Getting the drop on precision fluid dispensing in auto assembly

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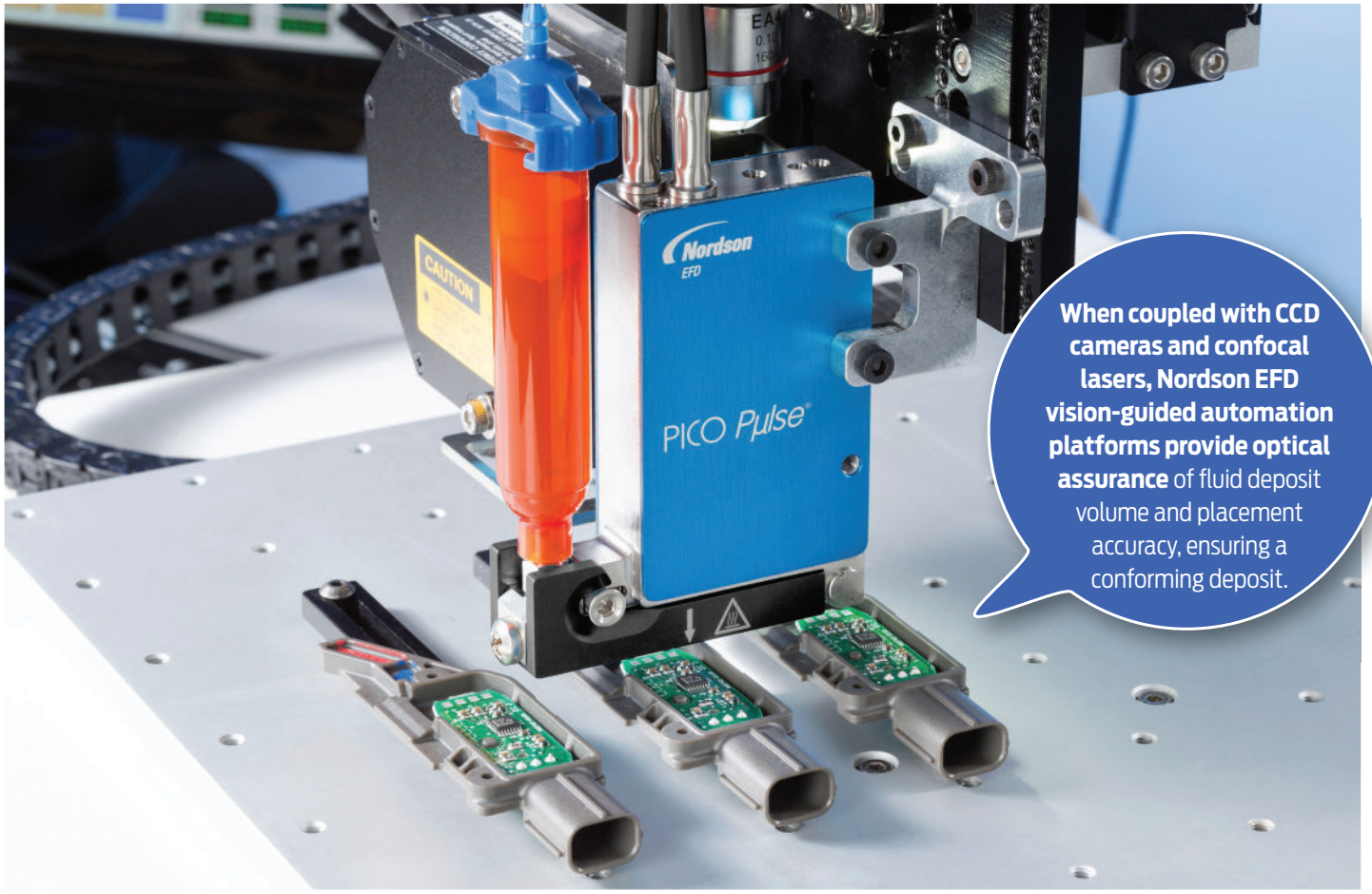


When coupled with CCD cameras and confocal lasers, Nordson EFD vision-guided automation platforms provide optical assurance of fluid deposit volume and placement accuracy, ensuring a conforming deposit.

