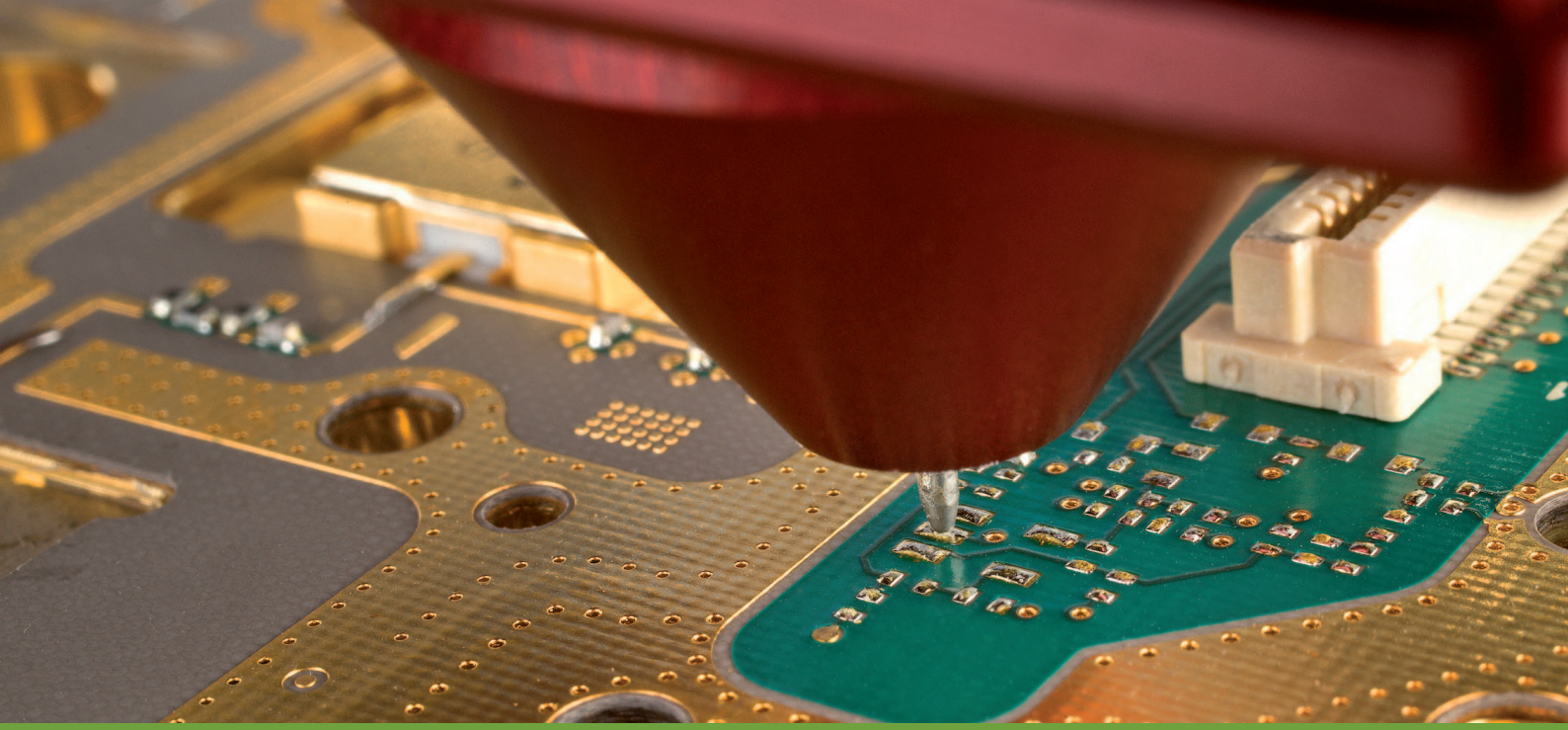


Hot Bump Pull/Hot Pin Pull

Application Note

The shift from tin-lead to lead-free materials has had many affects on the surface mount technology and printed circuit board industries. These affects continue to be a major focus of many sectors from telecommunications, military, aerospace to consumer electronics.

