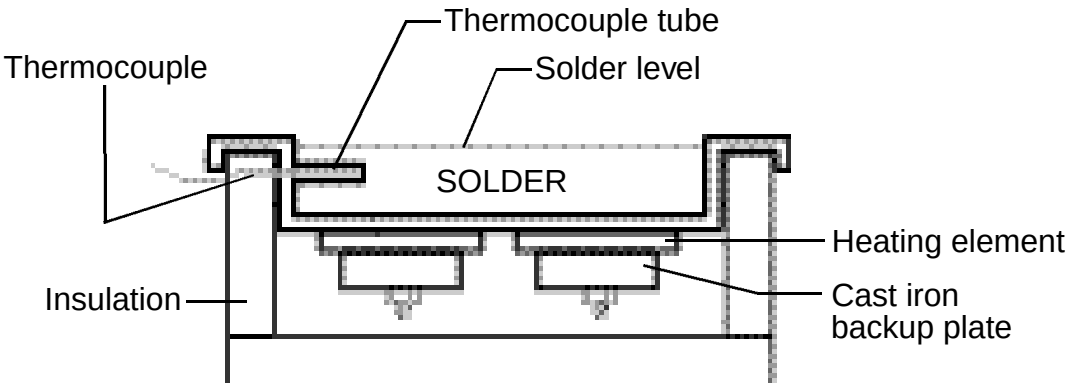


FIGURE 4. SOLDER POT

Solder pot temperature may be adjusted to suit composition of solder used. Typical setting for Sn63/Pb37 solder is 480-500°F (250-260°C).

The solder module consists of solder pot, thermocouple and heaters.

C A U T I O N !

Do not switch on heaters without solder in the pot or the heaters and solder pot will be damaged.

### 2.6.1 Initial Filling of Solder:

High purity virgin solder is recommended for good solderability. During initial solder charge, pellets or small solder chunks should be used to cover the bottom of the pot to avoid burn-out of elements. Larger solder

bars or sticks may then be added to speed up loading.

The heater elements are located outside the solder pot and are attached to the pot floor.

When the solder melts, add more solder to raise the solder level to the desired height. When solder falls below recommended level, the operator should add a solder bar gently into the pot.

2.6.2 Solder Pot Maintenance:

1) Replacing solder heater elements:

**C A U T I O N !**

Before replacing heater elements, power must be turned OFF.

The heaters are flat type ring elements and must be replaced when the solder is solid and cool.

Drain the flux tray and remove the fluxer and exhaust hood from the machine.

Slide the thermocouple out of its sleeve in the solder pot.

Remove the four flat-head screws from the solder pot rim corners and carefully lay the pot upside down.

Remove four nuts that secure the bottom insulation panel and lift insulation panel out.

Remove securing nut from element to be replaced. Remove appropriate ring terminals from terminal block located inside control panel.

To replace new element, reverse above procedure.

2) Solder Surface:

As a natural result of oxidation, a film of oxide (dross) will appear on the surface of the solder. The oxide film protects and inhibits further oxidation of the solder. But a PCB to be soldered should never come in contact with this dross. Carefully dedross the oxide surface prior to soldering

PCB using the dedrossing tool provided.

3) Solder Quality:

In time the solder may become contaminated. Check the solder annually or more frequently if necessary. A small sample may be sent to your local solder supplier or to a qualified lab for analysis.

To remove copper contamination from solder, set the solder pot tempera ture to 369°F (187°C) and keep it ON for 8 hours. Excess copper-rich solder can be skimmed off from the top of the solder. For better results repeat this procedure 2-3 times.

Note: This procedure applies only to eutectic tin/lead alloy (Sn63/Pb37).

2.7 Exhaust:

Exhaust header is located at the top of the exhaust hood. A duct (with a fan) can be attached to the header to evacuate fumes from the machine.

2.8. OPERATION USING COMPUTER CONTROL

2.8.1. The microprocessor based controller display has the following capabilities:

- 12 automatic programs (menus) of parameter setting storage.
- Program 00 is manual operation or "learn" mode and programs 01 to 12 are automatic modes.
- You can set all machine parameters in the EDIT mode.
- The machine will operate in the RUN mode.
- The machine can operate in two processes: flux/ pre-heat/ solder or flux/solder.


FIGURE 4. Controls

2.8.2. Front Panel:

The keys: There are five keys on the controller.

[ F ] Function key changes the status of the machine. By pressing this key you can toggle the machine to RUN mode or EDIT mode. In EDIT mode parameters can be changed as required. In RUN mode, the machine is ready for use per the pre-set parameters.

[◀ ] The cursor key controls the cursor movement. Pressing it will move the cursor to the digit you want to edit.
If the key is pressed for more than 1 second, the cursor will keep moving until the key is released.

[ ▲ ] The increment key changes the parameter values. By pressing the key once, the digit will increase by one.
If the key is pressed for more than 1 second, the digit keeps incrementing until the key is released.