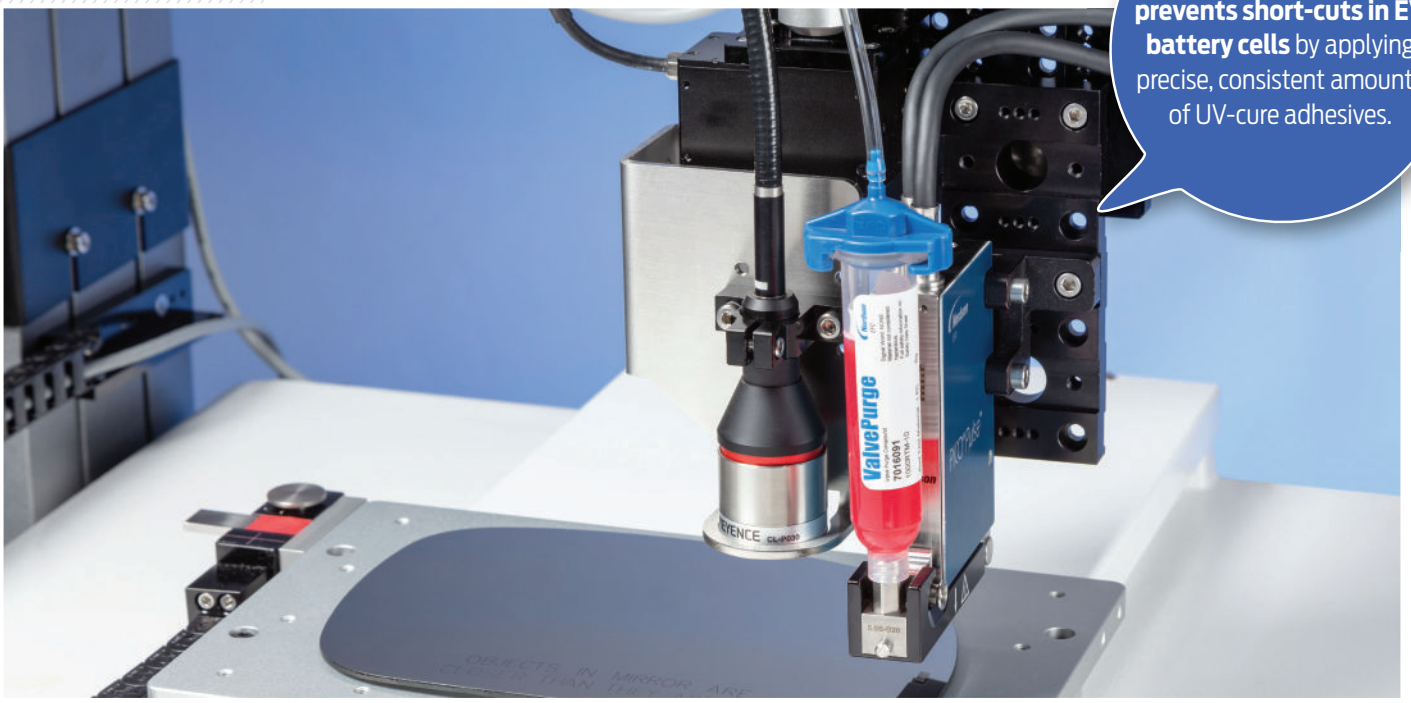
Automotive component manufacturers face several production challenges. The most vital is maintaining product quality supported by consistent production throughput with systems that ensure profitability. A key function in this process is assembly; the need to manufacture more complex assemblies poses challenges for process engineers in their manufacturing and assembly functions.

Fluid dispensing

Critical to meeting strict requirements is the need to deposit small and precise amounts of fluid — such as adhesives, greases, silicones, and lubricants — to parts during the assembly process. The minimal amounts of adhesive, silicone, and other fluids must be dispensed reliably and accurately. The precise positioning and quantity of these fluids deposited on the parts are critical to these products' viability.

This technique of depositing tiny volumes of liquid media dosages spans several assembly applications in automotive component manufacturing that require the precision dispensing of oils, grease, lacquers, and other media.

Depositing small and precise amounts of fluid is an ever-increasing challenge for automotive manufacturers of tiny micro-electronics and other minuscule parts. Substrates are becoming more



This jetting system prevents short-cuts in EV battery cells by applying precise, consistent amounts of UV-cure adhesives.

crowded and uneven in nature. Such is the case with printed circuit board (PCB) assembly and other applications.

