

## **Bench-top fluid dispensing: Easy when you know how**

*By Steve Collier, European Sales Manager, OEM Division – Techcon Systems*

Manual, semi-automatic and automatic bench-top dispensing systems represent the three disciplines of fluid formulation. Today, these disciplines can be found in applications ranging from prototype development and shop floor production, through to rework and in-field repair as superior valve technology and microprocessor control have continued to make their mark on the modern manufacturing industries.

The success of the bench-top dispensing process, as with any other process, relies heavily on making the right choice of equipment and consumables to suit the application. Guiding the manufacturer through the specification of dispensing technology in a high technology manufacturing environment and focusing on the unique benefits each option offers is a good place to begin.

Ten to fifteen years ago many printed circuit assemblies (PCAs) comprised little more than a through-hole PCB, with wave soldered components. Today, even modest electronic products can involve a bewildering array of surface mount, chip-scale, through-hole and electromechanical technologies. Screen printed solder paste and reflow/wave ovens are no longer sufficient to complete the build alone and this is where bench-top dispensing came into its own.

The list of commonly dispensed fluids in the electronics industry includes: adhesives (anaerobic, cyanoacrylates, epoxy and UV); conformal coatings; flux (liquid and gel); \*RTV silicone - Room Temperature Vulcanization (curing without heat); solder mask and solder paste. These fluids have vast differences in their properties, in particular their viscosities and typical dispensed volume, hence dispensing valves, dispensing tips/nozzles and controllers have been developed to provide an optimized solution. Whether securing a tiny surface mount component with a single dot of adhesive, conformal coating an entire assembly or using a formed dispensing tip to 'draw' an enclosure gasket, engineers responsible for specifying a dispensing system can rest assured a solution does exist.

### **Versatility with cost advantages - Syringes**

Whether powered manually or pneumatically, simple time/pressure dispensers offer a versatile, low cost solution to dispensing applications. From their modest beginnings, syringe barrels have since evolved into precision engineered products designed to offer the accuracy, repeatability and stability required in electronics manufacturing. To give you an example, silicone and chloride free, low friction polypropylene syringe barrel bodies are available in amber to protect the latest UV sensitive liquids (up to 520nm) while letting the operator view the volume of material in the syringe barrel. Similarly, different designs of air powered pistons have been developed to ensure an even pressure spread. Polyethylene wiper pistons are optimized for low to medium viscosity fluids, while straight wall pistons are recommended for reduced stringing with medium/high viscosity fluids.

For pneumatically powered applications, a quick and clean connection between the syringe barrel and time/pressure dispenser is possible due to the development of receiver head assemblies that comprise a syringe barrel receiver head, O-ring seal, pneumatic tubing and quick-connector. Similarly, for manual syringe barrel dispensing, simple, lightweight barrel applicator guns are also available which can provide excellent, drip-free control for medium/high viscosity products.

### **Rising to any challenge - Valves**

For more demanding applications, valve-based dispensing systems can range from simple pinch tubes to encoder controlled rotary feed screws (augers). This list introduces common valve types, including their advantages and typical applications.

**Pinch Tube Dispense Pen:** Offering a simple introduction to valve-based dispensing, pinch tube dispensing pens feature a mechanism which releases a pinched tube when the operator presses the handle. Capable of controlled shot size and flow rate, gravity or pressure fed pens can be used to dispense fluids ranging from 1 to 45kcps viscosity, such as adhesives (cyanoacrylates, anaerobics and two-part), lubricants, sealants and masks. Pneumatically actuated pinch tube valves are also available, giving an additional level of control. Benefits include a disposable fluid path, compact size, low weight and simple operation.

**Diaphragm Valves:** Diaphragm valves incorporate a design without seals for moisture sensitive fluids to accurately dispense low to medium viscosity materials (1 to 50kcps) over a wide range of shot and bead sizes: down to sub µlitre. They provide a fast, positive shut-off; while external stroke control adjustment lets operators fine tune shot sizes. They are available in both horizontal and vertical formats. Fluids typically dispensed via diaphragm valves include adhesives (cyanoacrylates and anaerobics), liquid fluxes, UV-cure adhesives, resins and lacquers. Benefits include compact size, low weight, adjustable stroke control, long-life (typically 1 million cycles) and simple, low maintenance construction where the diaphragm itself is the operating mechanism rather than a piston operating through a seal. More recently an all stainless steel construction has allowed a greater range of material compatibility and reduced turbulence in the flow for demanding applications such as spin coating and some Medical applications.

**Spray Valves:** Spray valves are designed for precision coating applications involving low viscosity materials from 1 to 10kcps. In electronics manufacturing environments, a common application is the environmental protection of finished products with conformal coating liquids. External stroke control can be used for fine-tuning flow, while total spray cycle control allows adjustment of pre-spray, atomizing air and post spray. Nozzle choice includes cone and fan in several different sizes. Benefits of using this design of valve include consistent spray coverage, no overspray, adjustable flow control and long operating life.

**Needle Valves:** As their name suggests, needle valves are used to dispense very precise deposits, over a wide range of shot and bead sizes thanks to a minimal dead fluid zone. External stroke control allows fine tuning of shot sizes. Precise deposits, down to  $0.0005\text{cm}^3$ , can be dispensed. Capable of handling liquids from 1 to 100kcps, needle valves suit applications such as glob-top dispensing and the delivery of UV adhesive microdots in medical device manufacturing. Benefits include precise and consistent shot sizes, zero dead fluid zone, adjustable flow control and simple, low maintenance design.