A common failure mode in lead-free assemblies is pad cratering, where the contact pad on a PCB or package substrate lifts away. There are many factors that cause this failure mode to be more prevalent in lead-free assemblies compared to tin-lead assemblies, these include:

- Lead-free solders are mechanically stiffer than tin-lead solders, hence it transfers more strain to the assembly.
- Lead-free solder requires higher reflow temperatures as well as cooling rates compared to tin-lead. This can lead to increased strains on the assembly.

Mechanical testing such as bend and shock testing are common practices on surface mount assemblies and printed circuit boards in order to verify product design, ensure quality and ultimately to ensure product longevity. The mechanical stresses applied, evaluate the susceptibility of a product to failure.

Although these mechanical test methods test the entire assembly, it can however be difficult to differentiate the types of failure modes occurring during the test. Common factors which contribute to different failure modes include:

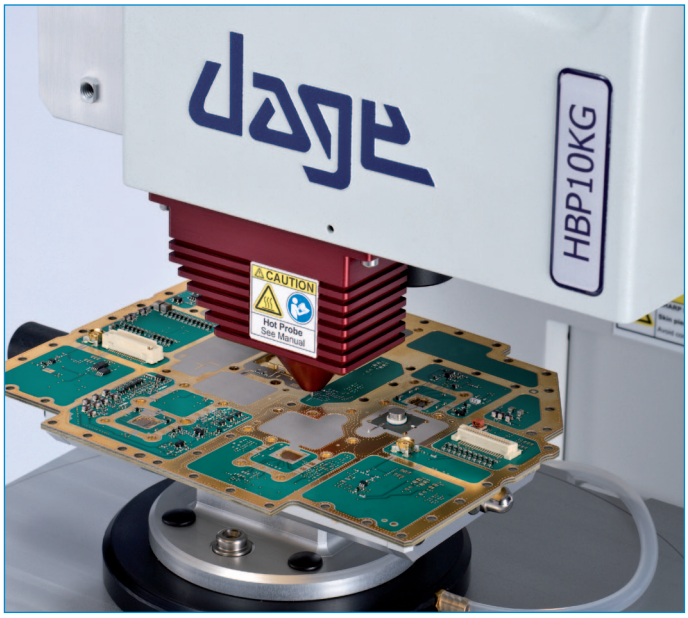
- Solder metallurgy
- PBA materials
- Reflow conditions

It is therefore important to isolate the failure modes in order to identify any weaknesses in the assembly. This is an important part of development and production, as it ensures correct design of product, manufacturing process control as well as quality of product produced.

Nordson DAGE

What is Hot Bump Pull?

The latest pad cratering standard, IPC-9708, defines hot bump pull as a method to evaluate the susceptibility of printed board assembly materials and designs to cohesive dielectric failure underneath surface mount technology attach pads. A method that can be used to rank order and compare different materials and parameters.



Hot Bump Pull load cartridge

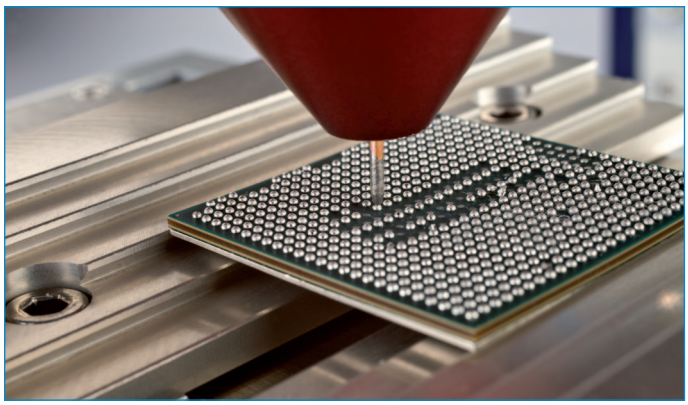
The new Nordson DAGE 4000*Plus* HBP system is a totally industry unique solution, conforming to IPC-9708 as well as JEITA ET-7407A. It is fully integrated into a single load cartridge on a standard 4000*Plus* system. Heating, cooling stages and pin clamping mechanism are integrated into the single load cartridge. The Paragon™ software provides a user friendly interface via temperature time profiles to setup a test.