Dispensing fluids onto hard-to-access areas or on delicate substrates are vital factors that must be assessed. These directly affect the Z-axis movement of a dispensing system, influencing its ability to move over uneven surfaces and dispense the correct volume of fluids. Cycle times for fluid dot deposition and throughput rates are regulated to some extent by the substrate surface topography.

The variety of fluids and fluid viscosities that can be dispensed in automotive assembly can be substantial — encompassing epoxies, adhesives, silicones, greases, oils, flux, lacquers, solder paste, and solvents. The fluid to be dispensed must readily flow through the dispensing heads. In some instances, once the fluid reaches the part, it must restructure and recover to keep it from spreading and contaminating other components.

Other properties of the fluid that must be considered include its density and weight, the presence of abrasive fillers, and whether it's safe to dispense or if it's combustible. The fluid properties can also be modified by the dispensing process being used. Temperature variation within the dispensing system can change the viscosity of the fluid, affecting the fluid pressure and line speed.

Whether applying UV cure glue to a sensor PCB, grease, or lubricant into automotive switches, anaerobic glues into connectors, or high-viscosity grease into multiple surfaces of an automotive part, characterizing different fluids and determining the best dispensing parameters are important factors for creating a successful dispensing process.

Parameters for precision fluid dispensing in automotive parts assembly

Fluid dispensing in the assembly of automotive components encompasses a range of methods that can accommodate specific fluid application processes. The latest benchtop and robotic dispensers provide a high degree of process control, capable of dispensing adhesives, solder pastes, lubricants, and other assembly fluids with high consistency.

Handling fluid dispensing of dots, beads, and fills under a broad range of conditions, these units are equipped with multiple capabilities to refine the dispensing process. From precision benchtop fluid dispensers, pneumatic valve systems, piezoelectric jetting valve systems, and in-line robotic dispensing systems, many factors would support adopting a more efficient and controlled dispensing method in the assembly of automotive components:

- Shot-to-shot repeatability and accuracy are improved as a more automated and controlled dispensing approach is employed.

- Increased productivity comes with increased automation.

- Part quality improves when switching from manual squeeze bottle dispensing to air-powered dispensing and further along to in-line automated dispensing, because operator-to-operator variance is reduced. The ability to set the time, pressure, and other dispensing parameters for an application improves process control and ensures the right amount of fluid is placed on each part.

- Rework and reject rates lessen when upgrading to more automated dispensing solutions, thus improving the yield of the manufacturing lines and greater profitability to the manufacturer.

- The amount of assembly fluid used decreases significantly when using a more controlled method of dispensing.

It is important to consider each of these five points, as they represent the actual cost-to-benefit factors influencing fluid dispensing processes in automotive parts assembly.

Shot-to-Shot Repeatability & Accuracy

Shot-to-shot repeatability and accuracy are critical in fluid dispensing. Depositing the right amount of fluid has a compounding effect of not only maintaining product integrity but also keeping downstream production moving. For example, in a bonding application, if too much fluid is applied, it can take longer to cure, which will delay production downstream. Conversely, if too little fluid is applied, the part will not properly bond, interrupting downstream assembly or causing product failure. Precision dispensing systems apply shot-by-shot repeatable amounts of virtually any manufacturing fluid by using digital timers and precision air regulators to determine the amount of material applied.

The latest generation of fluid dispensers can distribute practically all assembly fluids — from thin solvents to thick silicones and brazing pastes — with greater accuracy. They deliver exceptional throughput and process control, with consistent deposits from the beginning to the end of the fluid reservoir.

For the precise application of adhesives, lubricants, paints, solder pastes, two-part epoxies, UV-cure adhesives, and other assembly fluids, precision dispensing systems enable optimal results.

The consistency and repeatability performance of precision dispensing systems goes beyond the actual dispensing equipment itself and also depends on the quality and proper usage of the system components. These consumable plastic components — syringe barrels, adapter assemblies,

