MUST SYSTEM 3

Solderability Testing System

GEN3 SYSTEMS

ENGINEERING RELIABILITY IN ELECTRONICS

Solderability testing out of a box – **The MUST SYSTEM 3**

The MUST System 3 is the latest technological evolution of the original Multicore Universal Solderability Tester (MUST) that grandfathered all modern solderability test standards. It remains the unquestioned industry benchmark for solderability testing and test systems. The current version was developed in conjunction with the world-renowned UK National Physical Laboratory (NPL).

THE MUST SYSTEM 3 TESTS TO:

- IEC 60068-2-54 and 60068-2-69
- MIL-STD-883 Method 2022
- IPC/EIA J-STD-003A
- IPC/EIA/JEDEC J-STD-002B
- EIA /JET-7401

INCLUDING EDGE DIP TEST METHODS OF:

- IEC 60068-2-20 and 60068-2-58
- IPC/EIA/JEDEC J-STD-002B
- IPC/EIA J-STD-003A

- Gen3 Systems co-operates with IEC, ISO, IPC, BSI and other official standards authorities to help maintain and develop measurement standards including solderability metrology.
- The MUST 3 performs solderability testing in accordance with all major international standards and comprises everything necessary for all forms of solderability tests.

Key features include:

- Automatic component alignment and testing of multi-leaded components and Printed Circuit Boards (PCBs)
- Immediate pass/fail information on completion of each test
- Step & Repeat function for multi-leaded devices
- 4 x individual globule blocks for Wetting Balance testing (see overleaf)
- 4, 3.2, 2 and 1 mm pin diameters (1 mm is for components smaller than 0402 in size)
- Purpose-built clips to secure components during testing
- Testing ability down to 0201 devices
- Storage and recall of component data, test parameters and results
- Windows® XP software
- Colour graphical display of test results
- Computer control for maximum accuracy and ease of operation
- Optional magnification for small component alignment

The **MUST SYSTEM 3** comprises everything you need to start testing straight away:

- MUST System 3
- 4 solder globule blocks using pin sizes of 4, 3.2, 2 and 1mm
- 1000 x 100 mg and 1000 x 25 mg solder pellets in conventional 60/40SnPb or lead-free SAC305 alloy, 1000 x 5 mg solder pellets for 1 mm globule testing
- ARAX Sn60/40Pb, cored solder wire
- Solder bath for either conventional 60/40SnPb alloys or lead-free SAC305 alloy
- 1 kg solder bar either Sn60/Pb40 or lead-free SAC305
- Set of 12 clips suitable for testing the most popular components supplied in a convenient storage carry case
- 50 ml each of SMNA flux, and fluxes Actiec 2 and Actiec 5
- Accessories kit comprising:
  - *40 x cotton buds*
  - *Forceps*
  - *"Dropper" bottle*
  - *Spatula*
  - *Pair of leather palmed gloves*
  - *M8 Allen key*
  - *100 ml beaker*
  - *1 box of filter paper*
- CD-ROM instruction and system operation manual

E&EO

NEW: ***LEAD-FREE TESTING KIT NOW AVAILABLE***

Wetting balance testing to all prevailing test standards

Solder bath testing to all prevailing test standards

Basic Principles of Solderability Testing

QUOTING FROM THE IPC/EIA J-STD-003A DOCUMENT:

"The solderability determination is made to verify that the printed board fabrication processes and subsequent storage have had no adverse effect on the solderability of those portions of the printed board intended to be soldered. This is determined by evaluation of the solderability specimen portion of a board or representative coupon which has been processed as part of the panel of boards and subsequently removed for testing per the method selected.

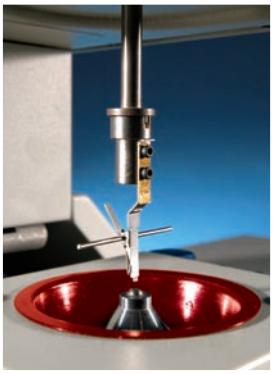
The objective of the solderability test methods described in this standard is to determine the ability of printed board surface conductors, attachment lands, and plated-through holes to wet easily with solder and to withstand the rigours of the printed board assembly processes."

The solderability of a Printed Circuit Board (PCB) or component's metallic terminations is a critical parameter in any soldering operation because it represents the likelihood of that termination forming a good alloy with the solder and a high quality solder fillet.

The most common electronics terminations include component leads and footprints, the pads of solder lands, and printed through-holes (PTHs). Unless these offer a reliably consistent level of solderability, soldering defect rates will be high, along with rework, scrapping and field failure costs.

As PCBs and components continue to become smaller and more fine pitch, coupled with the widespread use of less active fluxes, the soldering process window narrows and the impact of poor solderability increases. Although components and PCBs are generally assembled from parts of known (good) solderability, there is no way of guaranteeing this without testing: especially given that the prime cause of poor solderability is how well a part has been stored and its age.

