Rotary Auger Valves – Pros and Cons

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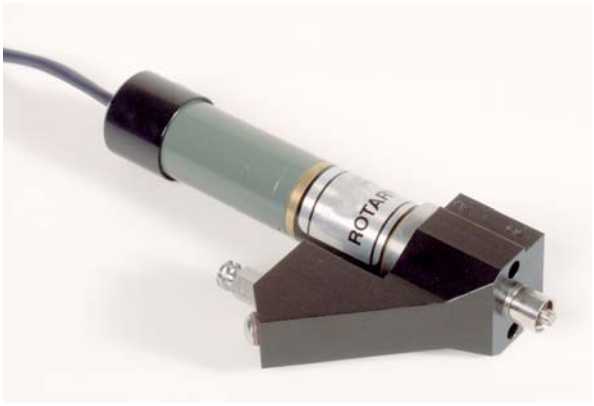
For more than 20 years, the Rotary Auger valve dispensing system has been recognised as the workhorse for the electronics industry. First introduced by Techcon Systems in 1987, the TS5000 Series Auger valves overcame many of the problems engineers faced, most notably the inability to dispense highly accurate deposits of high viscosity solder paste, silver-filled epoxy for die attach applications and high viscosity epoxy for dam writing applications (dam and fill) to name a few.



Working on the Archimedes screw principle, a syringe barrel or cartridge is permanently pressurised and constantly feeding the Auger valve with fluid. As the motor receives a voltage signal, a feed screw directly coupled to the motor rotates, forcing fluid through the threads to the output of the valve, whereby a dispensing tip determines dot or bead size. When dispensing with fluids at the lower end of the Auger valve viscosity range – 30,000 cps – pulsed air pressure often is considered. Rotary Auger valve output is controlled by the feed screw threads and motor speed. A common misconception is that to achieve more output, the air pressure must be increased. By increasing air pressure, the feed screw becomes semi-redundant and back pressure increases. Greater output is achieved by selecting a feed screw with fewer threads and by increasing motor speed. Typically, more threads per feed screw will reduce output, but dispensing accuracy increases. Fewer threads deliver more output but dot-to-dot accuracy decreases.

The Rotary Auger valve dispensing system relies on the inherent resistance to flow provided by the dispensing tip and feed screw. If dispensing fluids with viscosities less than the recommended minimum of 30,000 cps, oozing may be observed at the dispensing tip. Longer cannula and restrictive tips provide increased resistance and in some circumstances thinner fluids can be successfully dispensed. For thicker fluids, the use of tapered tips is recommended to ease the restrictive pressure generated inside the hub of the dispensing tip. If the selected tip is too restrictive for the type of fluid, back pressure increases and can cause blockages, sometimes referred to as clogging. An example of this is if the particles of solder paste are too large to pass through the cannula of a precision TE tip. As a blockage is created, more back pressure is built up and the feed screw will “churn” the paste until separation of the flux and the metal particles. The particles will form into a solid blockage referred to as “cold welding.” In cases of cold welding, the dispensing process should be examined to determine if a wider diameter tip or a tapered tip is required. If blockages are continuing to be observed, motor speed should be reduced and in turn, back pressure is reduced. Dispense time is compromised but Auger valve blockages are reduced or eliminated.

Typically, the Rotary Auger valve dispensing system is supplied with fluid by way of syringe barrel or cartridge. The syringe barrel or cartridge capacity can be pre-selected for the volume of fluid used per

shift. An excess of unused fluid will result in costly wastage but, on the other hand, a packaging size too small will result in frequent syringe barrel or cartridge replacements.

As with any fluid dispensing system, the fluid feeding mechanism must be free of air entrapment. Pockets of air, in the fluid, will flow into the dispensing system and either become trapped, or pass out of the dispensing tip and into the dispensed product, causing voids. Entrapped air inside the Auger valve generates unwanted internal pressure causing oozing while not in use.

This new Auger valve technology was quickly accepted as a preferred method of dispensing highly accurate and repeatable deposits of solder paste, and it wasn't long before other industries, outside of electronics, were using the Auger valve dispensing system technology. Other fluids, namely heat transfer compound, grease and flux were now able to be dispensed with the same degree of accuracy as that of solder paste.

