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Comparative Analysis for Die Attach Dispensing Methods

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I. INTRODUCTION

Die attach, also known as die bonding, is the process of attaching (or bonding) a die (or chip) to a substrate, leadframe or another die. This process can take on many forms and can be applied in many different ways. The common die attach material is Epoxy.

Epoxy Dispensed through dispensing needle or nozzle by controlled volume on the substrate. The location of the dispensing is controlled with vision control system in the die attach equipment as illustrated in Figure 1.

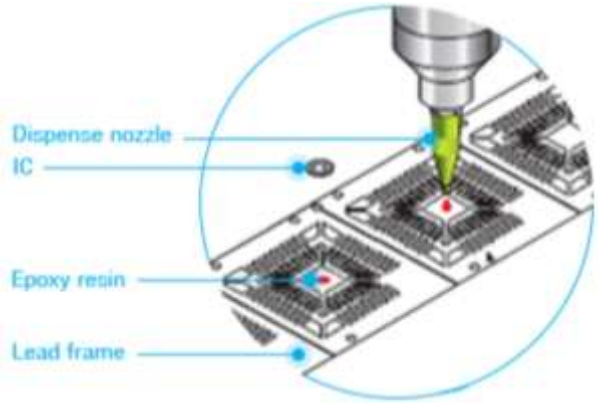

Fig. 1. Epoxy Dispense

Die attach material selection and process implementation play crucial roles in any microelectronic assembly. The chosen attach methods ultimately affect die stress, functionality, thermal management, and reliability of the assembly. Die attach applications are designed to optimize mechanical attachment of the die to the substrate, to create a thermal path from the die to the substrate, and to create an electrical path for a ground plane connection. Some of the more commonly used die attach materials in the microelectronics industry today are epoxies, polyimides, thermoplastics, silicones, solders, and special low outgassing, low stress, anisotropic adhesives.

The most common method systems used in Paste dispensing adhesives use a time pressure dispensing valve, auger pump, positive displacement pump, or a jetting valve. Each technique has its unique advantages and disadvantages.

Pneumatic Time-Pressure Dispensing Valve: The time-pressure dispensing valve (Figure 2) consists of a syringe containing adhesive which is directly attached to the dispensing tip. Adhesive is fed from the syringe using pressure in a time-controlled manner. Pressure is removed to stop material flow. Fluid flow is proportional to the amount and duration of the applied pressure. Since the air pressure is kept constant over time, as the syringe is emptied, dot sizes decrease because the plunger does not advance as far with each air shot. This variability can be adjusted by increasing the air shot size, but is often operator dependent and can lower throughput. Time-pressure systems are the most economical dispensing solutions, but have a lot of variation in their results, and are limited in the minimum dot size they can produce.

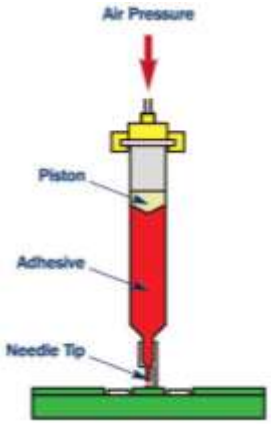

Fig. 2. Pneumatic Time-Pressure Dispensing Valve

II. PROBLEM IDENTIFICATION

Pneumatic Dispense is Air pressure forces the adhesive through the dispense needle. The Limitation is the Speed affects consistency due to limited pressure supply and Viscosity dependent.

Fig. 3. Pneumatic Dispense

Using the current machine epoxy dispenser, the variations

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in the amount of dispensed glue was experience. This variation can lead to different Bondline Thickness (BLT) and glue fillet height resulting in defective parts.

As the remaining volume in the syringe reduces, the amount of glue volume dispensed is reduced. Hence the pressure has to be increased to dispense the same volume with the machine buy-off was done. Current dispensing machine is not equipped with Auto compensate.

III. Process Improvement

The aim of this evaluation was to compare the consistency of glue dispensed between a Pneumatic (pressure-time) dispensing and a Musashi controller. To achieve more accurate and precise dispensing control.

Musashi Dispenser Controller the pressure and vacuum through Air Pulse Stabilization Circuit. It has an automatic correction of volume reduction in dispensing amount caused by the effects of decreased syringe volume as illustrated in figure 4. Constantly maintains the optimum volume level automatically for more reliable dispensing precession.

