



 TECHCON™

Piezo Jet Valve Dispensing

Tiny, precise dots of material shot
at up to 1500 times per second



TECHCON™

If your operation needs the ultimate in **speed and precision**, the cutting edge of dispensing technology may be right for you.

By Can La, Product Manager, Techcon

Selecting the automated dispensing technology that is the best fit for a specific application from the half dozen or so familiar technologies available—such as the auger valve, progressive cavity pump, time pressure valve or pneumatic jet valve—is not a consideration to be made lightly. For most operations, the consequent match is adequate, and attributes such as throughput and quality are well suited to the application on an ongoing basis. For others, however, such as medium to high volume mobile device, LED, consumer electronic and medical device assemblers, there is a constant drive for the ever higher yields that can drive improved profitability, and for an advanced dispensing technology that can better help them achieve it.

For these users, there is a relatively new technology that can increase dispensing rates for adhesives and other fluids by some 20x or more—at rates, for comparison purposes, as fast as 1500 Hz continuously with up to 2000 Hz maximum burst. It's called the Piezo Actuated Jet Dispensing Valve, and it dispenses at about twice the speed of even the pneumatic jet valve.

Operators are also often amazed at the impressive placement precision and small and neat dot sizes generated by a piezo jet valve, especially considering that a) it is moving so fast, and b), the material is being shot and not being physically placed, as would be the case with most dispensing solutions that rely on actual contact with the substrate. Using sophisticated controllers, shot sizes can be achieved as small as .5 nanoliter, with outstanding consistency and repeatability. This precision also makes the piezo jet suitable for some other niche applications where speed is less of a factor, but where operators have a challenging time achieving the desired dispensing of ultra-small dots or ultra-thin lines consistently over time.

2X FASTER
than pneumatic
jet solutions



Piezo Jet Technology

where the speed comes from

Jet valves—both the older pneumatic jet technology and the newer piezo jet technology—gain a significant speed advantage primarily by eliminating the Z axis of movement. The height sensing and re-positioning and the up and down motion that is necessary for contact-based valves such as progressive pump and auger valve technologies—with the needle moving down to touch the substrate to dispense the fluid and then pull back up—while reasonably fast by most criteria, account for a high percentage of the required dispensing time. Contact-less jet dispensing, by contrast, shoots the material accurately from a fixed location above the substrate, shot after shot. This enables the pneumatic jet valve to reclaim this excess motion time and dispense at speeds some 10x faster than contact-based valves.

However, while the pneumatic jet valve technology leaves the speed enhancement at “only” 1000%, the piezo jet valve ups the ante considerably. In these devices, rather than relying upon air pressure, a piezo-electric actuator converts an electrical signal into a highly precise motion that dispenses the material in the desired pattern far faster than a mechanical pneumatic based solution, which must open and close and reset, a process which expends some 20 extra milliseconds each time. In this way, speeds up to 2000%



Rather than relying upon air pressure, a piezo electric actuator converts an electrical signal into a highly precise motion

faster than contact-based solutions—2x faster than pneumatic jet solutions—can be achieved. For speed sensitive, high volume, high throughput applications, the increase in yield can be extraordinary—and highly profitable.

Further, the ability of the piezo technology to deliver the smallest dots or lines—with micro shots as small as .5 nanoliters—is hard to beat. As is the accuracy and repeatability of each and every dispense.

Another huge advantage of the piezo jet technology is its ability to deliver this up to 1500 Hz speed even to those operations involved with the production of substrates with irregular heights, or those where harder-to-access “nooks and crannies” must be reached. Since the fluid is shot rather than dropped, nozzles can be more readily angled to reach the exact point where material is required. Further, since the nozzle doesn’t need to drop down on the item, products with irregular protrusions such as a motherboard with high spots won’t be damaged as they might be when utilizing a contact-based valve that must come down close to the substrate, eliminating a common source of damage, waste and downtime.

