Seven different Dispensing Valves: Where does each work best?

Understanding how valves work and interact with the material they dispense makes it easier to select the right one.

Selecting a valve that will apply a lubricant, adhesive, or coating calls for at least three considerations: knowing how valves work, fluid characteristics, and how the material will be applied. Although this sounds simple, it's complicated by at least seven different basic pneumatic valves, fluid characteristics that vary, and applications that call for sprays, dots, or thick lines. A little study, however, can simplify the selection.

How the valves work

Pneumatic valves are frequently selected for dispensing jobs because they cycle fast and work reliably. These valves are powered by timed air pulses that open seals or gates which let a material flow. Return springs close the seals. Faster cycling calls for a 4way valve, one that needs an initial air pulse to open the seal and another pulse to snap the seal shut after the timed interval. These pneumatic units are available as spray valves, needle valves, diaphragm valves, spool valves, poppet valves, pinch tube valves, and positive displacement valves, which can have adjustable or fixed outputs.

JB1113N

Pneumatic valves are powered by timed air pulses that open seals or gates. Return spring close the seals. Second air input for applications that need a more precise close. Features: material inlet, operating air inlet, stroke adjustment. material inlet.

SV1000SS

Spray valves are one type of pneumatic valve powered by timed air pulses. When an application requires a spray, this valve works best.
Features: mounting hole, atomising air inlet, operating air inlet, material inlet.

Spray valves work best with low-viscosity material, typically less than 1,000 cps. For comparison, water has a viscosity of 1 centipoise (cps) while mustard paste, about 200,000. To ensure a proper selection from this category, consider the angle of spray permitted by the valve and the control module. This latter device ensures atomization takes place prior to material flow and remains on momentarily after flow ceases. This prevents clogging, common with conformal coating products.

Needle valves are ideal for single, micro shot deposits for many fluids, providing the valve is suitably configured to handle the fluid. These valves are often adjustable when rated for the high pressure that lets them handle high viscosity unfilled material. Needle valves are also suitable for applying beads of low-to-medium viscosities because they can be opened for any period. Needle valves are also available with a replaceable cartridge seal mounted between the wet-chamber and moving parts. This allows setting a maintenance schedule based on valve cycles. These are not recommended for abrasive materials, which can clog.

Diaphragm valves are chosen for adjustable high-cycle dispensing of many low-to-medium viscosity fluids including glues, solvents, and corrosive agents. They are light-weight and easily maintained. Spool valves are suitable for high-viscosity pastes, treacle, and gels. These valves operate at high material feed pressures necessary to move high-viscosity fluids. They include a suck-back or snuff-back feature.

Spool valves also work well applying beads. With proper automated control, a spool valve can, for example, seamlessly deposit a beaded path of fluid on a gasket.

790HP-LF

Spool valves are good for dispensing high-viscosity pastes, thick syrups and gels. Features: operating air inlet ¼ NPT, second air input 1/8 NPT, material outlet ¼ NPT, Oiler inlet 1/8 NPT, material inlet, ¼ NPT.

Positive-displacement valves are used in tasks that require highly accurate micro deposits. The choice is either a pneumatic or electrically controlled auger or screw valve. It is determined by viscosity and shot size.

Pneumatic valves can positively displace lower viscosities than other auger valves. Pneumatic positive-displacement valves are also less expensive than if choosing to use electrically controlled augers.

MV0180-LF

Needle valves work best for single micro-shot deposits of all fluids. Corrosive or abrasive fluids will require more durable materials and seals. Features: stroke adjustment, operating air inlet, material inlet, material out, second operating air inlet closes this valve.

VD510

Choose a diaphragm valve when a high-cycle rate is needed to dispense low-to-medium viscosity fluids such as glues, solvents, and corrosive agents. Features: material inlet, stroke adjustment, operating air inlet, material outlet.

Poppet valves are similar to spool valves with features such as suck-back, but work with low-to-mid-high viscosities. Poppets can apply a smaller shot size than a spool valve.

Pinch-tube valves work well dispensing aggressive solvent base fluids because they have disposable wetted parts. These designs work with moderate precision and repeatability within the confines of a pinch-tube design. The pinch-tube valve is often used for two-part, meter-and-mixed applications where the material will cure. The low-cost tubes are disposed at prescribed intervals.

VP300

Poppet valves are similar to spools, expect the poppet designs work best with low-to-middle viscosities. Features: stroke adjustment, operating air inlet, second operating air inlet 1/8 NPT for closing. Material inlet, mounting hole, material outlet.