The most effective quantitative method for measuring, testing and recording solderability is the Wetting Balance. Although the type of Wetting Balance used for through-hole (TH) and surface mount (SM) components does differ, both are based on the same physical principles. In essence, a Wetting Balance exploits the fact that if a metallic body is dipped into a bath of molten solder, the weight and speed with which the solder meniscus climbs upwards on the body's immersed surface indicates how well the solder wets it and thus its solderability. In simple terms, the greater the solderability, the higher a meniscus will climb, which can be measured as a change in the vertical force acting on the suspended specimen (Figure 1).



For TH components, the specimen device is immersed in a bath of molten solder and the forces of buoyancy and surface tension acting upon it are measured. For SM devices, a higher resolution method is required: the Microwetting Balance procedure. Here the solder bath is replaced by a globule block of 4, 3.2, 2 or 1 mm size employing 200, 100, 25 or 5 mg pellets of solder alloy (depending on specimen size) allowing individual leads to be tested on a multi-leaded component.

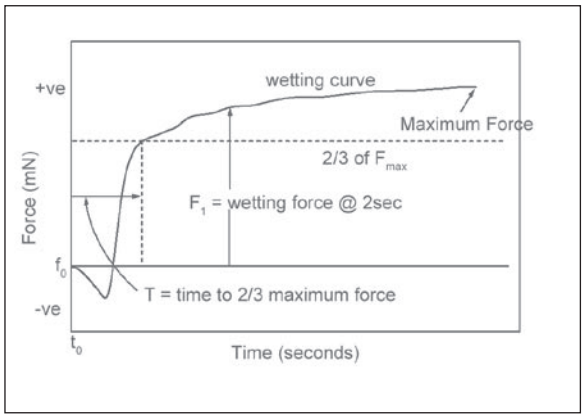
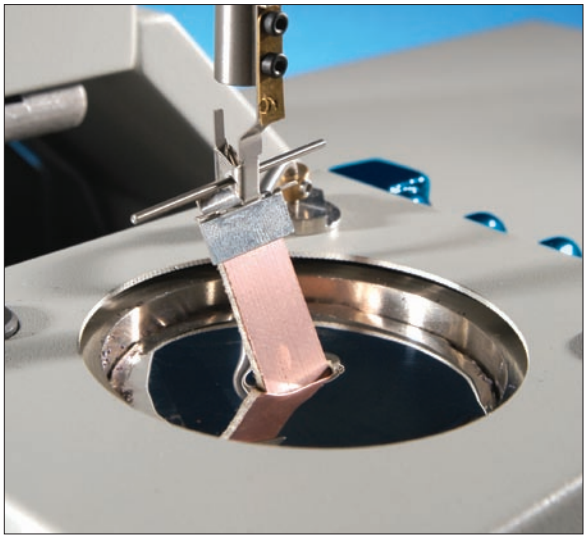


Figure 1: Typical wetting curve *(courtesy NPL)*

How the **MUST SYSTEM 3** works



The MUST System 3 is a high precision solderability tester for surface mount (SM) and through-hole (TH) components, as well as PCB pads and plated through-holes (PTHs or vias) on bare boards. It is also ideal for the laboratory testing of fluxes and other soldering materials.

By eliminating problems associated with poor solderability, the MUST 3 can significantly improve product quality and yield large potential cost savings by lowering defect rates during the soldering process. It can also help facilitate the use of less aggressive (lower activity) no-clean and environment-friendly soldering materials – including, of course, lead-free alloy testing – and is capable of testing at temperatures in excess of 260 °C.

The MUST 3 exploits the established Wetting Balance method described opposite. In operation, the MUST 3 automatically detects a small solder bath (TH devices) or globule (SM) which is mounted on a computer-controlled work table that is motor-driven in all three axes. This allows the instrument to align contact between the component termination and solder precisely, guaranteeing test reproducibility and accuracy. Furthermore, for multi-leaded components, this allows the globule to be advanced automatically to each subsequent termination. In each case, a component outline-specific specimen clip firmly holds the component in the correct position for testing. 12 specimen clips are provided as standard to allow testing of the majority of leaded and SM components, and a policy of continuous product development at Gen3 Systems means that clips will be made available for new components.

The MUST 3 exploits easy-to-use Windows-based software that guides users step-by-step through the entire test procedure via on-screen prompts. It also controls the semi-automatic replacement of the solder globule block or bath and the operation of a safety cover, preventing users from making accidental contact with the molten solder.