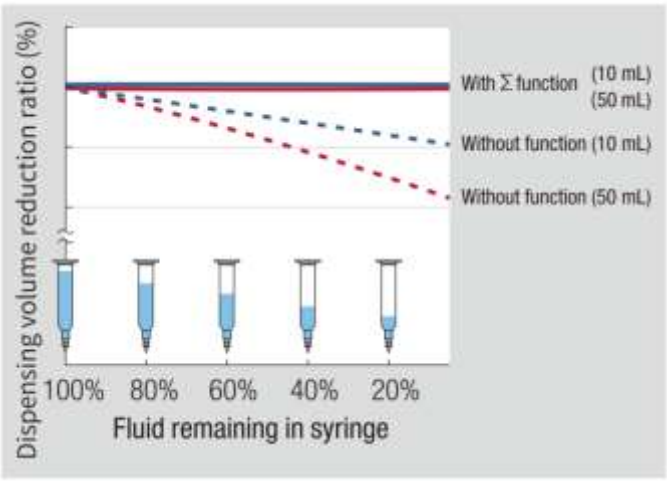

Fig. 4. Dispensing Volume Reduction

IV. Evaluation Assembly

Test 1: Data by lead frame using Timed mode function
Method: A preliminary test was carried out to check for dispensing consistency. The method used for this test was that:

1. Eight raw lead frames were marked.
2. Each lead frame was weighted.
3. Glue was dispensed on four lead frames using the Pneumatic Time-Pressure Dispensing system.
4. The Musashi controller was then connected instead of the Pneumatic Time-Pressure Dispensing system and glue was dispensed on the remaining four lead frames.
5. Measure each glue weight.

The difference in weight of glue between the Pneumatic Time-Pressure Dispensing system and the Musashi controller was not of major importance. This difference was a result of different glue weight or volume, over the time or syringe epoxy level, hence different glue fluctuations in dispensed volume as the remaining glue reaches the end of the syringe.

Better results for both range and variance were obtained when using the Musashi controller (Figure 6). Compare with Pneumatic Time-Pressure Dispensing Valve (Figure 5). This test was to measure the weight of one complete dispensed lead frame. More tests will be carried out to measure the weight of single positions to eliminate and fluctuations within the same lead frame.

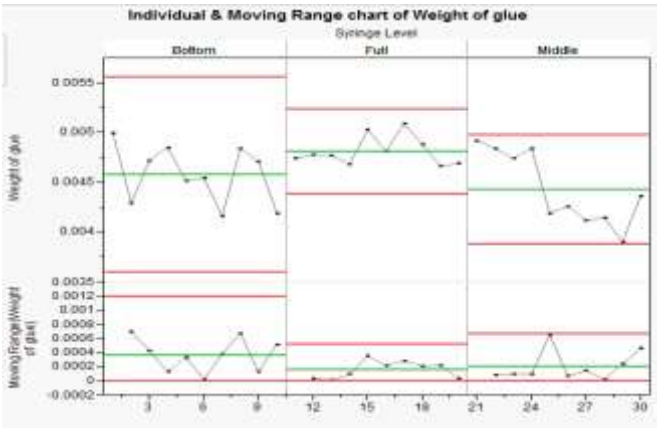

Fig. 5. Individual & Moving Range Chart for Pneumatic Time-Pressure Dispensing Valve

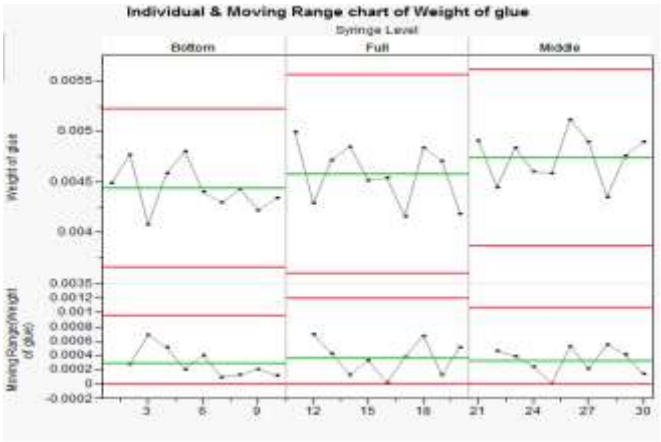

Fig. 6. Individual & Moving Range Chart for Musashi Dispenser

Test 2: The procedure used for this test was similar to the method used for the previous test. However instead of measuring the glue weight, we will measure the Bondline Thickness (BLT).

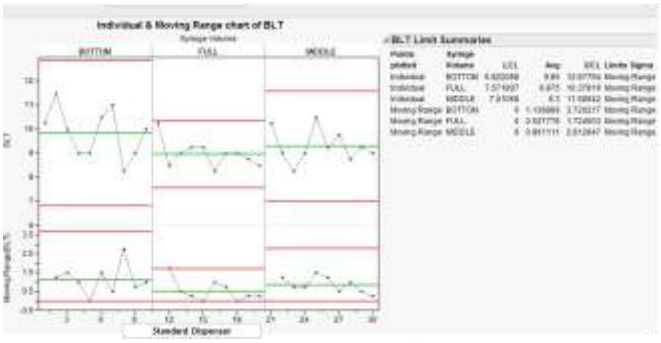

Fig. 7. Individual & Moving Range Chart for Pneumatic Time-Pressure Dispensing Valve

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For this test, better BLT results were obtained using the Musashi controller for glue dispensing (Figure 8). Compare with BLT measurement obtained form Pneumatic Time-Pressure Dispensing system (Figure 7). This difference was a result of different glue volume, hence different glue fillet and bond line thickness between the two runs. Both runs were within specification limits.

