Sizing and Selecting Metering Pumps Planning a Metering Pump Installation

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.

Neptune
A DOVER COMPANY

MOTOR DRIVEN HYDRAULICALLY BALANCED DIAPHRAGM PUMP

Sizing and Selecting Metering Pumps

Identify the required capacity in terms of **flow rate** and **discharge pressure**. Do not oversize a metering pump. A metering pump should be sized so the maximum expected flow rate is 85% to 90% of the pump capacity. This leaves additional capacity if needed. The minimum capacity should never be less than 10% of the pump capacity to maintain accuracy.

Consider **materials of construction**. Metering pumps are available in a variety of materials. Selection must take into consideration corrosion, erosion or solvent action. Solvent-based chemicals may dissolve plastic headed pumps. Acids and caustics may require stainless steel or alloy liquid ends. Consider the effect of erosion when handling abrasive slurries.

Is the chemical **viscous** or is the chemical a **slurry**? Does the chemical release **gas**? Special liquid ends are available for these specific applications. Standard metering pumps handle clear liquids with viscosities ranging from water-like to 1500 cps. Special liquid ends can handle viscosities to 5,000 cps and light suspensions. 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 available which automatically vent accumulating gases.

Sizing and Selecting Metering Pumps

continued

ELECTRONIC DIAPHRAGM PUMP

Double diaphragm heads with leak detection and alarm 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.

Select a **driver** matching the available **utilities** which may include electric, air, gas or other means of driving the pump. Identify hazardous area requirements when selecting the driver. When evaluating a **hazardous environment**, consider dust, which can ignite as well as fumes or vapors.

Consider the **environment** in which the pump will operate. Is the pump indoors or outdoors? The motor should be sheltered from direct sunlight. Pumps will operate in freezing temperature provided the fluid to be pumped will not freeze and correct lubricants are selected. **Freeze protection** and heat tracing may be required. **Corrosive environments** may require special coatings.

What **method of control** will be used: manual continuous operation, on/off operation or proportional to some process signal?

Metering pump flow rate can be **manually adjusted** by a **micrometer dial**. This manual control allows the pump to be operated between 10% and 100% of nameplate capacity by changing the **stroke length**. A manual **variable speed drive** changes the **stroke speed**. A combination of the two may allow additional adjustability or turndown over the range of the drive, depending upon the stroking speed of the pump. For example, a pump operating at 75 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.

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 less than 100 to 150 spm or there would not be a wide adjustable range. Slowing the motor causes each stroke to take longer from start to finish and, as a practical matter, motor driven pumps should not be operated at less than 15 spm. **Electronic diaphragm pumps**, which are pulsed by a solenoid, can operate at less than a single stroke per minute because the characteristic and timing of each stroke, from start to finish, is the same at all stroking speeds. 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.

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.

Consider the application and **level of quality**. 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?

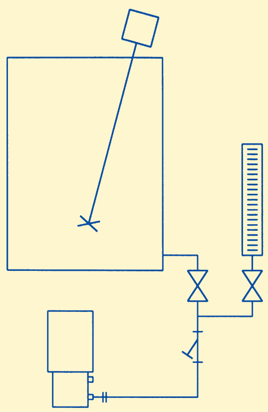
This information is not intended to guide you to a specific model number—we will be glad to do that for you.

Just call for our assistance.

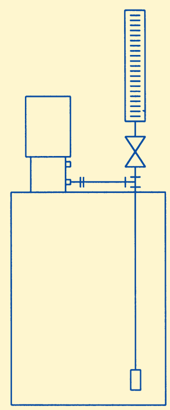
Planning a Metering Pump Installation

Plan the entire installation from the day tank or other liquid source up to the injection point and determine which accessories will be included.

Metering pumps will “push” against great pressures but they will not “pull” for very great distances.



PUMP SUCTION-FLOODED



PUMP SUCTION-TOP MOUNT

Flooded suction is always preferred—easier to prime—more “forgiving”. Flooded suction must be used for fluids where the vapor pressure could be less than the suction lift.

Limit the suction to 4 feet in a **suction lift application** if possible. A foot valve must be used in a top mount installation. Typically, combination foot valve strainers are used.

Limit the length of a **flooded suction** to 6 or 7 feet or seek application assistance from the factory. Use an adequately sized line. Minimize bends, elbows or other restrictions.

Suction Piping – The single, safest rule of thumb for selecting suction pipe size is to use one size larger than pump suction connection. Piping may be the same size as suction connection for slow speed pumps used with low viscosity chemical. As a practical matter, do not use hard piping smaller than 1/2". For low pressure, low temperature, low flow applications that use plastic tubing, 3/8" is a practical minimum size.

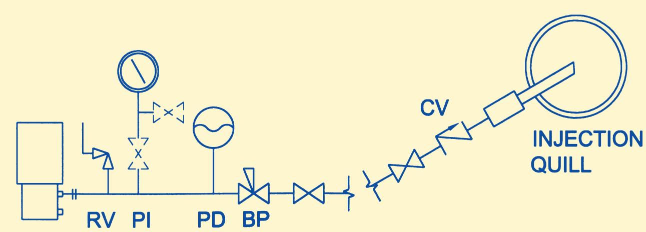
Discharge Piping – Specify piping suitable for the discharge pressure. Discharge pipe size is not as critical as the suction pipe size. Matching the pipe size to the discharge connection size is usually sufficient.

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 – Provide valves on both suction and discharge for ease of maintenance. Select large port, quick opening valves. A ball valve has a generous opening and is easily stroked from full closed to full open position. A needle valve would not be an acceptable suction valve as the port design would cause a restriction.

Calibration Column – The pulsed flow of metering pumps and the fact that metering pumps are often used in very low volume applications make a suction draw down column 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. Use a tall, thin column for ease of reading and accuracy. A calibration column may be helpful in observing wear or dirt in the pump 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.



PUMP DISCHARGE

Relief Valve – An external relief valve is recommended even if the pump has an internal relief valve. Set the relief valve at 50 psi or 10% (whichever is greater) above the maximum operating pressure. The relief valve return is piped back to 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 to 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 tank cannot be blocked.

Back Pressure Valve – Required when a system does not provide adequate back pressure and pump does not

Planning a Metering Pump Installation *continued*

contain a back pressure device. Back pressure valves are required when a low pressure injection point is hydraulically lower than the feed tank. 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 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 injection service would be adequately served by a 150 psi gauge, however, a 100 psi application with a 150 psi relief valve would require a 200 psi 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:

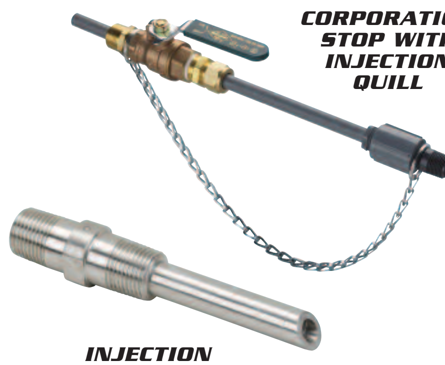
When replacing equipment or changing chemical programs, it is best to ask a few questions. Will the new program operate at the same feed rates as the previous program? Is the equipment properly sized for the new products? How well has the equipment been operating? Any problems with reliability, accuracy, 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

INJECTION QUILL WITH CHECK VALVE

For additional information, request controlled volume metering pump standard ANSI/HI 7.1-7.5-2006 from Hydraulic Institute, 9 Sylvan Way, Parsippany, NJ 07054 Tel: 973-267-9700 • Fax: 973-267-9055 • E-mail: info@pumps.org

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