However, in order to maintain accuracy, the auger valve would have to be regularly maintained or cleaned. In cases where the fluid particles are embedded — solder paste, silver epoxy — over time the feed screw would become scored and unable to remain competitive resulting in a return to the manufacturer for an expensive repair.

Due to the design of the TS5000 Auger valve dispensing system, many variations were made available to address most of the fluid types available. Manufactured with Aluminium or Delrin® bodies, 8, 16 or 32 pitch feed screws and 3 types of DC motor, the TS5000 range was extremely complex and sometimes difficult for engineers to choose which type would suit their application best. Additionally, Auger valves were generally slow at dispensing fluids and a need for greater output was demanded. The introduction of deep cut high output feed screws and faster rotating motors overcame some of the speed issues. If the high output feed screw's deposit still does not deliver the required deposit, in the time required, then a pneumatic spool valve should be considered for the application. Spool valves deliver high output with ease but deposit-to -deposit accuracy will be lower than that of the Auger valves.

The Birth of **DMP** (**D**isposable **M**aterial **P**ath)

Techcon Systems continued to develop the Auger valve product offering and as such implemented the positive customer feedback into a revolutionary patented Auger valve dispensing system. Commonly termed DMP — Disposable Material Path — this valve provided the industry with a valve technology that required little or no maintenance. A hinged clamshell door was incorporated into the Auger valve's body and a Delrin® disposable feed path would now become the only part of the valve that came into contact with the fluid. A choice of 6, 8 and 16 pitch cost-effective disposable feed paths were available and the need to clean the valve was eliminated. Feed paths were simply replaced and purged with fluid within one minute, whilst the main section of the valve remained on the production line. Disposable feed paths

offered color-coded dispensing tip collars for easy feed screw pitch recognition.

No feature was overlooked with the DMP specifications, which included the suitability of dispensing UV adhesive. Due to compatibility issues associated with UV fluids, the DMP valve was hailed a success for incorporating a precision Delrin® feed path. For the first time, even pre-mixed two-part adhesives could be dispensed using Rotary Auger technology.

Not all fluids are suitable with the DMP Auger valve. Should abrasive fluids be dispensed, the Delrin® components could be subjected to premature wear, resulting in increased usage of disposable feed paths. Concerns such as this should be addressed at the early stages of any application.

The Next Generation – IMP Hybrid Technology

Following years of success with Techcon Systems TS5000 and TS5000DMP Series Auger valves, development never slept. Numerous applications still required a harder wearing feed screw to accommodate the harsh conditions that particle-filled fluids, such as solder paste, brazing paste and conductive adhesives would put of the valve. At the end of 2007, the TS7000 IMP (Interchangeable Material Path) dispensing system was introduced and attracted much attention. This Hybrid valve incorporated the accuracy and robustness of the original TS5000 Auger valve dispensing system but with the versatility of replacing a metal cartridge similar to that of the DMP.

This modular design allows engineers to easily and confidently maintain the TS7000 IMP valve with no special tools required — just one thumbscrew to release the cartridge. A U-Cup seal design replaced the traditional lubricated O-ring as the sealing method, which further enhanced the TS7000's ability to dispense filled fluids and control fluids at the lower end of the viscosity range.

A hardened tool steel feed screw with a stainless steel chamber ensures that the TS7000 dispensing system is suited to deal with difficult fluids such as UV sensitive and abrasive types.

The Luer lock design for attaching the dispensing tip, found on other rotary valves, was redesigned with an integrated Luer taper and cap. Benefits of this include the unique attachment of Bent tips meaning the cannula is positioned in the same place after each tip replacement and contaminants could be effortlessly removed from the tip attachment area. Techcon Systems' TE precision, TE-BENT, TT taper and TS-SS all metal tips offer a wide array of tip style, gauge and length to satisfy most output requirements.

Featuring a "divorced" motor, the TS7000 dispensing system utilises a coupling that separates the motor from the wetted area. At some point, all valves suffer from the lack of maintenance because of ever increasing outputs demanded by production teams. If for any reason the TS7000's integral U-Cup seal

was operated past the regular working life, fluid could leak back towards the coupling but would not penetrate the precision motor.

An encoder option provides intelligent closed-loop feedback control, ensuring the highest possible level of control and a DMP kit is optional for retrofitting existing TS7000's should the dispensing process change.