OPERATION AND MAINTENANCE MANUAL

TE89-H-1 SOLDERABILITY TESTER

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PROCESS AUTOMATION SOLUTIONS

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1. HEALTH AND SAFETY

It is recommended that the machine be fitted with extraction to draw off any fumes that may be produced whilst the machine is in use.

When using the machine it is recommended, in view of the corrosive fluxes and the heat involved, that extreme caution is exercised and suitable protective equipment used when handling the samples.

This equipment contains voltages that can kill. Do not operate with the cover off. If it is necessary to remove the cover for finding faults and power is required to the equipment then take normal precautions for working with live equipment. Only qualified electricians should work on this equipment if it is live and the cover is off.

2. INTRODUCTION TO SOLDERABILITY.

The Multi-Function solderability test machine has been designed and manufactured to assess the solderability of printed circuit samples when used in the Rotary mode; of component leads, wires, tags and terminations of irregular form when in the Dip mode and of round wires with respect to standard solder pellet sizes when in the Globule mode.

These various tests are covered by a number of standards in difference countries, a few of which are listed within this handbook.

The object of the tests is to prove that the samples taken from the batch, be it boards or components will achieve a standard of solderability that satisfies the end user. The samples may well be subjected to ageing, damp heat or a number of other tests prior to the solderability test.

The results may be inspected visually or the sample may be subjected to further tests, electrical continuity etc, or in the case of the globule test a specific time will be indicative of the solderability of the wire.

The visual inspection will determine the ability of the sample to solder, or the degree of wetting, de-wetting or non-wetting that could be expected from that batch.

The information produced from the test results can be analysed and this will enable parameters such as solder temperature, immersion time in the wave solder machine or the type of flux used during the production process.

3. DESCRIPTION OF THE EQUIPMENT

The Multi-Function Solderability Test machine consists of a base frame upon which is mounted the mechanical assembly, the solder bath and the control electronics. A glass reinforced plastic moulding covers these components and an operator interface unit is mounted in this moulding.

The mechanical assembly consists of a number of aluminium castings. Mounted on the rear of the main casting is a stepper motor assembly with its associated electronics and home position switch. The motor drives a shaft to provide the rotary motion. The main casting moves vertically guided with recirculating ball bushings running on hardened shafts, this assembly is driven via a rubber timing belt and pulleys from another stepping motor.

The solder bath is a self contained insulated unit with immersion heaters. A thermocouple probe immersed in the solder monitors the temperature. A second thermocouple is attached externally to the base of the bath to provide safety backup in case the control fails.

The control electronics consists of a PLC, two stepper motor drives and a 24volt dc power supply to provide power. A combined display and keypad is connected to the PLC to provide an interface for the operator. This unit is mounted into the external fibreglass cover.

The head assembly will accept a variety of holders to cover the range of tests available.

4. INSTALLATION

The equipment should be mounted on a rigid base and at a convenient working height for the operator. Adequate extraction or ventilation should be provided and should be sited away from gangways or thoroughfares to prevent accidental knocks to the machine that might cause solder spillage.

Four levelling feet are fitted to the machine and they should be used to ensure that the solder bath is level. Use a spirit level across the two axis of the bath to achieve this.

The machine will be wired for 220/240 volt 50/60 Hz operation (110/120 volt 50/60 Hz optional) and will be supplied with an earthed power lead fitted with an appropriate plug. Other voltages may be available to special order, if in doubt contact Cemco.

It is not normal to supply the machine without solder, as it does not allow temperature calibration and setting up to be carried out. Either tin lead solder or lead free solder can be supplied.

DO NOT ATTEMPT TO MOVE THE MACHINE WHILST THE SOLDER IS MOLTEN.

5. OPERATING INSTRUCTIONS

Start up.

Switch the machine on using the on/off switch on the bottom left hand corner of the machine.

After initialising the PLC and display the following screen will appear.

