FLUID DISPENSING TERMS AND DEFINITIONS

This document is intended to clarify terms used in the area of fluid dispensing. As is often the case, different terms are used by different manufactures to convey a similar meaning. Common interchangeable terms are shown in parenthesis and the reader should not infer one term is preferred over the other.

1.0 GENERAL

1.1 Dispensing area The actual area (X-Y) that the dispensing head(s) can reach after dispensing options have been added to the system, such as vision or needle sensor. The dispensing envelop (X-Y-Z) includes the dispensing area and vertical Z motion.

1.2 Dispensing head The valve, pump or similar device which controls the transfer of fluid from a bulk supply to the substrate.

1.3 X-Y-Z motion: X motion is left to right, the direction of travel for a conveyorized system. Y motion is front to back and Z motion is vertical.

1.4 Z-head (Z-axis) Part of the dispensing system that moves in the vertical or Z direction to which the dispensing head is usually mounted.

2.0DISPENSING HEADS

2.1 VALVE A dispensing head that controls or regulates the flow of material from a pressurized reservoir, such as a syringe, to the dispensing tip by opening and closing a passage way. Valves can be actuated by several methods. Typically air pressure, springs or electric solenoids are used to actuate the valves and often are used in combination. For example, air pressure may be used to open the valve and a spring may be used to close it.

2.1.1 Diaphragm valve A valve where a moving plunger or poppet attached to a diaphragm is forced against an outlet seat to seal the flow of material through the valve. When the plunger and diaphragm pull away from the seal, the pressurized fluid is allowed to flow. The diaphragm motion produces a "suck back" action which provides a shaper cutoff of material flow than either a syringe or poppet valve.

2.1.2 Needle valve A valve where the sealing elements consist of a tapered needle and cone shaped seat. When the needle is pulled away from the cone, the material is allowed to flow. The distance the needle is retracted can be preset or adjustable to control the rate of material flow. At the end of the cycle the needle is forced against the cone.

2.1.3 Pinch tube valve A valve where the flow of material is controlled by pinching a continuous, flexible tube connecting the pressurized reservoir to the dispensing tip. A plunger is used to collapse or pinch the tube to stop the flow of material. When the plunger is removed, the material is allowed to flow. The rate of flow can be adjusted by the amount of the tube restriction applied by the plunger.

2.1.4 Poppet Valve A valve containing a moving plunger or poppet, typically elastomeric, which is forced against a seat to
control the flow of material through the valve. When the plunger is withdrawn from the seat, the pressurized material is allowed to flow from the reservoir to the dispensing tip.

2.1.5 Spool valve A valve where fluid flow is controlled by a spool that is seated in a circular fluid outlet seal. The spool is
attached to a piston. When the valve is cycled on, the spool is pulled out of the valve seal and the fluid, which is under pressure, is allowed to flow. When the valve is shut off, the spool is forced back into the seal to stop the fluid flow. The motion of the spool pulling back through the fluid and seal to a closed position causes suck back of the fluid.

2.1.6 Syringe valve (time pressure valve) The syringe valve consists of a syringe (barrel) containing fluid which is directly attached to the dispensing tip. Fluid is fed from the syringe by pressurizing the fluid, by either air pressure or a mechanical plunger, 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.

2.2 PUMP A dispensing head that transfers material from a reservoir to the dispensing tip by a pumping action. Pumps are typically driven with motors, solenoids or air pressure. Pumps are usually fed from a pressurized fluid reservoir, but gravity can also be used in some configurations.

2.1 Peristaltic pump A pump where fluid flow is controlled by peristaltic plunger motion on an elastomeric tube. The pump consists of a pressurized fluid source, two pinch off plungers and a central pump plunger. To dispense, the upper plunger is retracted and the lower plunger is engaged. The pressurized material is allowed to flow into the tube. Then the upper plunger engages to stop the flow into the tube. Next, the lower plunger is drawn back and the pump plunger actuates and squeezes a precise amount of material out of the needle. The cycle is then repeated for the next dispensing shot. This pump typically produces single dots of material only.

2.2.2 Rotary positive displacement pump A pump where fluid flow is controlled by a rotating augur screw. When the pump is on, air pressurizes a syringe of fluid and feeds fluid into the pump. The fluid is then channeled to a motorized augur screw which rotates and forces fluid from the pump by the positive movement of the augur screw. The amount of fluid dispensed is directly proportional to the augur rotation which is adjustable.

2.2.3 True positive displacement pump A pump where an exact metered amount of fluid is physically forced from the pump every cycle. A true positive displacement pump will have the material input port closed while the material is being displaced.

2.2.4 Piston positive displacement pump A pump where the material feeds into a chamber or cylinder and the material is forced from the chamber by a piston action. The actual volume of material dispensed is controlled by the displacement of the piston entering the chamber. The action of the piston stroking the chamber pressurizes the fluid in the chamber and transfers the fluid through he dispensing tip. The stroke of the piston is typically adjusted to achieve the desired dispense volume.

