Sizing and Selecting Metering Pumps

PLANNING A METERING PUMP INSTALLATION GUIDE

Neptune™

Sizing and Selecting Metering Pumps

This guide is intended to help the user define variables to be evaluated for proper selection and installation of a chemical metering pump or a complete chemical feed system.

When determining which metering pump is the best option for a chemical-injection application there are a number of variables that must be taken into consideration, including:

- **Flow Rate/Discharge Pressure:** Metering pumps should never be oversized, meaning that determining the exact flow rate that is required for the application is of paramount importance. With that in mind, a metering pump should be sized so that the maximum expected flow rate is 85% to 90% of the pump's capacity, which will leave room for additional capacity, if needed. The minimum capacity should never be less than 10% of the pump capacity to maintain accuracy.
- **Materials of Construction:** Metering pumps are available in a variety of materials, most commonly 316SS, C-20, PVC, and PVDF. When selecting a metering pump's materials of construction, the corrosion, erosion or solvent action of the chemical must be taken into consideration. Solvent-based chemicals may dissolve plastic headed pumps, and acids and caustics may require stainless steel or alloy liquid ends. The effects of erosion must also be considered when the chemical takes the form of an abrasive slurry.
- **Chemical Makeup:** Is the chemical viscous or a slurry? Does the chemical release gas? If so, special liquid ends are available for these specific applications. Standard metering pumps are typically able to handle clear liquids with

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viscosities ranging from water-like to 1,500 cPs. Chemicals with viscosities that approach 5,000 cPs or have light suspensions will require special liquid ends. For true slurries or higher viscosity, tubular diaphragm heads allow pumping chemicals to 20,000 cPs or slurries containing up to 10% solids. Liquid ends are also available which automatically vent accumulating gases.

- **Leak Detection:** Double diaphragm heads with leak detection and alarms are available for applications where any diaphragm failure must be sensed immediately. Examples are applications where contact between the process fluid and the pump hydraulic fluid cannot be tolerated or where, due to the toxic or hazardous nature of the fluid being pumped, leakage cannot be tolerated.
- **Driver:** Drivers, which can be powered by electricity, water, gas, air or the sun, must be selected according to the utilities that are available. Driver selection must also take into account any environmental hazards that may be found in the operating area. When evaluating a hazardous environment, consider dust, which can ignite as well as fumes or vapors.
- **Environment:** Determine if the pump will be operating indoors or outdoors. If used outdoors, the pump must be sheltered from direct sunlight. Any pumps that will be used in freezing temperatures can only pump fluids that will not freeze at that temperature and must have the correct lubricant selected. Freeze protection and heat tracing may be required. Corrosive environments may require special coatings.
- **Method of Control:** The operator must know how the pump will be used, either manual continuous operation, on/off operation or proportional to some process signal.
- **Manually Controlled Flow Rate:** Metering pump flow rate can be manually adjusted by a micrometer dial. Adjusting this dial changes the pump's stroke length and allows the pump to be operated anywhere between 10% and 100% of its rated flow capacity.

  Metering pumps with micrometer dials may also feature a variable speed drive that allows adjustment of the pump's stroke speed. Using the two in unison can allow additional adjustability or turndown capabilities over the range of the drive, depending on the pump's stroking speed.

  For example, a pump operating at 75 strokes per minute (spm) (which could be turned down to 15 spm) would allow a 5:1 turndown on speed using the variable speed drive and a 10:1 turndown on stroke length using the micrometer dial.
- **Automatically Controlled Flow Rate:** Metering pump flow rate can be controlled automatically (in response to a process signal) by electric or pneumatic positioners which change the pump stroke length, or by variable speed drives which change the stroking speed. Using a positioner gives you the full 10:1 turndown, the full adjustable range. Using a variable speed drive will give you only as much turndown as the ratio of the pump stroking speed divided by the minimum operating speed of the pump.

  It is not practical to use a variable speed drive on motor-driven pumps that normally operate at speeds less than 100 to 150 spm since slowing the motor causes each stroke to take longer to complete from start to finish. However, electronic metering pumps, which are pulsed by a solenoid, can operate at less than one spm because the timing of each stroke from start to finish is uniform at every stroking speed. The moving parts in modern diaphragm pumps offer long, reliable service at all stroking speeds. The highest stroking speeds should be avoided with viscous or abrasive chemicals.