Solder temperature
Setpoint 0 C
Measured 18 C

When the machine is switched on the set point defaults to 0 and the numeric display will flash to show that it can be changed. Use the vertical arrow keys to change the set point to the required solder temperature (usually 235 C for tin/lead solder and 270 C for lead free solder). The horizontal arrow keys may be used to move the cursor between digits, which allows values to be changed more quickly. The set point limits are between 0 and 300 degrees centigrade. When the correct set point is shown press the **ENTER** key to accept the value. The machine will now heat the solder to the new set point.

When the solder has reached the set point temperature the machine should now be calibrated. You need to allow plenty of time for the temperature to stabilise before proceeding.

Calibration consists of finding the height of the solder using the level probe. To access the calibration screen you first need to go to the main menu. This is found by pressing the **ESC** key. If the Set point is flashing you need to press the **ESC** key twice, once to cancel the flashing and once to move to the main menu.

The following display will appear.

Set temperature
Calibrate
Set parameters
Start tests

Use the vertical arrow keys to move the cursor to **Calibrate** and press the **ENTER** key.

NOTE: Additional items are available on the Main Menu that can be viewed by scrolling down with the vertical arrow keys.

Calibration.

The calibration screen appears as below.

F1 to calibrate level
F4 to abort
Height = 0 mm

Before the calibration cycle is started ensure that the level probe is fitted and set to the correct distance. The tip of the probe should be 100mm from the centre line of the rotary shaft. The solder cleaning paddle also needs to be fitted.

Press the F1 key and the calibration cycle will start. The cycle will not start unless the solder temperature is above 180 C for tin lead solder or 230 C for lead free solder.

Calibration cycle.

1. Move up to the vertical home position switch.
2. Rotate to the rotary home position.
3. Rotate 180 degrees so that level probe is pointing directly downwards.
4. Lower probe slowly until it touches the solder.
5. Raise the probe clear of the solder.
6. Rotate so that cleaning paddle is in the correct position.
7. Lower head 10 mm.
8. Rotate cleaning paddle to wipe the surface of the solder clear of dross.
9. Raise the head to clear the solder level.
10. Rotate so that level probe is pointing directly downwards.
11. Lower probe slowly until it touches the solder.
12. Zero solder height (display will show 0mm)
13. Raise head to clear solder (display will show 3mm)
14. Rotate to home position.

Calibration is now complete.

NOTE: The above cycle relies on the correct operation of all component parts. If the cycle does not appear to work correctly then use the F4 key to abort the calibration cycle. Try repeating the cycle and if this does not work you will need to determine the fault and correct it.

Return to the Main Menu by pressing the **ESC** key.

Select **Set parameters**.

The following screen will appear.

Dip test settings Immersion depth 0.0 mm Immersion time 0.0 s Dip speed 0 mm/s

Parameter setting screens for the Rotary and Globule tests can be selected by scrolling down using the vertical arrow keys. These are shown below.

Rotary test settings Depth 0.0 mm Time in bath 0.0 s

Globule test settings Maximum test time 0 s

The first display on the selected screen will flash to show that the value can be changed. Use the arrow keys to change the value and the **ENTER** key to accept.

NOTE: There are pre-defined limits for all the parameters and should they be exceeded these limits will be inserted when the **ENTER** key is pressed.

When the parameters have been entered return to the Main Menu by pressing the **ESC** key (twice if one of the displays is flashing).

Select **Start tests**.

The following screen will appear (temperatures will depend on operator settings).

Dip test (F1 = Start) Time: 5.0s Depth 8.0mm Temperature Set: 270C Actual: 271C

Screens for the Rotary and Globule tests can be accessed using the vertical arrow keys to scroll through them. These are shown below.

Rotary test (F1 = Start) Set Actual Time: 0.0s 0.00s Temp: 270C 272C

Globule test F1=Start F2=Stop F4=Abort Test time: 0.00s Maximum time: 20s

Each test is started using the F1 key and can be aborted at any time by pressing the F4 key. If the test is aborted you will need to go through the calibration routine again.

A description of each test follows.

Dip test

The dip test is intended to check the solderability of components. The test dips the end of a component lead into the solder for a defined time and to a defined depth. The component is then inspected to see how well the solder has wetted the lead. The component should be mounted so that the end of the lead is at the same level as the tip of the solder level probe. The clamp should be mounted so that the larger diameter hole is to the outside. See Appendix A.