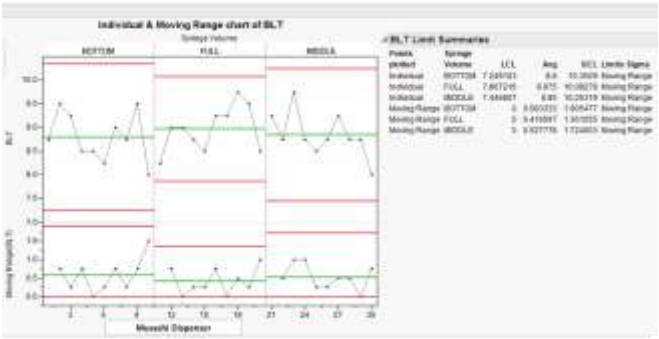

Fig. 8. Individual & Moving Range Chart for Musashi Dispenser `

In this exercise it was noticed that Musashi dispenser controllers have performed appropriately. In fact, very good data and small variations were observed resulting high Process Capability (Cpk) computed compare with Pneumatic Time-Pressure Dispensing system (Figure 9). The objective of this task, which was to compare the consistency of glue dispensed with less variation.

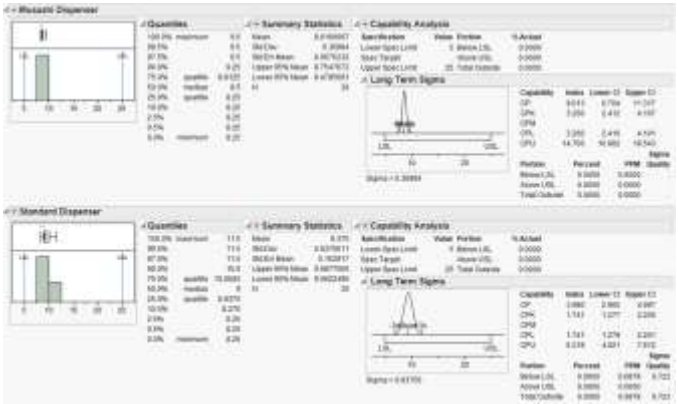

Fig. 9. Process Capability

Using Statistic tools 2-Sample T-test were fined out, at 95% confidence level, there is significant difference in BLT between Pneumatic Time-Pressure Dispensing system and Musashi Dispenser with P-value of 0.006. The Means are statistically being different with 26% variation in BLT.

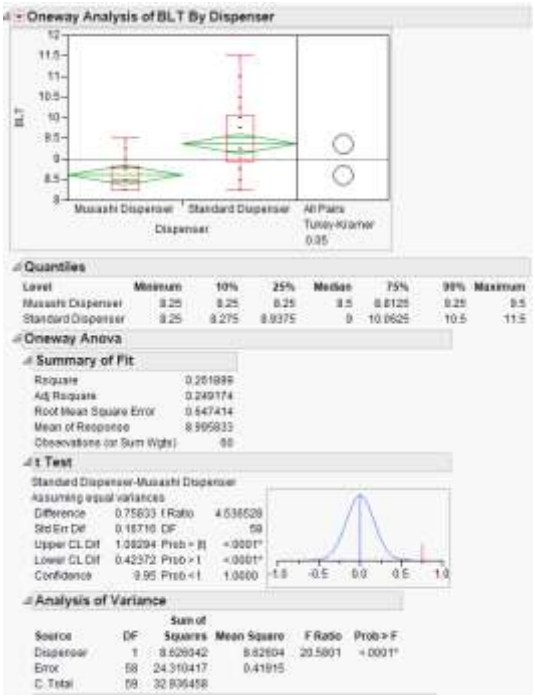

Fig. 10. 2-Sample T-test

V. CONCLUTION & RECOMMENDATIONS

It is believed that since the Musashi controller offers more options to control the dispensed volume as the remaining material in the syringe reduces, it can be a more suitable tool for glue dispensing. However, for each die size, different parameters have to be set. In order to find out these parameters, a test on each existing product/ die size must be accomplished. Moreover, when the dispense parameters are set, the dispense process speed (which is set from the die attach machine) must be kept constant. If the process speed is varied, the whole exercise must be carried out to find the suitable dispensing parameters of the Musashi controller. This is because the process speed of the dispenser is not directly linked with the dispensing time set in the Musashi controller, unless the Musashi controller is operated in manual mode (automatic correction of volume reduction not available in manual mode).

After the implementation of this change the glue volume consistency will be more stable. This controller has the option for pressure and vacuum compensation as the remaining fluid in the syringe reduces. Musashi dispenser controller is equipped with empty syringe detection. This can prevent fluctuations in dispensed volume as the remaining glue

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