Material characteristics

To get a better idea of where each valve works best, let's examine several industrial fluids and their applications. For instance, consider a thin material (100 cps) that cures fast, such as cyanoacrylates. The fluid will likely need purging, or a valve feature that parks the tip in a material that prevents clogging between dispense cycles. The valve design must separate air-actuated moving parts from the wetted parts. Watery or low-viscosity fluids require a valve that allows flow at low pressure, often gravity feed. Such materials call for either pinch-tube, needle, or diaphragm-operated valves. Medium to high-viscosity fluids have the consistency of cream.

710PT-LF

Pinch-tube valves work in a way suggested by their name: a tube carrying the material is pinched to close and released to open. Features: material inlet, operating air inlet, material out, stroke adjustment.

VDP150

A positive displacement valve can accurately place micro deposits. The choice is either to use a pneumatic or an electrically controlled auger-screw valve. Features: Auger screw, material inlet, servomotor or pneumatic drive.

Pressurised reservoirs that feed such materials to a valve can require degassing and agitation. Spool or poppet valves that include a suck-back or snuff-back feature are appropriate for such materials. Medium-viscosity fluids can also be dispensed with pneumatically operated needle valves. High-viscosity (500,000 cps) and corrosive materials with abrasive fillers will need heavy duty pneumatic valves with corrosive and abrasive-resistant seals. The material content calls for more frequent maintenance intervals than less abrasive materials. Thick fluids, such as gels or silicones, are usually dispensed from their container, often 0.1-gal. cartridges, or 1 to 5-gal. pails.

Thick fluid in pails is extruded to the valve by pneumatic pumps using a follower-plate correctly sized to the diameter of the container. It mechanically forces material through a high-pressure braided hose to the valve. A word of caution: Pneumatically pressurized cartridges can show an effect called tunnelling in which only the material in the centre is pushed out, especially when the package is not designed for automated dispensing. After viscosity, consider the thixotropic nature of some fluids. These are difficult to pour but agitate them and they take on a creamy consistency and move easily against themselves. Ketchup is an example. Fluids with the consistency of a thick syrup are subject to the same requirements as gels but often come in small cans that have not been degassed.

Therefore, consider how the material is to be fed to the valve so the fluid is air-free. Paste-like fluids have still higher viscosities and are dispensed directly from their packaged container. The material often comes degassed but confirm that with its manufacturer. Pneumatic valves appropriate for pastes are spool, poppet, and high-pressure-needle valves. Electrically operated auger or screw valves are also recommended when it's necessary to deposit small amounts of high-viscosity fluids.

A few materials and their viscosities

Fluid	*Viscosity (cps)*
Water	1
Milk	3
SAE 40 Motor Oil	650 to 900
Honey	10,000
Ketchup	50,000
Mustard	70,000
Peanut Butter	250,000

Aggressive Fluids

Additional considerations include the harshness of the fluid. For example: Corrosive fluids can contain acids, alkaline, methanol, and solvents. Each reacts upon the fluid wet-chamber, seals, and O-rings in the wet-chamber. Therefore, a diaphragm or needle valve must be tolerant of the corrosive substances. Seals and O-rings should be fabricated from ultra-high-molecular weight (UHMW) material resistant to acids. UHMW is also suitable for alcohol and methanol. PEEK can also be used depending upon the corrosive content. Pinch-tube valves are often used with acids and all types of solvents because their polyethylene tubing is disposable. These valves have no wet-chamber to corrode. Adhesive fluids, such as cyanoacrylates, are solvent based and highly corrosive, so applying them calls for a diaphragm valve with a UHMW polyethylene wet-chamber with UHMW seals and O-rings. Abrasive fillers, often found in pastes, increase conductivity or improve a material's dielectric properties. Not all fillers are abrasive so the filler's nature should be discussed with the manufacturer or supplier to avoid an unnecessarily expensive valve. But once confirmed that the fluid contains an abrasive, select a valve with a high-hardness stainless steel wet chamber and tougher seals that stand up to constant abrasion with minimum maintenance. It is good practice to have replacement valves on hand for maintenance.

Cure rate is relevant in automated and robotic dispensing because a changing cure rate alters process consistencies, such as the time to complete a bead. If the fluid cures quickly, continuous monitoring and a park-and-purge feature is necessary. While this does not impact the type of pneumatic valve, it will probably affect the maintenance. Therefore, a valve should be selected with easily replaceable or disposable parts. It is often necessary to apply a temperature control system that includes the valve to maintain a constant fluid viscosity throughout the dispensing apparatus, thus ensuring consistent deposits and reduced down time. Anaerobic fluids cure in the absence of air, so the material feed and the valve's wet chamber must be porous. Valves which best handle anaerobic fluids are likely to be diaphragm or pinch-tube designs with plastic wetted materials.

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