The Dip test cycle is as follows.

1. Rotate the cleaning paddle to the correct position for cleaning the solder
2. Lower the head to the solder cleaning position.
3. Rotate the head to wipe the dross from the solder surface.
4. Raise the head.
5. Rotate the head so that the component lead is pointing downwards.
6. Lower the head at the defined speed to the defined depth
7. Wait for the time specified (Immersion time).
8. Raise the component clear of the solder at the defined speed.
9. Rotate the head to the home position with the component pointing upwards.
10. Send the test results to the serial output.

Rotary test

The rotary test is used to check the solderability of printed circuit boards and does this by simulating the effect of a wave-soldering machine. The test rotates the board through the solder at a pre-defined depth and for a pre-defined time. The board is then inspected and tested to see how well it has been wetted. The depth is usually set so that solder will not flood over the top of the board during the test. The board is held in a height adjustable clip that is set so that the underside of the board is level with the tip of the solder level probe. During the height adjustment the board of course is upside down so the underside is the highest surface. See Appendix A.

The Rotary test cycle is as follows.

1. Rotate the cleaning paddle to the correct position for cleaning the solder
2. Lower the head to the solder cleaning position.
3. Rotate the head to wipe the dross from the solder surface.
4. Raise the head.
5. Lower the head to the correct height for the defined depth.
6. Rotate the head at a speed calculated to immerse the board for the pre-defined time.
7. Raise the head
8. Rotate the head to the home position with the board pointing upward.

9. Send the test results to the serial output.

Globule test

The globule test allows the user to check the solderability of electrical wire. It does this by placing a sample of the wire into a globule of solder. The operator then views the test and presses a button when the wire has wetted. The time taken is displayed on the screen and is used as a guide as to the solderability of the wire. For this test the solder cleaning paddle and the solder level probe need to be removed. A special holder is used to clamp the wire under test. An anvil assembly is provided and should be mounted carefully onto the solder bath with its' base immersed in the solder and screwed in place. The centre of the anvil provides the location for the solder pellets to be used for the test. See Appendix A for mounting details.

The Globule test cycle is as follows.

1. Lower the head slowly until the wire makes contact with the solder globule.
2. Start timing the test.
3. If the operator presses key F2 stop the test and record the time.
4. If the maximum time elapses and the operator has not pressed F2 stop the test.
5. Raise the head back to start point.
6. Send the test results to the serial port.

Maintenance

In addition to the standard test and calibration procedures there are screens that can be used for maintenance and setup purposes.

In the maintenance screens it is possible to operate the stepper motors independently to check their functionality and to return them to their home position should there be a fault.

Another level of menus is available to the operator and these can be accessed by pressing the **ESC** key while in the Main Menu.

The following Menu will be displayed.

DISPLAY ALARMS OPERATOR MENU DIAGNOSTIC MENU RELEASE PASSWORD

Selcting the Operator Menu opens another menu that allows you to change the time and date.

6. ANALYSIS OF TEST RESULTS

ROTARY TEST

The results of the sample under test will enable the operator to establish the condition of the sample and to decide if it exhibits wetting, de-wetting or no wetting.

These characteristics will show up if the sample is plain copper or an etched sample with conductors, holes etc.

Whether the sample is judged to be acceptable or not will depend upon the specification that is being used, however as the requirements of the British Standard 9760 are generally accepted the following guidelines are based on that specification.

For conductors, a 2 second immersion will prove wetting ability. The soldered area shall be covered with a smooth and bright solder coating, not more than traces (approximately 5%) of scattered imperfections such as small pin holes, unwetted or dewetted areas. These imperfections shall not be concentrated in one area.

For a 5 second immersion the specimen shall not have dewetted, again not more than traces of imperfections, as above, shall be evident.

For holes, a 3 second immersion will prove wetting ability. The specimens shall be examined with suitable illumination. The solderability of the hole shall be considered acceptable if the following conditions are observed:

(a) The hole is filled with solder which may have wetted the top metal surface

(b) The solder in the hole exhibits a concave surface (ie with a contact angle of less than 90°) on the top side of the specimens

(c) If the solder in the hole does not have sufficient residual volume to fill the hole completely, the wall of the hole shall be free from a dewetted area and shall show a smooth continuous solder coating.