[↵] This is the ENTER key. Press this key when you are satisfied with the value of the parameter or ON/OFF status in the edit mode. This will save the settings and automatically go to the next parameter.

[⏻] This key toggles the machine ON or OFF.

2.8.3 Display:

The display consist of a 16 x 2 character LCD module. The LCD module displays the machine status in two lines. The upper line displays set values of the parameters. The lower line displays the current status or actual value of the parameter. The display can also indicate the calibration mode.

## 2.9 MACHINE OPERATION:

2.9.1 When the machine is turned ON, the start-up display will momentarily appear.
The program last stored in the machine will then be displayed.
The machine is now in RUN mode and will operate according to the parameters set in this program.

To operate in the flux/ solder process, slide the trolley gently toward the fluxer until the bottom surface of the PCB is fully in con tact with flux and then withdraw to the home position. Dedross the solder pot using the dedrossing tool provided and press the process start/ stop switch (a single beep will be heard). Slide the trolley toward the solder pot until the bottom surface of the PCB is fully in contact with solder and rock the trolley. Withdraw the trolley to home position when the beeper sounds three times.

To operate in the flux/ preheat/ solder process, slide the trolley gently toward the fluxer until the bottom of the PCB is fully in contact with flux and then withdraw to the home position. Lift the pallet onto the preheat standoffs and press the process start/ stop switch (a single beep will be heard). Slide the trolley toward the solder pot to hover the PCB over the solder. Slide the trolley back to home position when two beeps are heard. You now have 10 seconds to gently lower the pallet from the preheat standoffs and dedross the solder pot. When a single beep is heard, slide the trolley toward the solder pot until the bottom surface of the PCB is fully in contact with solder and rock the trolley. Withdraw the trolley to home position when the beeper sounds three times.

2.9.2 Changing Programs:

To change to a different program, press [ F ], Prg/EDIT will be displayed, press [ ▲ ] to change the program #, then press [ F ] to switch the machine into the RUN mode.

2.9.3 Editing Parameters:

2.9.3.1 Press [ F ], the screen will display the Prg #/EDIT. The machine is now in EDIT mode.

2.9.3.2 Press [ ↵ ], the cursor will move to the solder temp. setting. Change the value of the first digit by pressing [▲]. To shift to the next digit press [ ◀ ]. When satisfied, press [ ↵ ] to store the changes. The cursor shifts to next parameter. Make changes by using the [ ▲ ] and [ ◀ ] keys. When satisfied with the entire menu, press [ F ] to switch the machine to RUN mode.

Note: An entry of 1 to 999 seconds in the preheat field creates a program which runs in the flux/ preheat/ solder process. To run in the flux/solder process, simply enter 000 seconds as the preheat time value.

2.9.4 Changing Manual/Auto Mode:

For convenience, it is sometimes desirable to switch the machine to manual or "learn" mode. For example, when you want to make trial runs for a certain PCB type to determine what the correct parameters should be.

Press [ F ]. Prg #/EDIT will be displayed. Change to Prg # 00. The machine is now in the manual mode. Press [F] to go to work mode or press [enter] to change the process. The preheat and solder entries will appear as 999 and 99 respectively. This will function for the flux/ preheat/ solder process. To operate in the flux/ solder process, simply change the preheat time to 000. Press [F] to return to work mode.

When working in learn mode, the Cycle Start/Stop switch will initiate the solder or preheat and solder time to count up. Pressing the process start/ stop switch again will stop the count up and store (freeze) the setting.

When satisfied with parameters developed in the learn mode, you may store the parameters in an automatic menu (PRG # 01 to 12).

2.10 Calibrating the Machine: CAUTION! To be done by skilled technician only - contact factory.

2.11 SHUTDOWN

2.11.1 Turn main power OFF. Last program will be saved for next startup.

2.12 ELECTRICAL DIAGRAM: See Page 21.

## 3.0 Troubleshooting Solderability

If all variables and parameters which lead to good solderability are not properly controlled, some typical defects will occur. The description and causes of some common defects are listed below.

1. Poor Wetting:

   Wetting is the primary factor in achieving good solder joints. A condition when the surfaces to be joined are only partially covered with molten solder, leaving behind areas of unwetted surfaces, is called non-wetting or poor wetting. It shows up as pin holes and areas of bare copper or insufficient solder on the surface of the parts to be soldered. There is virtually no adherence of the solder.

2. De-wetting:

   This condition is similar to poor wetting. It differs in that the areas to which the solder does not adhere results from the solder pulling back from the surfaces prior to solidifying.

3. Disturbed Joint:

   When components move in relation to PCB during the solidification stage disturbed joints are formed.

4. Excess Solder:

   This condition occurs when too much solder remains on the joint. Excess solder joints have solder fillets which appear round and fat.

5. Icicling:

   Icicling is excess solder which solidifies during the peel-back stage. An icicle has a fillet shape which appears conical and ends in a sharp point.

