ARO®

ABRASIVES IN AUTOMOTIVE ADHESIVES

CHOOSING THE RIGHT PISTON PUMP CONFIGURATIONS TO CUT SERVICE COSTS

PISTON PUMP PROBLEM SOLVER

Adhesive Applications



Ingersoll Rand

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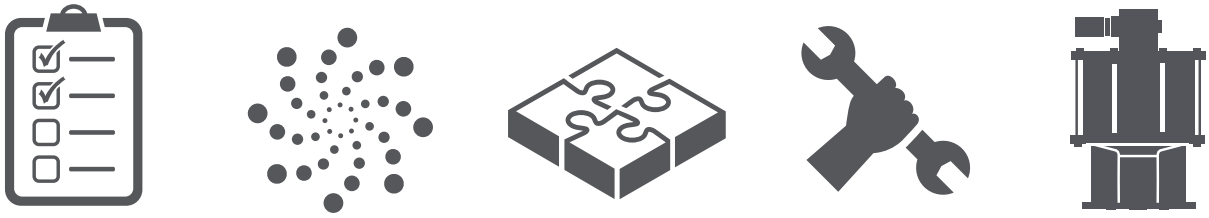

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Piston Pump Selection and Configuration for Adhesive Applications: Getting It Right at the Beginning Lets You Focus on Your Business and Not on Downstream Service Problems

New types of adhesives for automotive and industrial applications replace spot welding, rivets, and other fasteners, and provide labor and materials cost savings, reduced weight, and higher bond strength

A new range of high-strength industrial adhesives is now being used in the automotive field, and in other manufacturing operations, as a replacement for spot welding, mechanical fasteners, and other traditional joining methods. These adhesives, available in a wide variety of chemistries, such as methyl methacrylates, two-part epoxies, silicones (for sealants), and polysulfides, are often custom-formulated, based on the bonding requirements for a manufacturer's specific application and material type.

Adhesives offer several major advantages compared to conventional fastening techniques, including more uniform bond strength over a larger surface area, versus the localized strength points typically achieved with mechanical fastening. In the automotive field, new types of adhesives are being used in body panel assembly instead of spot welding, and in many other bonding applications, such as interiors, headliners, and subcomponent assemblies. In addition to labor savings, use of these new adhesives reduces vehicle weight—a major focus for vehicle manufacturers—while increasing overall panel rigidity for car bodies and providing higher bond reliability for other vehicle components.



When used for both automotive and general manufacturing purposes, these new industrial adhesives are applied using a wide variety of adhesive delivery systems. These range from fully robotic application systems -- which rapidly apply a precise, consistently measured bead of adhesive to a workpiece, such as an unprimed body panel or windshield -- to gun-based applicator systems used by plant workers to manually apply adhesives to panels and parts during production line assembly. To achieve a more consistent flow and bead of material during application, fluid regulators can be added downstream of the pump. This controls fluid pressure beyond the regulator, cutting fluid pressure to the desired level to ensure smooth delivery.

> OEMs building new adhesive application systems must select and configure pumps and packages designed to match the properties of the specific adhesive being used by their customer

For OEMs designing and building adhesive application systems for automotive and general manufacturing systems, the pump that moves the adhesive from its container through the lines and hoses to the applicator nozzle is the most critical component of any OEM system. A one- or two-post ram package, including a follower plate, may be needed to apply downward force to supply adhesive material to the pump. This downward force can be generated either by the weight of the follower plate itself or by air pressure applied to the ram. For thicker or heavier adhesives and sealants, a two-post ram can apply greater downward force than a single-post ram. Due to the challenging nature of the new types of adhesives and sealants being used for various applications, special care must be taken to select and configure a pump and ram package that is reliable, economical, and optimized for its specific application.

Step 1

Selecting the Right Piston Pump for Optimal Performance and Service Life in Adhesive Applications

Due to the higher viscosities of adhesives and sealants used for these applications, piston pumps usually offer the best performance for OEM system designers. Based on material viscosity, two types of piston pumps are generally used:

> **Chop-check pumps**, which are self-priming and can move very thick fluid material, are used in very high viscosity adhesive applications -- up to and over one-million Centipoise (cPs);
>
> **Two-ball pumps**, which create a vacuum to pull fluid into the pump, are used for adhesives of lower relative viscosity, or where the material must be moved more gently due to suspended beads or catalyzing agents.