The new cartridge design allow simple straight test pins to be used, allowing maximum force to be transferred as well as providing a low cost consumable for testing. The new straight pin design provides successful and consistent testing.
It is important to pull the pin vertically, directly by the apparatus without imposing any bending moments.

The Hot Bump Pull Test Procedure

The test procedure consists of two parts, set up of the test parameters and positioning of the pin over a solder bump.

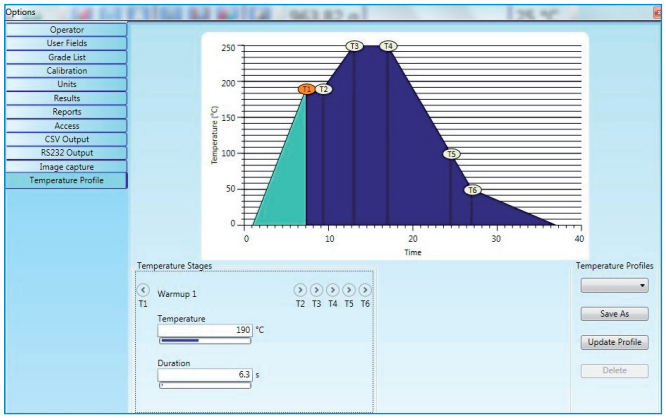
First a temperature profile is created, this allows a user to input temperature and time criteria for reflow and test conditions.
This simple interface only requires the desired temperature and the time to reach that temperature. The heating and cooling rates as well as test execution are then automatically handled by the hardware and software.



Close up of copper probe on BGA

A temperature time profile consists of the following stages.

- **Preheat**
- **Soak**
- **Rate of rise**
- **Reflow/Liquidus**
- **Cool down**
- **Test execution**



Temperature-time profile in Paragon™

T1 is the preheat region, this is selected by defining the temperature to reach and the time to achieve this heating period.

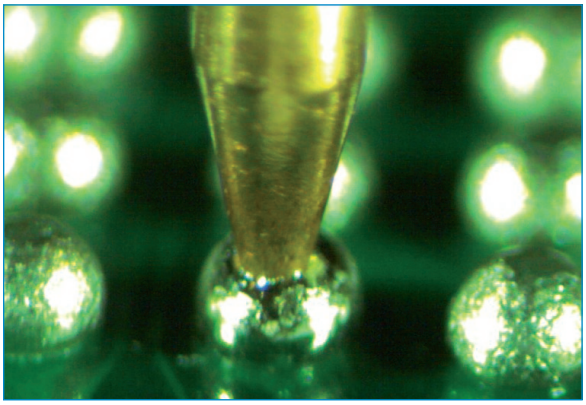
T1 to T2 is the soak period, the soak time can be selected.

T2 to T3 is the rate of rise.

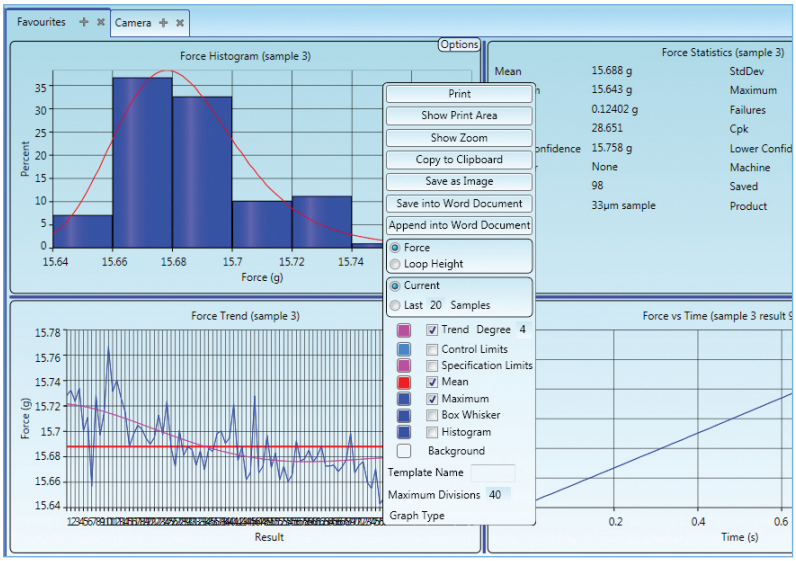
T3 to T4 is the reflow period, the reflow time period can be selected.

