

Bond Testing of LEDs

Application Note

LEDs offer an energy efficient, low maintenance form of indication and illumination. LEDs are rapidly becoming the option for lighting design from architectural lighting systems to medical equipment, display systems, street lighting to automotive lighting. Most LEDs have a natural lifespan - while degradation failures are unavoidable, correct LED manufacturing processes ensure that they do not fail within the planned life of the product.

Heat generated by the LED is a key issue. Heat stresses the die attach as well as the wire bond which causes displacement in the bulk of moulding compound.



Typical LED device

If heat is not removed efficiently from the die there will be degradation of both performance and quality of light produced. Thermal and mechanical stress weakens the wire bond, eventually leading to failure.

Wire bonds within LEDs need to perform in all possible environments the LED will be exposed to in its lifespan, with this in mind the manufacturing process needs to be carefully monitored and optimized to guarantee a long operating life of the product.

LEDs typically fall within two major categories; high performance LEDs and general high volume LEDs. The testing requirements differ but both are met by the Nordson DAGE bondtester.

Test Methods

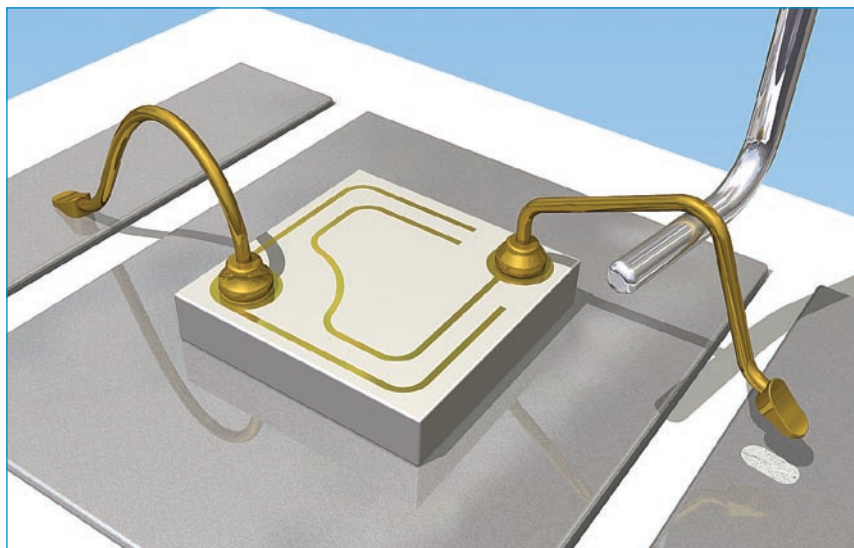
The Nordson DAGE bondtester caters for the full range of test methods including:

- Wire pull
- Ball shear
- Die shear
- Low profile die shear
- Tweezer pull
- Wafer level LED

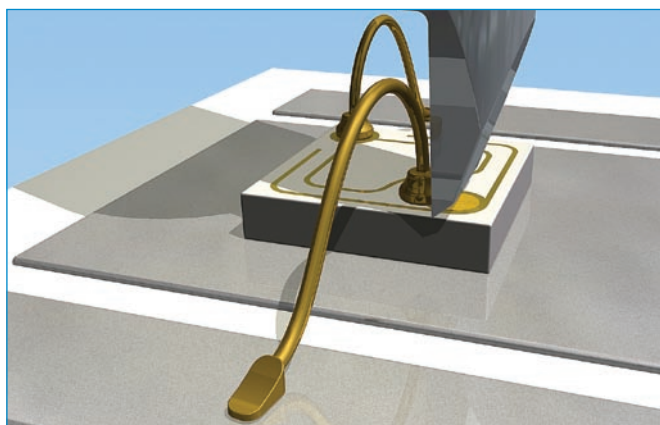
Wire Pull Test

The wire pull test evaluates the wire bond quality and integrity and is also used for wire bonding process control and process optimisation during assembly manufacturing.

As LED wire loops can be very short and low, the Nordson DAGE wire pull cartridge offers 360 degree rotation of the test hook and a wide range of tools to cater for all geometries. The loop height measurement feature automatically detects the height of the loop and monitors its consistency. The wire breaking force and loop height are saved in the database to enable future analysis.



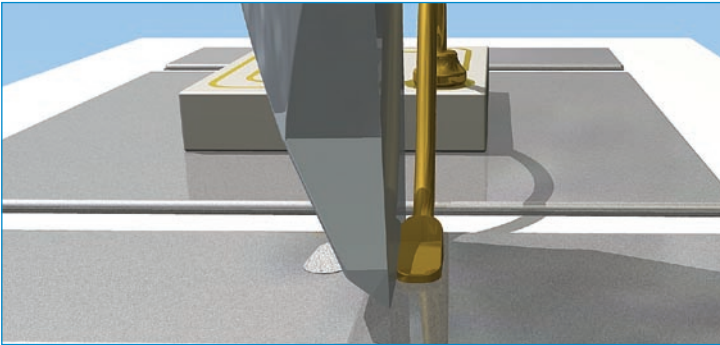
Wire Pull Test



Ball Shear Test

Ball Shear Test

Where the wire pull test provides one aspect of bond integrity measurement, in order to achieve a complete test of the bond, the Nordson DAGE ball shear cartridge provides ball shear test capabilities that can be performed with chisel or cavity tools. With an additional feature of tool rotation up to 180 degrees for accurate alignment and operator convenience. The Nordson DAGE ball shear cartridge features a touchdown sensor to allow smooth and accurate landings on the brittle LED die. The touchdown force is highly sensitive and accurate step back repeatability typically better than $\pm 1.0\mu\text{m}$.