By their physical nature, chop-check piston pumps generate a lower flow rate compared to 2-ball pumps, but both types can be configured to operate within the same pressure range. As material viscosity of the adhesive increases, a follower plate is often needed to help move the material from the container into the pump.

Just as many manufacturers use specialty adhesives formulated specifically for their applications, when specifying and integrating piston pumps and related in-line components, OEM system builders must pay very close attention to the special challenges and requirements presented by the specific adhesive or sealant material being used for their customer's application.

2-ball pumps are among the most versatile in the ARO line. They are capable of handling applications from simple transfer to the extrusion of low- to medium- viscosity materials up to 100,000 centipoise (cPs) with fluid delivery up to 18.1 gpm (68.6 L/min).



The heavy-hitters of the line, ARO chop-check pumps are designed to move medium- to high- viscosity fluids ranging from 15,000 to more than 1,000,000 cPs, and at delivery rates up to 12.2 gpm (46.3 L/min).

Step 2

Abrasive Materials Used in Adhesive Formulations

Abrasive wear is a major consideration for OEMs when integrating piston pumps into a new adhesive application system. Many newer adhesives make use of various fillers to create structure and texture in their products, for improved bonding strength on smooth surfaces, such as steel body panels, glass, or injection-molded plastic. These filler materials are often made from abrasive materials ranging from very fine to coarse sizes.

> Many new adhesives contain abrasive materials, which can cause premature wear and early breakdown of piston pump internal components on pumps not properly configured for use with abrasives

Continuous flow and pressure magnifies the impact of abrasive wear on internal pump components: It is important to recognize that the impact on internal pump components of any adhesive formulation, even with the finest abrasive material, will be amplified as the abrasive material moves continuously under pressure through a piston pump, lines, and hoses.

If the material composition of these parts and surfaces can't withstand this abrasion, the result is premature wear on key internal parts and early pump failure. Just as the action of rapidly-moving water carrying the finest sand particles downstream eventually wears down the surface of the roughest rocks in the stream bed, if the pump is not configured for use with abrasives, the presence of any type of abrasive material in an industrial adhesive or sealant will, in a far shorter period of time, lead to premature wear and eventual breakdown of the pump and related in-line components such as lines, hoses, and application hardware. This abrasion wear effect is also magnified as the speed of the pump increases, which makes selecting a pump that is operable at the desired pressure and flow rate while running as slowly as possible a critical part of the OEM pump selection process.

In piston pumps, for example, abrasive filler particles in adhesives can lodge between the plunger and the packings of the pump, creating gaps or scoring in the packings that causes early leakage in piston pump assemblies. In addition to reduced performance, a leaking pump which has not been properly configured to handle abrasive materials can fail entirely when this material finally breaches the pump's lower assembly and leaks directly into the pump's air motor.



Further, if the pump is required to stop or idle for a period of time during any part of the application process, it is critical that the pump be stopped on the down-stroke so the plunger rod is submerged in the adhesive material. This prevents the material hardening or curing on the plunger rod and destroying the packings when the pump is restarted, and also prevents scratching or wear that can damage internal parts and create a path for leakage.

Step 3

Proper Component Material Configuration is the Key to Abrasion-Proof Pump Operation

For OEM system builders, preventing early pump failure and costly downtime and servicing of piston pump systems on adhesive application systems means paying extra-close attention to selecting the right pump, internal pump component materials, and configuration early in the system integration process. The correct internal pump components must be matched specifically to the exact adhesive being used for the application, based on the chemical formulation, properties, and performance characteristics of the adhesive used by the OEM's customer.



This process begins with a careful evaluation of the adhesive's chemistry and formulation as specified in the SDS sheet for this adhesive. Once this evaluation is made by your pump supplier, internal pump components are selected to best match the adhesive product's properties to the optimal pump configuration achieving the best wear characteristics and pump performance.

For example, upper and lower pump packing seals are subject to extensive wear when moving abrasive materials for adhesive applications. For many abrasive-bearing adhesive applications, leather is often the best seal material choice since leather is highly resistant to abrasive wear when operating in continuous contact with adhesive fluid and steel or ceramic pump components. Depending on the adhesive formulation, polyurethane may also be a suitable material for use in packings. Other common materials used in packings, such as teflon, while having good pressure resistance, do not hold up well under extensive use with materials containing abrasive fillers and are therefore not recommended.