For a 5 second immersion the specimen shall not have dewetted.

DIP TESTS

A great number of components may be tested in this mode, ranging from simple resistor leads to the latest surface mount devices, also unusual components such as brass screw terminals with relatively large mass which have to be soldered into a printed circuit board could be evaluated.

In all cases we are concerned with the wetting ability of the component and the time to achieve good results consistently.

Experimentation with fluxes, speeds, dwell times and temperatures could well lead to improvements in the quality of the finished component or the speed of production or both.

The actual result of each test is likely to be subject to a visual examination, perhaps with a comparison with a known standard or to a particular specification.

GLOBULE TESTS

The results of the wire under test will give a good indication of the solderability of the component lead when populated on a printed circuit board and traversed over the solder wave in a soldering machine.

If, for example, a typical sample gives a 1.5 second reading on the globule test and the wave soldering machine is operated at a speed which gives say a 2 second contact with the solder then it can be reasonably expected that good solderability results can be achieved.

If greater throughput is required or a batch of particular components, for example a heavy gauge wire, are taking longer to solder, then experimentation with different fluxes and solder temperatures may lead to an improvement in production output or alleviate a problem with a troublesome component lead.

7. MAINTENANCE

The machine will require little maintenance but, as with any soldering process, it is necessary to ensure that the unit is clean as this may significantly affect the results.

Any excess residues should be cleaned from the bath using a PTFE spatular or similar.

The probe, which operates the timer, should be cleaned after each immersion if required.

A sample of the solder used in the bath should be analysed regularly for excessive contamination, should the solder prove to be unacceptable, it should be removed carefully using a ladle; the utmost care should be exercised when performing such as operation.

8. MACHINE SPECIFICATION

Temperature	:	Centigrade
Warm up time	:	30 mins approx
Minimum temperature set point	:	0°C
Maximum temperature set point	:	300°C
Temperature resolution	:	+/- 1 °C
Dip test immersion/withdrawal speed	:	1 – 50mm/sec
Dip test immersion depth	:	0 – 30mm
Rotary test immersion depth ***	:	0 – 3mm
Immersion time ***	:	0.5 - 20 sec
Power consumption	:	600 W
Voltage	:	110/120 or 220/240 (or to special order)
Dimensions (mm)	:	675W x 5900 x 440H
Weight	:	30 Kg

*** It is not possible to use every combination of time and depth for the rotary test. For the minimum time setting of 0.5s the maximum set depth is 1.5mm. If settings outside these limits are used the equipment will limit the rotary speed and a longer immersion time will be recorded.

9. TEST STANDARDS

The procedure for assessing the solderability of a specimen is similar for standards throughout the world, there may be detail differences between one standard and another but these in general are limited to alternative immersion times, temperatures etc.

The machine conforms to all major standards.

In addition to BS 9760: 1977 (plus amendments 3225 Nov.1980 and 3792 Oct 1981) for rotary tests some other standards are: -

BS 2011: Part 2.IT: 1981.

BS 6221: Parts 2 and 2.IT. 1982

IEC 326: Parts 2 and 2A.

CECC 23300: 00 010 Issue 1 1984/5.

ANSI/IPC-S-804 4.2 Method 2. 1982.