Electronic Diaphragm Pump

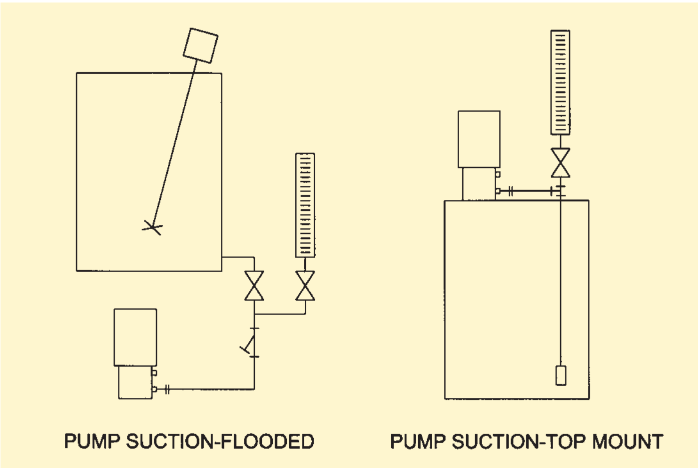
  When a metering pump is controlled by automatic, electric or pneumatic stroke positioners, the number of doses remains constant and the size of each dose is reduced, thus keeping the doses uniformly distributed in a constantly flowing line. Use of a variable speed drive changes the stroke speed and the size of dose injected on each stroke remains the same, but doses are less frequent. This can produce an undesirable process result in a constantly flowing line as the discreet slugs of chemical are more widely separated than if a constant dose interval were maintained. Choice of control can be an important process consideration.
- **Application and Level of Quality:** Finally, considering the application and level of quality is important. Is the unit for intermittent operation in an HVAC or light duty application where economy is an important consideration? Is the unit for an industrial plant/waste treatment facility/refinery/power plant where ruggedness and additional features are required? Is first cost or life more important?

Just call for our assistance.

This information is not intended to guide you to a specific model number—we will be glad to do that for you.

Planning a Metering Pump Installation

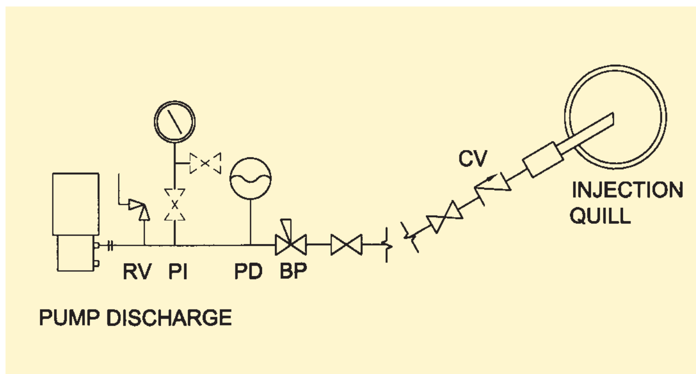
Now that all of the variables have been identified and reviewed, it's time to design the pumping system, keeping in mind any location or environmental concerns that may be present. For best results, the system's design should originate from the liquid source or feed tank and work its way to the injection point. Note that metering pumps will be able to "push" against great pressures but will struggle to "pull" over longer distances. This means that suction lift should be limited to no more than 4' (1.2 m) and that a foot valve should be used in top-mount installations. Typically, combination foot valve strainers are used.



Flooded suction is always preferred in a metering-pump installation as it makes the pump easier to prime, but the length of the flooded suction should be limited to 6' or 7' (1.8 to 2.1 m). Flooded suction must be used for fluids where the vapor pressure could be less than the suction lift. And, as with all pump installations, adequately sized lines should be used and piping runs should have minimal bends, elbows or other design characteristics that may restrict or limit flow.