For pump plungers, steel which has been heat treated (hardened) or hard chrome-plated provides the best abrasion resistance for adhesive dispensing piston pump applications. Hardened carbon, hard chrome-plated, or hardened stainless steel are the best material choices for plungers used in pumps for these applications. Other common steels used in pumps, such as regular, non-hardened stainless steel, exhibit poor abrasion resistance.

For applications in which adhesive material is both abrasive and corrosive, ceramic coated internal parts, such as plungers and cylinders, offer the best overall wear resistance.

Selecting the right materials for in-line components also makes a big difference: In addition to the pump itself, anything that touches the adhesive fluid while it is moving through the system must be carefully configured to avoid abrasive wear. For dispensing hoses, nylon is the best choice, and downstream in the process, regulators and filters, which are usually made from nickel-plated carbon steel, must also be matched to handle the abrasive being moved through the system.



Additionally, pay close attention to materials selection for seals used on follower plates to minimize wear as adhesives are pumped out of their containers. Here, ethylene propylene rubber (EPR) is an excellent material for follower plate seals and carbon steel follower plates are another good choice.

Make sure the gun you are specifying uses tungsten carbide seats in the valve assembly for the best abrasion wear resistance when building a system for manual adhesive application. Additionally, tungsten carbide should also be specified for use on key wear surfaces in material regulators.



> Specifying the correct internal pump components early in your system design process maximizes the wear life of components and reduces the possibility of potential service problems due to abrasion wear in adhesive applications

Step 4

Dial in the Right Piston Pump Performance Level for Maximum Service Life and Minimum Fluid Impact

> Regardless of the brand or manufacturer of the pump being used, to maximize piston pump performance and service life, select a pump that can meet your system's fluid delivery requirements without running continuously at its maximum cycle rate

For adhesive applications (and for all other piston pump applications as well), to ensure maximum service life, specify the pump to run continuously below its rated full speed. A pump that must continuously run at its maximum cycle rate to provide the fluid transfer rate needed for the application will ultimately have a shorter operating life. This applies to any piston pump produced by any manufacturer.



Selecting a pump that delivers the desired performance at a cycle rate below its full-rated speed ensures the best long-term service life for your application system with fewer service intervals, which means lower total ownership cost. The key here is to run the pump as slowly as possible to achieve both the desired flow rate and fluid pressure while maintaining the intended consistency of the adhesive material. Maintaining this consistency also prevents material separation in the adhesive or other undesirable material changes which can sometimes occur when moving adhesive through a pump at higher speeds.



Step 5

Piston Pump Selection and Configuration for Adhesive Applications: Getting It Right at the Beginning Lets You Focus on Your Business and Not on Downstream Service Problems

As the heart of any application system, piston pump failure on a customer's site means expensive production downtime and on-site service headaches for any OEM. Any error in the initial pump selection, configuration, or construction can increase your ongoing service costs and create big problems for your customers in lost production time. Working with your piston pump supplier to configure the right internal and external pump components made from the right materials and selecting a pump with a high enough speed rating to allow for extended continuous operation are two major steps toward ensuring trouble-free performance.



For your customers, selecting the best pump for their adhesive application reduces the chance of production downtime, extends pump service life, and keeps ongoing service costs as low as possible. Getting your customer's piston pump configured right from the beginning allows you to focus on the systems you design and build and on building your customer relationships, instead of servicing or replacing pumps after system installation.

Piston Pump Overview



For over 85 years, the ARO® Fluid Products business of Ingersoll Rand® has developed partnerships with more than 200 original equipment manufacturers and distributors, enabling us to better focus on the unique pumping needs of many industries. It's a strategic merger of our partners' application expertise, along with our decades-long legacy of designing and building outstanding piston pumps.

Simply Versatile

ARO piston pumps are capable of handling a wide variety of viscous fluids. With a wide selection of pressure ratios and displacement rates available, ARO offers a number of piston pump packages that can meet your specific application needs. Offered in multiple configurations, including single-post, two-post and heavy-duty two-post.



Our partnerships create unmatched application expertise in:

- Finishing
- Coatings
- Sealants and adhesives
- Lubrication
- Bulk material transfer and circulation
- High-pressure cleaning



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