Some vertical dip tests are covered by the following: -

BS 2011: Part 2, IT:.46

IPC – S – 804

MIL – DTD – 202F, Method 2080

Some globule tests are covered by the following: -

BS 2011 Part 2.IT:4.6

MIL – STD – 8838

10. CEMCO TEST EQUIPMENT

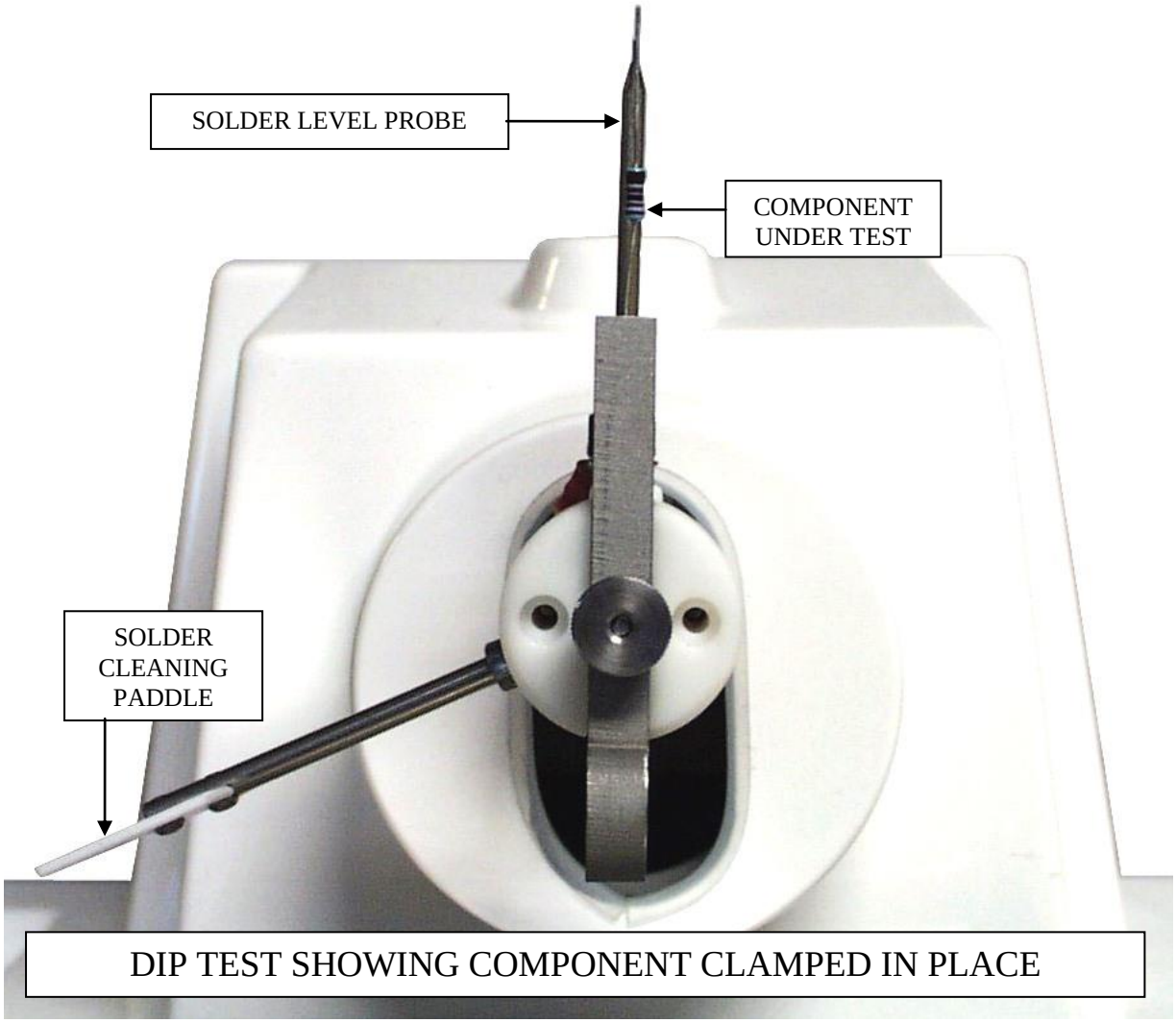
The following equipment is available to compliment the equipment referred to in this handbook. This equipment is designed and produced to meet the BS 9760 requirement, however it is suitable for any company wishing to test and inspect a variety of printed circuit boards, either for internal use or to customer's standards.

Please contact CEMCO for further information on any of these products.