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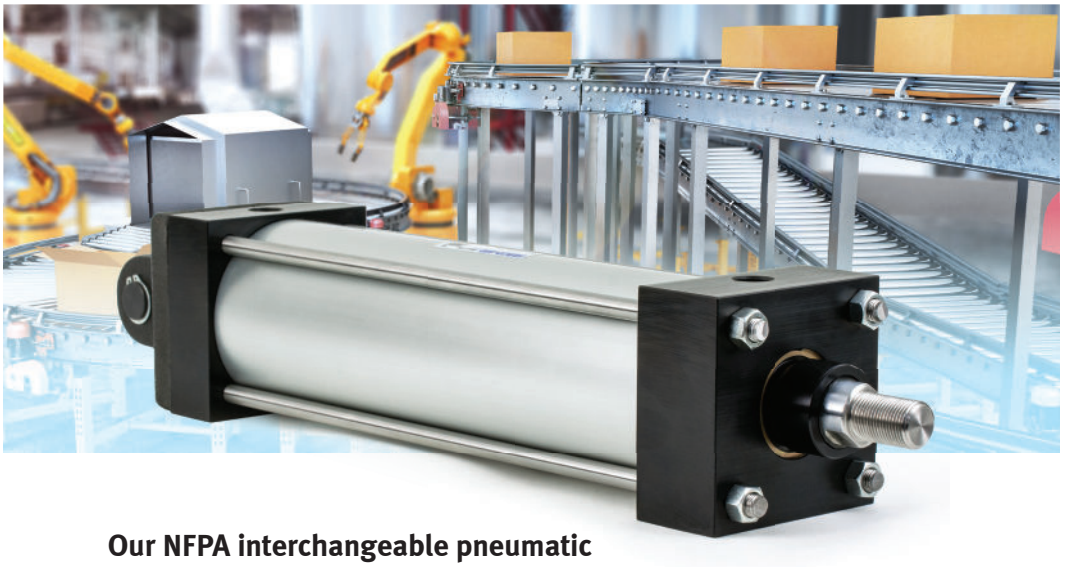

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Another feature supporting precision dispensing, particularly applicable for automotive component manufacturers, is Automated Optical Inspection (AOI).

pistons, caps, and dispense tips — are designed to meet the requirements of different types of fluids and applications and to dispense the most precise fluid deposit possible.

Consumable plastic components working together as part of an integrated system are designed to reduce fluid waste and air entrapment.

For the highest level of performance from these dispensing systems, several requirements necessary:

- Each of the consumable plastic components should be designed as part of a complete, integrated system. This will improve yields and reduce costs by producing the most accurate, repeatable fluid deposits possible. Mixing and matching components from different systems or suppliers is a recipe for diminishing performance.

- Maintaining precision shot-to-shot repeatability in dispensing starts with quality manufacturing of the components. For best performance, all components should be certified that no silicone mold-release agents are used in the precision molding process or at any other time during the production of the dispensing components.

- The dispensing components should always be used as single-use consumables. In high-precision dispensing systems, barrel internal diameters (IDs), piston diameters, and dispensing tips, are manufactured with tolerances that make any residue from prior dispensing residing in the barrel, piston, or tip degrade dispensing repeatability performance. Once the piston reaches the bottom of the barrel; the barrel, piston, and tip should be discarded.

Process Control

The ability to set the time, pressure, and other dispensing parameters for an application improves process control and ensures the right amount of fluid is placed on each part.

The latest generation of fluid dispensers provides a high degree of process control for dispensing applications in the assembly of automotive components, are capable of dispensing adhesives, solder pastes, lubricants, and all other assembly fluids with high consistency.

Fluid dispensing of dots, beads, and fills can be achieved with dispensing equipment features such as a 1-100 psi air pressure regulator, timed-shots, vacuum control to keep thin fluids from dripping, digital time/pressure displays, and electric foot pedals. Time adjustments can be as fine as 0.0001 seconds, and constant-bleed air pressure regulation will provide reliable control when dispensing any type of fluid.

Some of the latest fluid dispensers allow programmable sequencing to automatically adjust dispensing parameters, making them suitable for applications that involve two-part epoxies and other fluids that thicken over time or get thinner as ambient temperatures rise.

Another feature supporting precision dispensing, particularly applicable for automotive component manufacturers, is Automated Optical Inspection (AOI). When coupled with CCD cameras and confocal lasers, Nordson EFD vision-guided automation platforms provide optical assurance of fluid deposit volume and placement accuracy, ensuring a conforming deposit.

With robotics, using a robot's existing vision systems, the AOI software verifies fluid deposit widths and diameters. With the AOI confocal laser, the system measures the height of a fluid deposit in addition to the width and diameter, providing 3D deposit verification and determining if dispense requirements have been met. The confocal laser detects deposit height measurements regardless of the transparency of the fluid, which can sometimes distort quality data. Constant closed-loop feedback delivers automated quality control data, saving automotive component manufacturers time and costs.

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