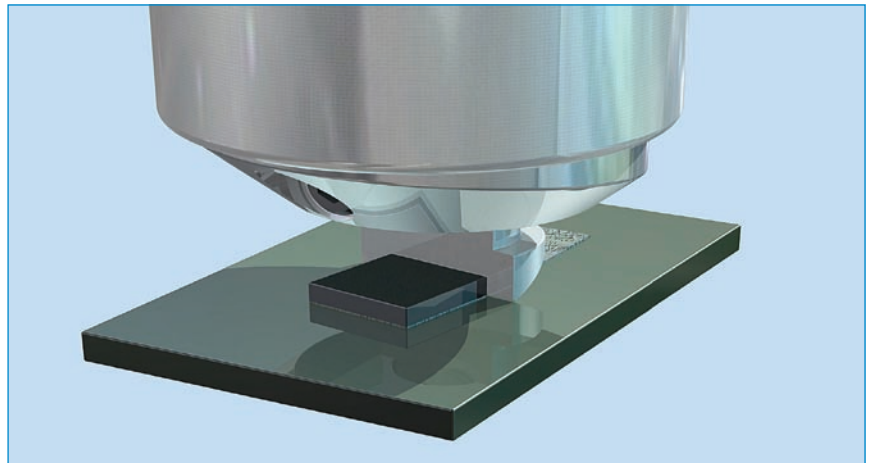
Wedge Bond Shear Test

Tweezer Pull Test

In order to achieve a complete test on an LED wire bond, after the ball bond has been sheared, the wire on the wedge side can be tested using tweezers. The Nordson DAGE tweezer pull cartridge parallel closing tweezers can be controlled to apply the closing force very accurately to the interface; providing consistent and accurate testing in all LED die bond applications.

Die Shear Test

GaAs and other LED die materials are very brittle, therefore an absolute parallel alignment of the shear tool to the edges of the die is required otherwise the die will break before the necessary load can be applied to test the interface. The Nordson DAGE self-aligning shear tool ensures absolute parallel alignment. The operator simply positions the tool to one edge and then the self-aligning adapter applies the load uniform to the whole width of the die.



LED Die Shear Test

Low Profile Die Shear Test

Constant innovation means that dies are getting thinner in order to better transfer the heat to the package however the areas are also becoming larger due to the higher light output required. In order to meet these new testing demands, the Nordson DAGE die shear cartridge provides excellent step-back repeatability and a work holder which allows co-planarity levelling which together ensure the high repeatability of shearing low profile dies is guaranteed.

Wafer Level Ball Shear Test

Tests can be performed on LED wafers. The high step back accuracy of the Nordson Dage bondtester allows accurate shear tests to be performed at wafer level.

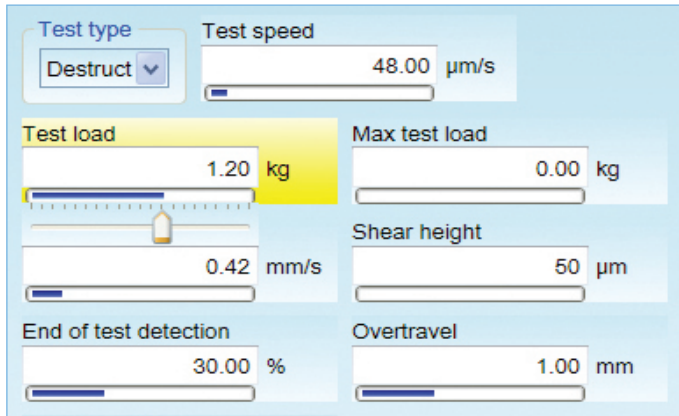
The Nordson Dage bondtester has a versatile range of standard and application specific wafer chucks.

The chucks will accommodate single or multiple wafers dependant on their diameter.

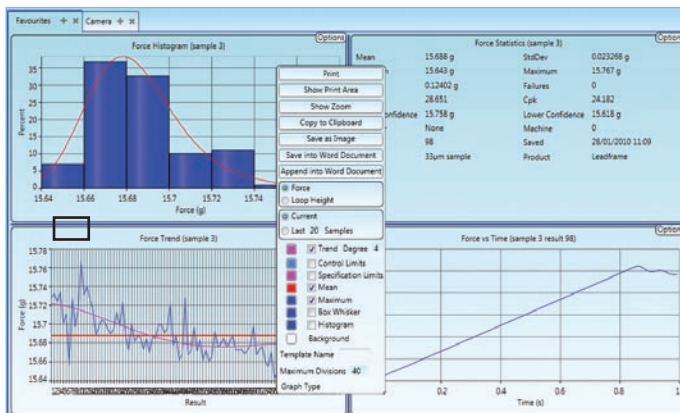
This combined with semi automatic test routines allows efficient, repeatable and consistent bond testing for improved throughput.

Paragon™ Intelligent Bond Testing Software

Nordson DAGE's next generation bond testing software Paragon takes bond testing to the next level. Its highly intuitive and configurable interface provides quick and easy access to advanced functionality, increasing efficiency and providing 100% confidence in your bond testing results.



Quick and Easy Test Set-Up Intuitive design ensures test set-up parameters are easily accessible with the start-up check list enabling a quick start



Advanced Data Presentation Extensive charting functionality allows several graphs to be displayed at once and to resize and zoom in easily

For more information,
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