2.3 JET DISPENSING A non-contact dispensing process that utilizes a fluid jet to form and shoot droplets of adhesive, solder, flux or other fluids from the jet nozzle to the substrate.

2.3.1 Continuous jet A method of jet dispensing where drops of material are formed by pressurizing a fluid and ejecting the material through a small orifice to form a continuous stream of material. The drops are generated by an instability that occurs when the stream is modulated at a high frequency and a continuous generation of drops occur at the end of the fluid stream. The fluid must be conductive and the drops are charged during the drop formation. The charged drops are then deflected by high voltage to the desired position. The drop size is typically not adjustable.

2.3.2 Drop-on-Demand jet A method of jet dispensing where individual drops of material are formed at the end of a fluid jet. The drop is formed by the forward momentum of the fluid being ejected out a small orifice. The jet is typically formed by rapidly changing the volume of a filled chamber of material. The dot size is proportional to the volume change of the chamber. Another method of drop generation uses magnetic forces applied to a conductive fluid which is carrying an electric current within the chamber.

2.3.1 Fluid jet A thin, stable, high speed fluid stream formation that results from a fluid exiting a small orifice under high pressure.

3.0 DISPENSING

3.1 MATERIAL PROPERTIES AND CHARACTERISTICS:

3.1.1 Dot aspect ratio The ratio of the diameter of the dispensed dot to its height. i.e. Diameter/Height.

3.1.2 Dot profile The shape of a vertical cross section bisecting a dot of adhesive, paste, or other fluid after being dispensed onto a substrate.

3.1.3 Dot size The diameter of a dispensed dot.

3.1.4 Dot volume Dot volume can be measured by weighing a sample of dots and determining the volume using the specific gravity of the material. Volume can be determined by squeezing a dot to a known thickness with glass slides and measuring the diameter and calculating the volume based on a cylinder,

3.1.5 Fluid wetting The act of the fluid leaving the dispense tip, contacting and clinging to the substrate and remaining on the substrate as the dispense tip pulls away.

3.1.6 Green strength (wet strength) The strength of a material in the uncured state while at rest. In the static, uncured condition a fluid will act like a solid until the shear force exceeds the yield strength of the material. Once the material starts to shear and behave like a liquid, the green strength has been exceeded.

Lap shear strength The strength of adhesive in holding a component under a horizontal load.

Rheology The science of the deformation and flow of matter. Rheology is the study of material flow characteristics.

Viscosity and thixotropy are two important fluid flow parameters.

Skip (miss) A missed dot in a series of dispensing.

Suck-back (snuff-back) At the end of a dispense cycle when the valve is shut off, a small amount of fluid will be drawn back up into the valve by the movement of the valve parts.

Taiing (adhesive stringing) The phenomena associated with dispensinrz from a dispense tip in which a thin thread of adhesive stretches from the dispensing needle to a dispensed dot & a substrate as the needle is moved away from the substrate. The uncontrolled break off of the thin adhesive thread results in pad contamination and poor solderability if the adhesive falls onto a solder pad.

3.1.11 Viscosity The measure of a material's resistance to deformation under mechanical stress. The viscosity is usually measured in units of poise or centipoise by means of a rotational viscometer. Viscosity is a function of fluid temperature and usually decreases as temperature increases.

3.1.12 Thixotropic index Many materials will exhibit a viscosity change with time when subjected to a constant shear rate. A thixotropic material will show a decrease in viscosity measurement with time. The thixotropic index is typically given as the area of a hysteresis loop of a shear stress/shear rate curve measured when a material is subjected to an increasing followed by a decreasing shear rate.

3.1.13 Torque shear strength The strength of adhesive in holding a component under a torsion load.

3.1.14 Voids (entrapped air) Air bubbles in the fluid reservoir or feed channels that may cause missed or skipped dots and causes the fluid to be compliant or act compressible.

3.1.15 Weeping (drooling) The phenomena associated with dispensing from a dispense tip in which fluid flows from the dispensing tip after the normal dispensing cycle is complete.

3.1.16 Wetted parts Refers to the parts within a dispense head that come in contact with fluid.

3.2 FLUID APPLICATIONS

3.2.1 Area fill Dispensing lines of fluid within a geometric pattern to completely cover an area. The pattern of motion during an area fill can be several types. Typically, a spiral motion or a back and forth zigzag motion provide adequate coverage of the desired area.
3.2.2 Dam and fill The process of filling an area by first outlining the area with a material which forms a barrier or dam, then filling the interior of that dam with another material.

3.2.3 Dual dot Two dots dispensed at one time for a specific component (such as a MELF). Often dual dots are used to cradle a component in order to provide a more secure and stable attachment to the board or for UV exposure.