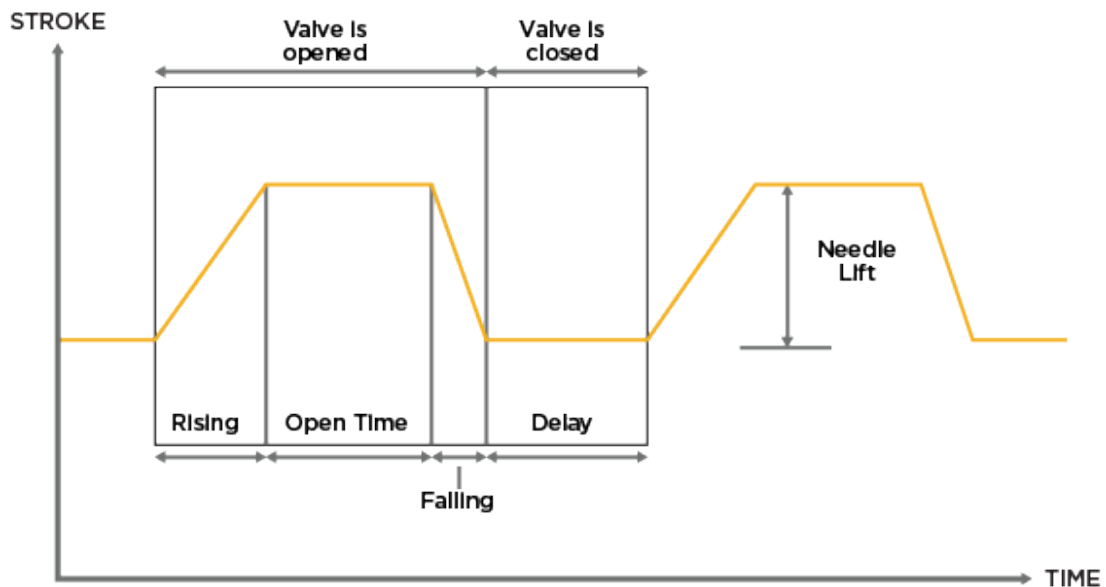
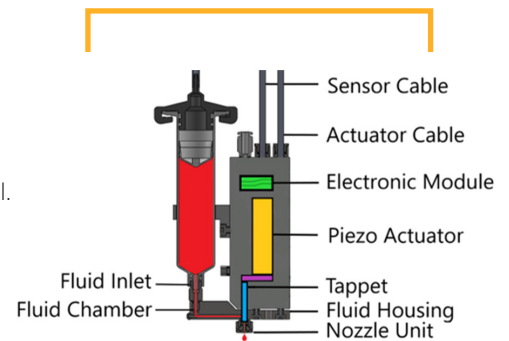


How It Works

In a piezo jet valve cycle, the fluid starts up inside the valve, held between the tappet (piston) and the nozzle. The electronic piezo crystal oscillates up and down at a high rate of speed, generating kinetic energy that forces the fluid to shoot out under carefully controlled pressure to form a perfect bead of material at the target location.

A complete, five step piezo jetting cycle consists of:

- Rising Time - Total time for the tappet to move to open position
- Open time - Total time the valve stays opened
- Falling time - Total time for the tappet to move to closed position
- Needle lift - is the stroke length, based on the viscosity of the material.
- Delay time - Time the valve stays closed, waiting for the next cycle



All of these steps can occur, repeated over and over again, up to 1500 times per second continuously, with that number an objective basis for comparison with other dispensing methods being considered. Under real world conditions, the number of drops dispensed per second will be impacted by factors such as desired shot size, the viscosity of the material, and the speed of the horizontal movement of the substrates being assembled. In use, as noted, contact-less piezo jet valves can typically dispense about 20x faster than any contact valve.

Ease of use, size of footprint and other purchasing considerations

When considering upgrading to the power of a piezo jet valve dispensing system, a vital point to be aware of is that the phrase “jet valve” can refer to both the older pneumatic jet valve as well as the newer piezo crystal driven jet valve technology. While both technologies, as noted, are significantly faster than familiar contact dispensing options such as the auger valve or progressive cavity pump, the newer piezo version of the jet valve ups the ante considerably, and as noted can deliver some 2x the speed of the incumbent pneumatic version. Nevertheless, since for so many years “jet valve” referred only to “pneumatic jet valve,” many people still use the terms interchangeably, and, indeed, many potential users and even valve manufacturers are relatively unfamiliar with the piezo jet valve or have not yet had the impressive experience of seeing it in action. In other words, it behooves the buyer to specifically refer to “piezo” in all discussions to ensure that everyone is on the same page.

Currently several manufacturers provide piezo jet valve dispensing solutions, and, as one would expect, a number of aspects of their design as related to both the valve itself and the related controller can differ significantly.



Techcon TS9800 Series Jet Valve



Highly repeatable and precise dispensing for outstanding process control

For example, a key issue to consider is the relative ease of identifying the right “recipe,” the combination of parameters to ensure correct placement and the correct amount of material. Piezo valves gain much of their small dot consistency through not only making use of tiny aperture nozzles but also by providing the flexibility to fine-tune both material pressure and jetting pressure. Once the correct parameters are determined, the valve is extremely accurate and consistent in maintaining them, but getting to that point can and often does take some trial and error. Key in reducing the challenge are the capabilities of the controller provided, as well as any assistance that might be available from the manufacturer. As to the latter, some manufacturers might just look at an MSDS and render an opinion. Others will offer some level of hands-on testing of your material in their labs to assure efficacy. Further, they might be willing to use the knowledge gained to help you more quickly fine tune the parameters back in your operation. It pays to inquire before the sale.