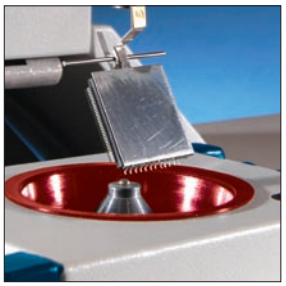
Testing is initiated by simply selecting the relevant component code and its associated set of test parameters (the MUST 3 stores hundreds of parameter and default test files of various SM components). This procedure ensures that each test is performed correctly. The MUST 3 Software then automatically calculates and records the component's solderability value and wetting curve, which can be presented as an immediate pass/fail for each device or stored for future reference.

The MUST 3 also allows bare board manufacturers and assembly companies to test and guarantee the solderability of their PCBs. Although quantitative standards do not yet exist for the solderability testing of PCBs (but are being investigated by various national and international committees) the instrument extends the scope of the present Microwetting Balance test for SM components to encompass SM pads and PTHs as well.

Step and repeat testing of multi-leaded components

Test pieces require a series of pads or PTH land areas such that the edge of each pad extends to the edge of the PCB or test piece. The sample is placed into a special clip to allow it to be lowered at an angle of 45° to the solder globule. The number of pads or PTHs may be pre-programmed so that the solder globule advances automatically to perform the next test (see opposite). The globule block is lowered between each test to allow the flux and solder pellet to be replaced. The sample is immersed in the solder globule to a depth of 0.1 mm and the wetting force registered.

Test result presentation options (such as immediate pass/fail) are identical to those offered for components. Test results can also be displayed as a series of colour-coded wetting force curves, with failed components highlighted on the results display screen. Graphs and test data can be sent direct to a suitable parallel printer and/or stored on disk.



The MUST 3 has an optional magnification enhancement system to aid in testing the solderability of very small devices such as 0402s and 0201s, 1.27 mm pitch or smaller multi-leaded components, and miniature PCB test samples. A supplementary visual analysis can also be extremely useful in R&D and SPC applications as it allows users to visually correlate the test data.

The Gen3 Systems **MUST SYSTEM 3** is uniquely able to offer a 'Step & Repeat' function for multi-leaded devices

The method is specifically designed to meet the enhanced testing demands of the latest miniaturised SM designs and packages.

For TH devices the component lead, or surface to be tested, is fluxed with a standard flux and dried. It is then suspended from the Wetting Balance and immersed to a pre-set depth into the oxide-free, molten solder bath that is held at a stable thermostatically controlled temperature, and raised upwards at a given speed to meet it. The Wetting Balance measures the vertical force acting on the specimen over time.

Changes in forces, during wetting, are converted by the Gen3 Systems MUST 3 Plus instrument; for example, into digital signals (at a high sensitivity sampling rate of 1000Hz). This data is then automatically collected, stored and analysed by the software. This results in the production of a graph of force against time (a wetting curve) from which the solderability of the specimen under test can be analysed (as illustrated opposite).

A typical curve – as illustrated in Figure 1 – will first dip downwards (due to the upthrust or buoyancy of the molten solder on the immersed specimen). This lasts for a short time until the test specimen is warm enough to be wetted by the solder and for the flux to begin its work. With small specimens this will happen quickly and may even start during the immersion.

The curve (along with the solder meniscus) will then climb upwards at a rate governed by the efficiency with which the flux cleans the specimen surface. When the meniscus stops climbing, the wetting curve flattens out to what can be considered its maximum value. The force recorded at this point is called the wetting force. The larger the wetting force, the better the solderability of the component. The amount of time that is required to achieve maximum force or wettability, then determines the suitability of the component under test, to the soldering process and line-speed that is in use.

Early attempts to produce a reliable scientific method for measuring the solderability of SM components were hindered by the design of traditional TH Wetting Balance instruments and difficulties associated with handling and aligning smaller devices with precision.

Although the standard TH Wetting Balance could be used to test larger SM components, the test is difficult to perform on smaller SM devices due to a lower measurement resolution. This is because the buoyancy of small components in molten solder is close to the size of the wetting force being measured. A much better technique is known as the 'Microwetting Balance' procedure in which the solder bath is replaced by a small globular block of solder.

This technique produces a larger wetting force for analysis and also allows small surfaces, such as 0402 or smaller terminations, including 0201s, and the individual leads on a multi-leaded component, to be tested. As before, the specimen is fluxed, dried and suspended from the measuring head of the Wetting Balance.

A thermally stable (heated) table carries a molten solder pellet of 5, 25, 100 or 200 mg, dependant upon the globule unit in use. Once again, it is raised against the specimen from below until it touches the specimen. As soon as the globule makes contact with the component termination, the surface tension of the bridge of molten solder (which forms between anvil and specimen) pulls it downwards. The wetting curve and solderability is then calculated in terms of the time taken for the resultant wetting curve to reach two-thirds of its maximum value (normally within a second).