CEMCO No.	DESCRIPTION
90	PEEL & PULL TESTER
91	ACCELERATED AGEING MACHINE

11. APPENDIX A

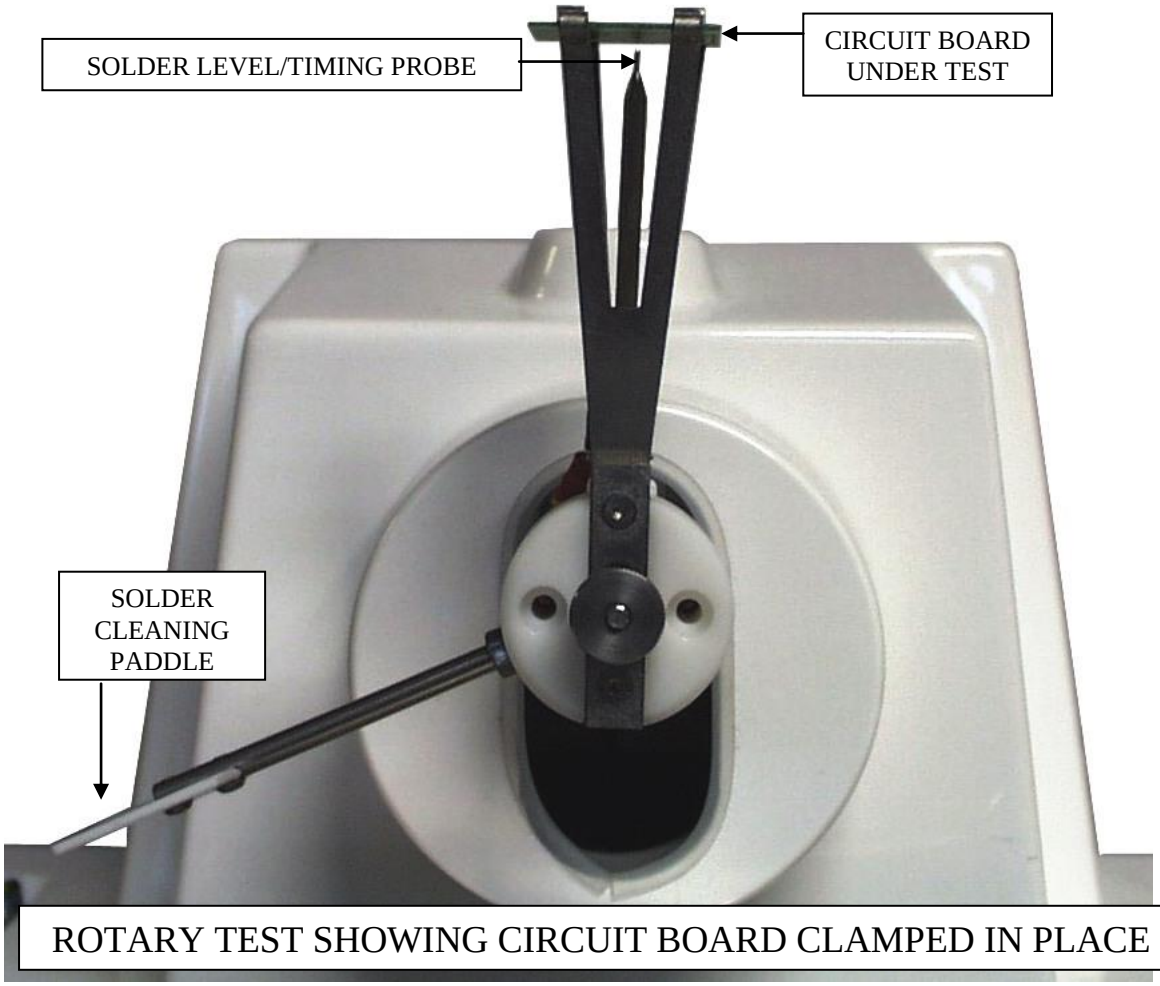
Mounting for Dip test.



DIP TEST SHOWING COMPONENT CLAMPED IN PLACE

NOTE: Clamp the component so that the end of the component lead is level with the tip of the solder level probe.

Mounting for Rotary test.



ROTARY TEST SHOWING CIRCUIT BOARD CLAMPED IN PLACE

NOTE: The board clamp should be adjusted so that the bottom of the circuit board (side to be soldered) is level with the tip of the solder level probe.

Mounting for Globule test