Components Considerations

- **Suction Piping:** The traditional rule of thumb is to use suction piping that is one size larger than the pump's suction connection, though it is acceptable to use piping that is the same size as the suction connection if the metering pump will be operating at a slow speed when transferring low-viscosity chemicals. Generally, do not use hard piping that is smaller than 1/2" (12.7 mm) in diameter or that is smaller than 3/8" (9.5 mm) in diameter for low-flow applications that use plastic tubing.
- **Discharge Piping:** The size of discharge piping is not as critical as that of suction piping, but the piping must be suitable for the discharge pressure. Typically, matching the pipe size to the discharge connection should be sufficient to ensure proper and reliable operation.
- **Suction Strainer:** Always use a suction strainer, 40-60 mesh to prevent foreign matter from getting into the ball checks of the metering pump.
- **Flanges, Unions or Compression Fittings:** Should be installed at the pump suction and discharge to facilitate maintenance.
- **Isolation Valves:** Large-port, quick-opening isolation valves should be placed at both the suction and discharge ends of the installation as a way to ease maintenance operations. Ball valves are usually the best choice for this operation, while needle valves should not be used because their design will cause the creation of a flow restriction.
- **Calibration Column:** Because metering pumps very often feature pulsed flow at low volumes a draw-down calibration column is the most accurate and convenient method to measure pump performance. Columns should be sized to allow at least a one minute test. Lower capacity pumps may be better served by a two minute test. A tall, thin column should be used to ensure ease of reading and reporting accuracy. Calibration columns can also be helpful in determining if any wear has occurred or dirt has accumulated in the pump's check valves. The liquid in the calibration column should draw down smoothly and stop smartly at the end of each suction stroke. If the liquid in the column "bounces", it would indicate the valves are worn or dirty. A calibration column may facilitate priming in a top mount installation.
- **Relief Valve:** An external relief valve is recommended even if the pump has an internal relief valve. Set the external relief valve at 50 psi (3.4 bar) or 10% (whichever is greater) above the maximum operating pressure. The relief valve return is piped back into the tank. Transparent return tubing allows fluid to be observed in the line if the relief valve opens. When portable, replaceable containers are used as the chemical source, it is convenient to pipe the relief valve back into the suction line. When piping the relief valve return to the suction, be certain the return is upstream of the pump suction isolation valve so that the flow path back to the tank cannot be blocked.



- **Back Pressure Valve:** This component is only necessary when the installation does not produce adequate back pressure and the pump does not contain a built-in back-pressure device. Back-pressure valves are also required when a system has a low-pressure injection point that is hydraulically lower than the feed tank.

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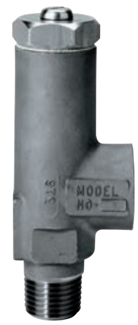
NOTE: A partially closed valve is not an acceptable back pressure regulator. A spring loaded, diaphragm type back pressure valve is required to provide proper back pressure. Always use a back pressure valve when feeding from a bulk tank to an injection point with little or no back pressure—do not depend on spring loaded pump valves for this application. If a back pressure valve is not installed under these circumstances, fluid can syphon and pump rate may be erratic, often pumping at a rate higher than the dial setting. Valve should be set to provide a 50 psi (3.4 bar) minimum differential between suction and discharge.

- **Pressure Gauge:** If a gauge is desired, use a snubber for pulsating services. A diaphragm seal must be used for chemicals that are corrosive to the stainless steel gauge parts, or that are viscous or contain particles that could clog the Bourdon tube within the gauge. Gauge should be sized 30% to 50% larger than maximum expected pressure. CAUTION—Consider the relief valve pressure, not the operating pressure. Example: A 100 psi (6.9 bar) injection service would be adequately served by a 150 psi (10.3 bar) gauge, however, a 100 (6.9 bar) application with a 150 psi (10.3 bar) relief valve would require a 200 psi (13.8 bar) gauge.
- **Pulsation Dampener:** Always discuss the requirements and goals of pulsation dampening with the pump manufacturer. Provide the reason for dampening and the degree of dampening required. The acceleration in a long discharge line can challenge the pump maximum pressure capacity or, at the very least, the relief valve setting. Use of a pulsation dampener will minimize the spikes caused by acceleration and, in the case of higher volume pumps, reduce piping harmonics.
- **Injection Quill and Check Valve:** Install a quill at the injection point both to serve as a check valve and to provide better dispersion. Low pressure applications may be better served by an injection quill with corporation stop.

Helpful Hint:

When replacing equipment or changing chemical programs, it is best to ask a few questions. Will the new program operate at the same feed rates as the previous program? Is the equipment properly sized for the new products? How well has the equipment been operating? Any problems with reliability, accuracy, unusually high maintenance requirements? There is no better start to a new chemical-feed program than to ensure that chemical is delivered accurately with trouble-free equipment.

Calibration Column



Relief Valve

Back Pressure Valve

Pulsation Dampener

Corporation Stop with Injection Quill

Inejection Quill with Check Valve

For more information on these additional solutions, visit us at psgdover.com/neptune.

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