**Spool Valves:** Designed for shot accuracy and high volume, spool valves can handle a wide range of material viscosities, (5k to 3,000kcps depending on model type), shot sizes and pressures. When dispensing moisture sensitive materials, an oil chamber can be used to seal the spool. Suitable for dispensing RTV silicone, spool valves can be used to manufacture form-in-place gaskets around electronics enclosures. Benefits include fast flow rate, end-of-cycle anti-drip feature and simple, low maintenance design.

**Rotary Valves:** Completing the valve options, rotary valves use a rotary feed screw (auger) to dispense fluid with a positive displacement action, allowing ultra-precise control. In keeping with their precision design, rotary valves can dispense 30k to 1,300kcps viscosity liquids in die attach, surface mount bonding, semiconductor

encapsulation and dam writing applications. Plus, two-part products can be dispensed without separation. Benefits include precise and consistent shot sizes, adjustable dispense rates and a wide variety of configurations.

### **It's in the control**

When the most appropriate syringe barrel or valve technology has been identified, successful application then relies on selecting the most appropriate control system.

For syringe barrel applications, programmable time/pressure dispensers are used to produce beads and dots. An adjustable vacuum can also be used to control drips between dispense cycles. Pressure options relate to material viscosity with, for example, zero to 1 bar specified for low viscosity applications. Shot duration can typically be controlled between 0.01 and 99.99s.

For valve-based applications, controllers are designed to match the specific characteristics of different valve types. For example, needle, spool, diaphragm and pinch tube valves can be controlled using a programmable time/pressure controller similar to that used for syringe barrels. Added control functionality can include a low pressure alarm, valve purge, valve test, end-of-cycle signal digital control and a computer interface. Having all these functions in one valve controller, as well as the option to control both Rotary and Spray valves, can significantly reduce costs and future proof the applications

Rotary valves require a timer/power source which provides an adjustable DC output (6 to 24V) for motor drive and a digital time-set for motor on-time, forward and reverse (1ms to 99.99s). Motor activation can be foot or limit switch operation.

Likewise, spray valves benefit from three-stage microprocessor control which manages pre-spray, spray and post-spray (0.001 to 99.99s). Continuous spray can be initiated and terminated with a continuous signal. Atomizing air pressure must also be tightly controlled to ensure the fluid is evenly dispersed.

### **Automation and Handling**

Although bench-top dispensing valves can be used manually, their full potential requires integration with a semi-or fully-automated handling system. A simple system could involve a bench-top syringe barrel/valve stand and product jig. The operator places the product in the jig, presses a foot switch and the controller manages the dispensing process. For more complex two and three-dimensional applications the product or dispenser can be moved using an X, Y, Z mechanism, either in the form of traditional bench-top platform, robot arm or bespoke system. Moving one stage further, dispensers and controllers can be integrated into much larger automation systems, either free standing or conveyORIZED. For example, dispensing systems can be found operating within solder paste printers, surface mount placement machines and odd-form assembly cells.

### **Manufacturing Flexibility**

Responding to the electronics industry's need for flexible production capabilities, dispensing systems have been developed to reduce maintenance and ease product changeover. An example is disposable micro valve technology which can dramatically reduce the maintenance requirements of conventional rotary valves. When dispensing abrasive and viscous electronics materials, conventional rotary valves can clog. If dispense performance begins to degrade, users can simply replace the old feed screw with a new one, significantly easing cleaning and maintenance. Recent innovations include the Disposable Material Path (DMP) and Interchangeable Material Path (IMP) versions which allow fast changes to minimize downtime and reduce production costs.

### **Don't miss the point – the Dispensing Tip**

By focusing the discussion on valve and control options, it is easy to forget one of the most critical components in bench-top dispensing, the dispensing tip. For example, to optimize the precision dispensing capabilities of rotary valves in automated applications requires precision metal dispensing tip. Dispensing tips are now available with internal diameters ranging from 1.6mm to an astounding 0.102mm.

Because of the enormous variety of dispensing applications, a wide range of dispensing tip designs have been developed. For example, beyond conventional, straight, stainless steel cannula dispensing tips, come bent needles (45 and 90deg) which are ideal for dispensing fluid into otherwise hard to reach places and smooth flow taper tips for higher viscosity materials. Soft sable and stiff nylon brush tips are also available for spreading dispensed materials.

Although dispensing is a non-contact operation, issues such as delicate substrates, awkward product geometry and dispensing tip proximity can be resolved simply by using flexible polypropylene dispensing tip which can also be cut to length. Teflon lined dispensing tips are an ideal way to effectively dispense materials such as cyanoacrylate.

### **Bench-top dispensing – the manufacturers champion**

There can be few generic manufacturing processes that reach across so many diverse industries and applications as bench-top dispensing. OK International's Industrial Products Division Techcon Systems brand of dispensing systems have been used in thousands of medical, automotive, telecommunications, aerospace, electronics and industrial applications, spanning forty nine years. Thanks to equipment and software innovations, bench-top dispensing technology, this hitherto unrecognized champion of so many manufacturing operations, has taken its rightful place as a process characterized by accuracy and repeatability.

### **For reader enquiries, please contact:**

Steve Collier  
European Sales Manager – Industrial Products Division  
Techcon Systems  
Tel: +44 2380 489074  
e-mail: [scollier@okinternational.com](mailto:scollier@okinternational.com)  
website: [www.techconsystems.com](http://www.techconsystems.com)