6. Solder Webbing:

   When solder adheres to the solder mask between the metallization, it is called solder webbing. The surface leaves thin lines of solder which form a pattern resembling a net or web.

7. Pinholes and Blowholes:

   Small holes are seen on the solder fillet. The bigger ones are called blow holes and the smaller ones pinholes. A pinhole often conceals a much larger internal cavity.

8. Bridging:

Bridging occurs when excess solder shorts two adjacent pads, conductors or leads.

**Causes and remedies for solderability defects described above:**

1. Poor Wetting

| Cause | Remedy |
|---|---|
| a) Organic contamination of the surface | Remove such contamination (oil, grease, paint, etc.) with suitable solvent and/or abrasive. |
| b) Heavy tarnishes that cannot be removed by flux | Clean board and components prior to assembly. |
| c) Plating done over partially contaminated surface | Clean and replace the surface. |
| d) Improper fluxing | Check flux height. Make sure that flux is being properly applied to entire area of PCB. The flux height may require adjustment. Using a hydrometer, check flux density. Correct if necessary by adding thinner. |
| e) Insufficient solder temperature or wetting time | Check solder dwell time. Check the temperature of the solder. Usually, it should be 110°-140° F (60-80°C) above the melting point of the solder. |
| f) Areas of PCB do not fully contact flux and/or solder properly | Check that pallet is properly properly seated on trolly and PCB in fingers. Check flux or solder height. Adjust solder/flux heights or level solder pot/fluxer. |

2. De-Wetting:

Since this condition is similar to poor wetting, the same cause and remedy as above apply to this defect.

3. Disturbed Joints:

| | Cause | Remedy |
|---|---|---|
| a) | Jarring of the PCB after soldering | Check the trolly tracks and bearings. Check PCB solder side for protrusions or excessive lead length. Trim if necessary. |

4. Excess Solder:

| | Cause | Remedy |
|---|---|---|
| a) | Insufficient solder dwell time and/or temperature | Increase solder dwell or temperature |
| b) | Insufficient preheating | Raise temperature of pre heated board by increasing dwell over solder pot. |
| c) | Low flux density | Increase density of flux. Increasing the density of the flux will increase the propensity of the solder to drain off (peel-back). |

5. Icicling:

| | Cause | Remedy |
|---|---|---|
| a) | Poor solderability of the PCB or component leads | Clean PCB and/or leads and/or use a more active flux. |
| b) | Low solder temperature | Increase solder temperature. |
| d) | Large empty holes or metallization | Apply peelable mask to these areas on PCB prior to soldering or remove such icicles with a soldering iron. |

| | | |
|---|---|---|
| e) | Excessive lead length | Longer lead protrusions increase propensity for icicling. Trim leads accordingly. |

6. Solder Webbing:

| | Cause | Remedy |
|---|---|---|
| a) | Material used for coating PCB is not compatible with flux | Change flux or coating. Try uncoated board to confirm the cause. |
| b) | Solder dross comes in contact with PCB | Clean surface of molten solder and add if necessary. |

7. Pinholes and Blowholes:

| | Cause | Remedy |
|---|---|---|
| a) | Flux does not dry before the PCB enters the solder | Check that excess flux is not applied to the PCB. Increase preheat dwell time. |
| b) | Flux is activated inadequately | Increase preheat dwell time |
| c) | Contaminated plated through hole (PTH) or metallization or lead | Clean surfaces using appropriate solvent and/or abrasive. |

8. Bridging:

| | Cause | Remedy |
|---|---|---|
| a) | Poor design of layout of the PCB | To correct the layout, consult a designer familiar with manufacturability of PCBs. |
| b) | Contaminated solder and dross | Clean and de-dross the solder. Send solder sample to qualified lab for analysis. |
| c) | Excessive lead length | Longer lead protrusions increase propensity for bridging. Trim leads accordingly. |

## 4.0. Troubleshooting Machine

| Failure | Corrective Measures |
|---|---|
| Solder does not melt | Check the fuse, relays and heaters. If the fuse is open, replace it. If the relay is fused,replace it. If the heater is burned, replace it. |
| Solder takes too long to melt | Check heater elements. Replace defective one. |
| Pre-set temperature is not achieved | Check heater elements, replace defective one. |

## 5.0 Spare Parts List:

### TRANSPORT

| | |
|---|---|
| BD-PAL | Pallet |
| BD-PATH | Path |
| BD-CLIP | Titanium Finger |
| BD-BRGSET | Bearing Set |

### SOLDER POT

| | |
|---|---|
| BD-HTR | Heating Element |
| BD-TC | Thermocouple |
| BD-DRSTL | Dedrossing tool |

### FLUXER

| | |
|---|---|
| BD-FLXTUB | Flux Drain Tube |
| BD-FLXVLCV | Flux Drain Tube Valve |

### CONTROL

| | |
|---|---|
| BD-FUSE | Fuse |
| BD-RLY | Relay |
| BD-XFMR | Transformer |
| BD-MNCONT | Main Controller |