T4 to T5 is the cooling period.

T6 is the temperature where the test will be executed.



Close up of solder ball reflow



Test results in Paragon™

A straight pin is vertically inserted into the cartridge, where it is held in place. The pin is then lowered onto the solder bump via motorised horizontal and vertical stages. The pin is set so that it is touching the solder bump. The test is then executed, where the pin temperature ramps up according to the defined temperature profile created. At reflow point the pin drops down to a desired level, ensuring a good solder joint. The clamping mechanism then engages and clamps the pin so it is ready to be pulled. The cooling is handled internally by pulsing compressed air past the pin and onto the test sample, cooling at the defined temperature profile.
Once the test temperature is reached, the test is automatically executed, recording the force-time, force-distance and energy values.

Nordson DAGE

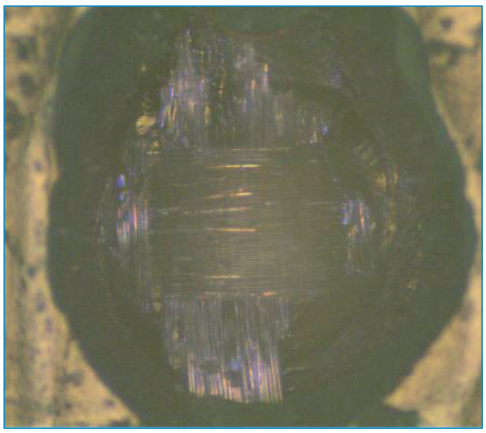
Hot Bump Pull/Hot Pin Pull Application Note

Failure mode inspection

Conducting a HBP test and producing a failure mode is one part of the test. The other is to capture the visual data and be able to store it in a convenient manner, not slowing down the testing operation.

The 4000*Plus* has the capability to take detailed images in between tests. This is achieved via the optional built in image capture camera. The camera can be set up to take a high resolution image of the area under test and store it for analysis or reporting.

The test operator can also allocate appropriate failure modes via a user friendly GUI, which is important for failure analysis. Reports can be generated where force, data, failure mode and image can be presented.



Failure mode image capture via integrated camera

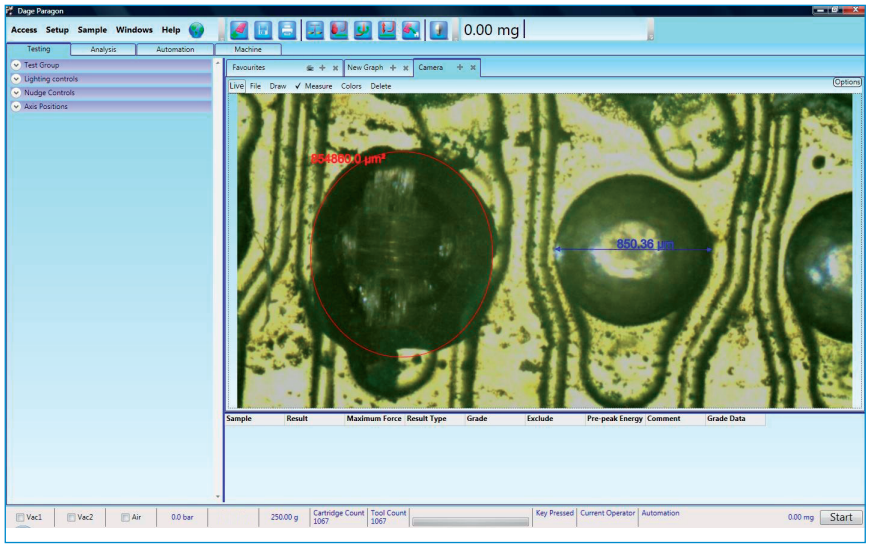


Image analysis within Paragon™

For more information, please contact your Nordson DAGE regional office or speak with your Nordson DAGE representative, all of which are listed on www.nordsondage.com.

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