Even more impactfully, the user interface of the controller can make a huge difference in the relative ease in determining the proper parameters, and therefore the level of potential wasted product or loss of productive uptime during initial product set up.

Ease of use, size of footprint and other purchasing considerations (cont.)

Some piezo jet dispensing systems require manual tweaking with varying levels of precision; others provide the ability to fine-tune using software allowing the operator to modify the jetting properties for different fluid types and optimize the process for repeatable dispensing; and some are entering the market that include even more full-featured controllers with touch screens and graphic interfaces that optimize usability and make set up faster and more intuitive than in the past. Some manufacturers are raising the bar even further by providing the ability to set parameters as well as monitor and troubleshoot remotely, allowing operators to control their systems from anywhere at any time, even from across the ocean, using an app on their phone or tablets. These piezo jet valve models would fit right in to the operation of a sophisticated Industry 4.0-based smart factory—or one that is working towards becoming one.

The amount of space that the piezo jet units require may also be of great importance to both benchtop users and machine integrators. For the former, sleeker units mean smaller work area demands and more efficient delineation of factory space. For the latter, with the speed and precision benefits of the piezo jet valve, machine builders are more and more frequently

looking to build one or several units into high end automation application equipment, combining them in the cabinet with robots and other complementary devices to deliver truly best-in-class capabilities to their customers. Towards this end, the relative size, weight and footprint of the individual brand piezo jetting dispensing valves being considered may be worth noting.

A more esoteric issue is the fact that, of all the dispensing valve technologies available on the market, in addition to being the most advanced, the piezo jet is also, by far, the most challenging to manufacture. The tolerances on components such as the nozzle and tappet are extremely tight, and crafting them accurately is beyond the capabilities of many parts fabricators. Piezo jet models that cut costs using less complying components would be likely to quickly demonstrate issues such as fluids dispensed out of place, inconsistent speeds, cleaning challenges, frequent failures and other problems that would negatively impact productivity and quality. Speaking to other users about their experiences in this regard might be a good part of the due diligence process as one weighs the relative benefits of different models.



20x faster dispensing speeds compared to a contracting dispensing valve



Industry **4.0 compliant** for remote access and control over Ethernet networks



Reduces downtime and scrap by eliminating risk of needle crashing into the workpiece

Is a Piezo Jet Valve **right for you?**

In addition, there are some limitations to consider. For examples, potential users should take into account the type of materials they wish to dispense. Piezo jet valves can be used with materials demonstrating a very wide range of viscosities—up to two million centipoise or more and including materials as thick as silicone and urethane rubber. However, due to the need to evenly shoot the material, those that have solid particles blended into them, such as solder paste with its ultrafine metal particles, are usually not the best candidates for any jet valve dispensing technology.

Lastly, and there's no way around it—obtaining the superior cutting edge technology of a piezo jet valve likewise represents a larger upfront investment than that of contact dispensing systems. However, it can be surprisingly comparable in cost to the older pneumatic jet valve considering how much faster it is. Further, helping significantly defray the life cycle cost is the



Highly robust
and rated at around
1 BILLION CYCLES

fact that the most expensive part of the system, the piezo assembly, is highly robust and rated at around one billion—yes billion with a “b”—cycles. Nevertheless, if your process is not one that can benefit from the highest speed dispensing available anywhere as well as super high precision, the investment might not be worth it. However, if a quantum leap in throughput with super accuracy would be valuable to you, helping to boost your profitability significantly almost overnight, then a piezo jet valve might be a highly desirable investment indeed.

U.S. Corporate Headquarters OK International/Techcon Headquarter

10800 Valley View Street
Cypress, CA 90630



714-230-2355



oemorders@okinternational.com



714-828-2001



www.techcon.com

European Corporate Office

OK International/Techcon

Eagle Close, Chandler's Ford Industrial Estate, Eastleigh

Tel: English +44 2380 489 100

Tel: Français: +33 176 710 403

Tel: Deutsch: +49 (0)3222 109 1900

Email: Europe-Orders@okinternational.com

China Corporate Office

OK International/ Techcon

4th floor East, The Electronic Building Yanxiang Industrial Zone High Tech Road, Guangming New District Shenzhen, P.R.C

Tel: +86-755-2327 6366

Fax: +86-755-2329 5492

Email: china@okinternational.com