3.2.4 Encapsulating (glob top) Covering a component or die with epoxy to protect it.

3.2.5 Potting Filling a well or cavity with fluid.

3.2.6 Spiral fill Dispensing lines of fluid in a spiral motion to completely cover an area.

3.2.7 Underfilling The process of material flowing under a component, such as a flip-chip.

3.3 EQUIPMENT CHARACTERISTICS

3.3.2 10,000 dot test A test for material dispensing propensity that consists of dispensing 10,000 dots without interruption and measuring the number of defects due to skips, stringing or inconsistent dot volume. Dot Placement Accuracy The preciseness of placing a dot of fluid onto a substrate. The dot placement accuracy includes all components of error in the system which combined determine the accuracy of the dispensed fluid on the workpiece. Dot placement accuracy should be measured on a high precision X-Y measuring system to eliminate dispensing machine errors. Often, a glass plate is used as a substrate for measuring dot placement errors so PCB errors are not included in the total error. Dot placement accuracy can be stated as a total indicated reading (TIR) of the group of accuracy measurements or expected results. Dot placement accuracy can also be stated statistically in terms of a number of standard deviations of a group of accuracy measurements or expected results. Often, three standard deviations (3 sigma) are used when describing dot placement accuracy.

3.3.3 Dot rate The speed at which dots can be placed on a substrate in a grid spacing without stringing, measuring the time from the first dot placed to the last. Dot rate can be measured on several different grid spacings resulting in different average dot rates. Typical grid spacings range from 0.05" (1.27mm) to 1.0" (25mm).

3.3.4 Run test A test for dispensing consistency that consists of dispensing dots and then measuring the weight and/or diameter of the dots to establish consistency trends.

3.3.5 Throughput (cycle time) The actual time required to process a substrate from start to finish including conveyor time for both loading and unloading the board, board alignment, fiducial finds, Z height compensation, and dispensing. Items that could affect cycle time are board size, board alignment (manual or automatic), board layout, board warp, component size, and adhesive viscosity. Throughput will also vary with the number of dots per substrate since the conveyor cycle time and vision alignment cycle time will be constant whether there are 50 dots or 500 dots on the substrate.

4.0 ENHANCEMENTS OR OPTIONS

4.1 Cartridge A way of packaging small to medium quantities of fluid for a dispensing application (usually 2.5 oz and greater). Looks very similar to a cartridge of material for a caulking gun.

4.2 Compliant Tip (Z axis Compensator) A mechanical means positioning the dispense tip a predetermined distance from the workpiece while contacting the substrate. This mechanism should have enough compliance in the vertical direction to allow for substrates that are not flat.

4.3 Height sensing (Z compensation) A height sensor senses the surface of the substrate to determine its height so the dispense tip can be positioned to an exact location above the surface, ensuring consistent dots. Height sensing can either be done with a probe or a non-contact means such as a focused vision system or a laser.

4.4 Needle (Nozzle, Dispense tip) The part of the dispensing system through which the dispensed material flows onto the board. The needle can also controls the profile of the dispensed dot.

4.5 Needle heater A small heater that is used to heat the dispense tip and the fluid in the dispense tip thereby reducing the viscosity of that fluid.

4.6 Needle sensor (needle calibrator) Locates the position of the needle in the X-Y or X-Y-Z directions after the operator changes a needle or as required.

4.7 Pail pump A pump that is attached to a pail of fluid and feeds that fluid to the dispensing system. Used in high pressure or high volume dispensing applications.

4.8 Stand-off Generally a small metal post or ring attached to the dispense tip that keeps the dispense tip a preset distance off the substrate.

4.9 Syringe (barrel) A popular package of fluid typically plastic, usually holding 1 -30 cc of fluid. Looks similar to a medical syringe.

5.0 VISION SYSTEMS

5.1 Automatic vision correction (automatic alIgnment) Automatic vision correction is when a vision processor automatically aligns a fiducial or component lead with a dispense pattern by determining the actual position of the fiducial or lead and adjusting the programmed location.

5.2 Inspection vision (automatic dot verification) The process which a vision processor automatically inspects dispensed dots. Typical inspection parameters are the diameter of a dispensed dot and the presence and location of a dot.

5.3 Manual vision correction (manual alignment) is when the operator aligns a crosshair over a dot or fiducial to aid in programming or alignment.

6.0 CONVEYOR SYSTEMS

6.1 Automatic width adjust is a conveyor system which uses a motor to automatically adjust the conveyor width specified in a program.

6.2 Manual width adjust is a conveyor system which requires manual adjustment to set the width of the conveyor rails.

6.3 Reversible conveyor is a conveyor system which allows the conveyor to transfer parts either right to left or left to right.

ABOUT SMEMA

The Surface Mount Equipment Manufacturers Association (SMEMA) is a non-profit organization of companies manufacturing equipment or producing software for surface mount board production. Its objectives are to promote standards for the interface and operation of equipment, provide users with the ability to select equipment with the assurance that the equipment will interface easily, advance SMT and promote its use, and investigate areas where the association can act to the benefit of all member companies.

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