## Basics of Automated Dispensing for Electronics Manufacturing

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Automated dispensing of electronic materials in fluidic form is employed across the full range of electronics manufacturing, from board-level assembly to semiconductor applications. Materials dispensed can range from very low (water like) to very high (toothpaste like) viscosity and encompass many different functions. These include solder paste to electrically connect components, encapsulants to protect devices from atmospheric conditions, Thermal Interface Materials (TIMs) to help dissipate heat from parts, and adhesives to attach parts to a substrate or assembly.

Each material may be dispensed in a range of dot sizes or complex lines and patterns depending on application requirements. Common applications include underfill, selective coating, fastening, dam and fill, potting and dielectric dispense. Shape and function are determined by the type of pump(s) mounted in the dispenser. A dispenser may be fitted with more than one pump head types so that it can perform multiple dispense operations on a single substrate. For example, for an individual PCB or workpiece being processed, one pump head might be dispensing tiny adhesive dots 300 microns in diameter to hold very small passive or chip components onto the assembly, while the other head is performing an encapsulation operation on a wire-bonded chip, or applying a selective coating.

When electronic materials such as solder paste are being stencil printed onto a PCB, for example, multiple depositions are made at once. Dispensing in most cases is slower than stencil printing. Some dispense methods eject one dot at a time; thus, minimizing cycle time between dots is the key to achieving a reasonable production throughput. Many factors contribute to cycle time in the dispense process, and one of the simplest is known as Dwell. Dwell, measured in milliseconds, is the time that the dispense head remains in the down position after dispensing a material to allow for sufficient wetting of to the substrate so that when the head lifts away, the dot of material remains on the product. Reducing Dwell helps reduce cycle time and helps increase throughput. Too short a dwell and the dot of material won't stay in place when the dispense head pulls away. This is just one example of the many parameters that affect the dispense process.

As one may see, dispensing is a complex process with many different controllable variables. But essentially, all dispensing is divided into two main sets of separate parameters; these are Material and Machine parameters. Under Material, we include such variables as Viscosity, Temperature Stability, Flow Behavior, Absence of Air, Wetting Behavior, and Homogeneity. Machine parameters are all those software parameters that a given system uses to be able to execute the process of dispensing the material.

With automated dispensing, there are different types of pump technologies used for precisely metering the deposition of materials, ranging from traditional auger-screw constructs to piston and streaming designs, and even cutting-edge technologies that involve non-contact and radical new fluid management technologies. Each type has its pluses, from reliability to speed to precision, whether the application is dot dispensing or streaming lines of material. Pump designs incorporate special materials or features to accommodate the types of material that they are dispensing; for example, some types of adhesives are

filled with highly abrasive material that will quickly wear out pumps that aren't built with carbide and sapphire components.

As the requirements for ever-smaller dot sizes and higher throughputs increase, OEMs must work even harder to offer dispense systems with higher accuracy and higher speeds. We see this in the new pump technologies offering faster cycle times and higher degrees of process control through more sophisticated software and more robust X, Y gantries. To obtain higher accuracy and speed DC linear motors and linear encoders are used to move the dispense heads around quickly and with great precision. Proper gantry design enables higher speeds and accelerations up to 3g without sacrificing accuracy. With today's automated dispense systems, speed, accuracy, and dispense control are paramount. Machine vision systems ensure accuracy and more user-friendly GUI and software tools speed teaching and setup.

In terms of pump technologies, in addition to greater dispense control and ever-smaller dot sizes, ease of setup and simple maintenance without overly-involved cleaning procedures are important goals, driven by the ever-growing number of high product mix environments where down time between different product runs is money out of pocket.

Directions that dispenser OEMs are going, or trending, include smaller, more compact footprints to maximize limited factory floor space without compromising throughput. This often means dual lane processing capability built in. Dual lane processing allows parallel loading of production parts onto two lanes for continuous dispensing, eliminating lost time in non-dispensing activities such as material flow-out and substrate loading/unloading. Another key goal of any dispenser OEM is high repeatability, dot after dot, syringe after syringe, over thousands of assemblies daily, dispensing fluids that occupy the full range of viscosities.

Today's automated dispense systems are complex, high-performing yet flexible systems engineered to meet the growing challenges of advancing electronics packaging and assembly technology. They are an integral part of virtually every electronics manufacturing line or facility.

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