



3 and 4 Point Flexural Testing

Application Note

With ever increasing demand for high quality and reliable electronic components and materials, flexural tests have become an important test method in both the manufacturing process and research and development to define a material's ability to resist deformation under load. A component's or material's flexural strength provides critical insight into the modulus of elasticity in bending, flexural stress and flexural strain.

The rising popularity of human interface devices such as touch screens means that everyday devices such as mobile phones are subjected to many cycles of flexing during normal use. As a result manufacturers are committed to ensuring products do not fail within their planned lifetime and of guaranteeing performance across a range of usage scenarios. In order to achieve this, the manufacturing and quality control processes need to be optimised by testing the performance of the material or product.



Bend testing of final assembly

Test Methods

Flexural tests simulate stresses of tensile and compression on a specimen, such as PCB or final assembly. The physical response behaviour of the PCB or assembly is then monitored. Two common methods to test flexural strength involve destructive and non-destructive testing.

Destructive tests involve applying a uniform force on a PCB or assembly until it fails and recording the maximum force required as well as the distance displaced.

Non-destructive tests involve applying a uniform force up to a specified limit and recording the displacement and ensuring the PCB and assembly can tolerate the specified force.

Cyclical and fatigue testing, where specified force-displacement and force-time waveforms can be executed. This test method enables different strain rates to be induced onto a sample over a period of time, allowing analysis of cycles to failure as well as force-displacement and force-time characteristics to be determined.

The Nordson DAGE Solution

The Nordson DAGE 4000*Plus* tester provides the ability to perform 3 and 4 point flexure tests. A combination of fixtures as well as bespoke test solutions conform to a range of international standards including; ASTM D790 and D672, IPC TM-650, IEC 61189-2:TM20 and ISO 14125.

■ 3 point flexure test

The 3 point flexure fixture produces its peak stress at the specimen mid-point with reduced stress elsewhere. This stress localisation is ideal for testing for specific isolation of stress on a component or material.

■ 4 point flexure test

The 4 point flexure fixture produces peak stresses along an extended region of the specimen hence exposing a larger length of the specimen with more potential for defects and flaws to be highlighted.



Push/pull 50kg with 3 point bend jig

■ Bespoke tests

Specimen testing provides one aspect of flexural strength properties. Materials and substrates may go through several phases, such as heat reflow, before a complete product is produced. These steps can reduce the flexural strength of a product.

Nordson DAGE provides bespoke test solutions which cater for unique properties and designs in order to aid end product testing. This provides a clear flexural strength of the end product.

Please contact Nordson DAGE for further information.

Software:

The Nordson DAGE Paragon™ flexure test software features an easy to use interface allowing minimum test setup time, enabling the following material characteristics to be determined:

- Flexural strength: defined as the materials or assemblies ability to resist deformation under load. Measured at the moment of rupture where the highest stress is experienced within the material.
- Stress-strain properties: the relationship between stress and strain. Usually represented graphically. From this graph the following properties can be determined:
 - Flexural offset yield strength
 - Tangent modulus of elasticity
 - Secant modulus of elasticity
- Flexural stress
- Flexural stress at break
- Stress at given strain
- Flexural strain
- Chord modulus

In addition, the Paragon flexure test software allows bespoke cyclic testing for custom test procedures, user defined cyclic patterns and selectable load range and speeds. Destructive and non-destructive tests are also featured. These custom test features allow for the determination of fail points of components or materials.



4 Point bend Jig

Typical example of test

PCB and SMT technology are constantly facing new challenges in packaging and substrate design, where a typical product such as a mobile phone will undergo many types of mechanical strain and shock. Flexural testing has to be performed in order to determine how the product will react under force or changing forces such as bending or flexing.

It is also important to determine the flexural properties of the product so that the design is within the desired tolerance. Cyclical and fatigue testing determine how long the product can sustain certain forces before failure and hence allow correct design of product.

A flexural test would allow a range of characteristics to be determined of a PCB, including maximum force to failure, cycles and time to failure, flexural strength and flexural strain. These characteristics can help determine the quality of a bare PCB material or final assembly in order to deduce quality and reliability which was not previously possible on a bond test platform.

Nordson DAGE provides a complete solution for 3 point and 4 point testing which coupled with the cyclic and fatigue software capabilities provides for a robust, reliable and repeatable test for research and development, test and inspection as well as process control.

The Nordson DAGEe 4 point bend jig utilises an additional displacement sensor to measure midspan deflection of a sample under test accurately to 50um, this is achieved with a Baumer laser displacement sensor.

Paragon™ Software Flexible Analysis and Reporting

Data Analysis

Paragon provides an incredibly flexible analysis suite suitable for the most demanding of applications including:

- On-board statistics and Statistical Process Control (SPC) package complete with histogram distribution curves (mean and current samples)
- Force trend analysis (with box whisker and optional mini histogram on the same chart)
- Grade pareto
- Loop height trend analysis
- Force/time displacement curves

All combined with a powerful statistical results display, for mean, maximum and minimum range, standard deviation, mean – 3s, Cpk and Cp.

Data Manipulation

Data can be manipulated in a number of ways:

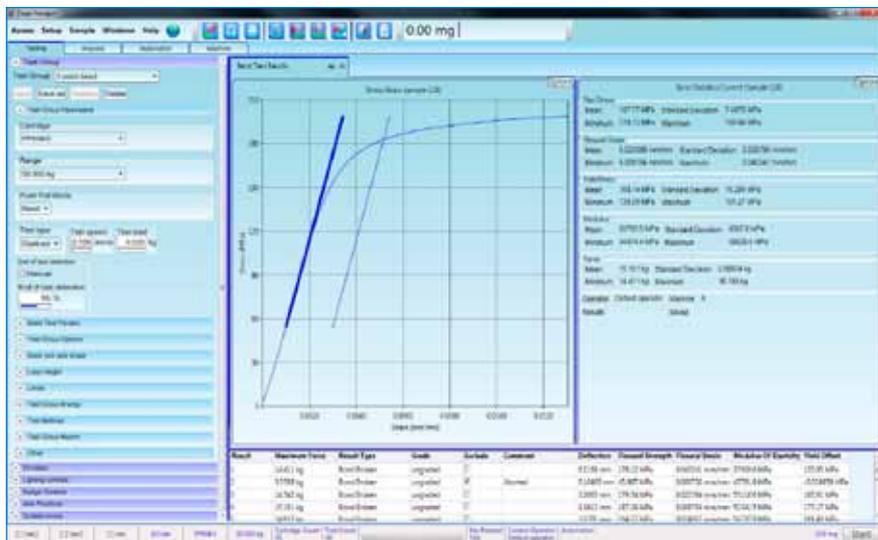
- ODBC compatibility (locally or via a network link)
- RS232 including a fixed field option
- CSV file format availability
- Copy results to the clip board to paste directly into Microsoft Excel or save direct to Excel or Word

Third Party Statistical Process Control (SPC)

Paragon can be configured to output results into industry leading SPC packages. These packages are directly available from, and supported by, the manufacturer.

Exporting Results

Test results can be saved directly to Microsoft® Excel and Word as well as Adobe® Acrobat, while graphs can be exported in common picture formats, such as .jpg, .tif and .bmp.



Flexural test results analysis

For more information,
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