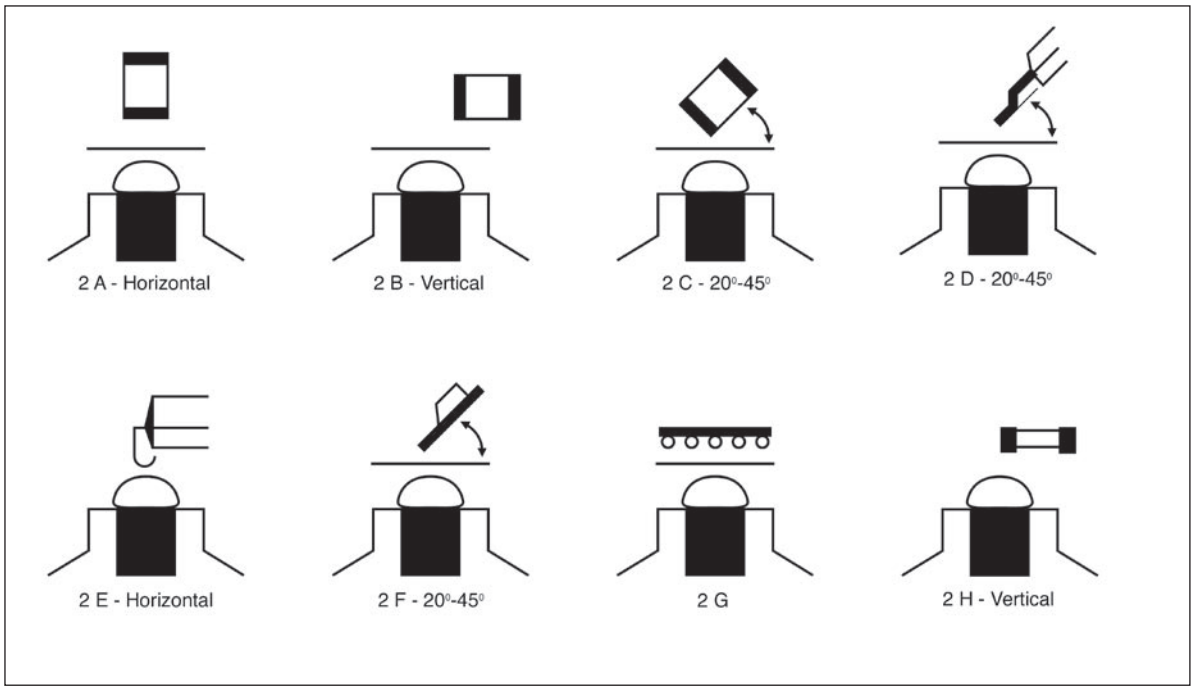
Solderability Tests for Components

QUOTING FROM THE IPC/EIA/ JEDEC J-STD-002B DOCUMENT:

"Solderability evaluations are made to verify that the solderability of component leads and terminations meets the requirements established in the standard and that subsequent storage has had no adverse effect on the ability to solder components to an interconnecting substrate.

Determination of solderability can be made at the time of manufacture, at receipt of the components by the user, or just before assembly and soldering.

The resistance to dissolution of metallisation determination is made to verify that metallised terminations will remain intact throughout the assembly soldering processes."



TECHNICAL SPECIFICATION

SOLDER TEMPERATURE:	0 – 350 °C (32 – 622 °F)
DIPPING SPEED:	0 – 30 mm/s (0 – 1.2 in/s)
IMMERSION DEPTH:	0 – 30 mm/s (0 – 1.2 in/s)
DWELL TIME:	0 – 30 s
MAXIMUM COMPONENT WEIGHT:	40 g
FORCE SAMPLING FREQUENCY:	1,000 Hz
GLOBULE SIZES:	1 mm (5 mg), 2 mm (25 mg), 3.2 mm (100 mg) or 4 mm (200 mg)
SOLDER BATH DIAMETER:	60 mm (2.38 in)
SOLDER BATH CAPACITY:	1 kg (2.2 lb)
POWER SUPPLY:	240 V, 50 Hz or 110 V, 60 Hz
POWER CONSUMPTION:	750 W
NET MACHINE WEIGHT:	45 kg (100 lb)
PACKED (SHIPPED) WEIGHT:	70 kg (115 lb)
PACKED (SHIPPING) SIZE:	970 x 730 x 540 mm (37.25 x 19 x 27 in)
VISUAL MAGNIFICATION (OPTIONAL):	

MUST SYSTEM 3
SOLDERABILITY TESTING SYSTEM

SOLDAPRO
THERMAL PROFILING

AUTO-SIR
SURFACE INSULATION RESISTANCE TESTING

CM-SERIES
CONTAMINATION TESTING

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