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A measured step forward™

System Design Guide

Total Fluid Management | *Metering* *Transfer* *Chem Feed*

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Forward

The intent of this manual is to review those aspects of metering pump system design and installation which must be met to assure satisfactory operation. Metering pump installations which are properly designed, installed and maintained will give dependable operation for long periods of time. Frequently, unsatisfactory performance of metering pump systems is attributable to failure to follow principles of good design. Consideration of the operating parameters in the initial design stages can avoid subsequent problems after installation.

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Metering Pump Flow Characteristics

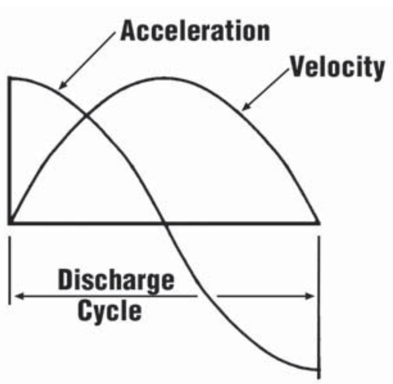

Figure 1

In applying single-acting reciprocating metering pumps, it should be understood that the characteristics of this type pump require that particular attention be paid to the piping system. Reciprocating metering pumps exhibit a sinusoidal velocity and acceleration profile as shown in Figure 1.

The typical acceleration curve decreases from maximum to zero as the velocity curve reaches maximum, then becomes a negative acceleration (deceleration) as the velocity drops to zero. Inertia pressure in the system is developed as a result of this pump characteristic. The force required to accelerate the mass of liquid in the discharge line in the direction of the point of discharge is provided by the pressure of the pump discharge.

Improper attention to piping design can produce inertia pressure surges in the discharge system of sufficient magnitude to physically damage both pump and piping.

Installation

The accuracy of a metering pump depends on proper installation. All factors and considerations of sound hydraulic practice, accurate and reliable seating of valves, proper size and length of piping, liquid vapor pressure, viscosity and temperature may mean the difference between a successful or unsuccessful installation. The application of basic hydraulic principles during the planning, installation and operation is essential.

A typical tank, pump and piping arrangement is shown schematically in Figure 2.

The installation should be made with careful attention to all instructions regarding handling of corrosive, toxic or hazardous chemicals to assure personal safety. It is of utmost importance that safety procedures established by the owner or user be carefully followed.

Location

The preferred location of a metering pump is indoors. Although pumps can be installed outdoors, manufacturer's recommendations for ambient operating temperatures must be followed. Gear lubricants and hydraulic system fluids are subject to viscosity increase when temperatures fall. Viscosities over those stipulated by the manufacturer can cause malfunctions.

All pumps used outdoors where temperatures can fall below 32°F should be provided with a means of heating the pump as well as being sheltered from precipitation, direct sunlight, blowing sand, dust or other contamination.

All pump installations should allow sufficient room all around for operator access. Do not install the pump under tanks or other equipment here possible overflow would damage the pump. Maker sure the pump foundation has sufficient height to accommodate the system pump/pipe.

Installation

A strainer should be employed to prevent foreign matter from entering the pump with the possibility of interfering with check valve operation. The strainer should be cleaned frequently to avoid starved suction conditions.

Strategically located shut-off and check valves should be incorporated to permit servicing the pump without draining the entire system. Drain valves should be installed at the lowest point in the discharge line. If the pump is not provided with check valves which are removable without disconnecting the pipe, install unions near the pump suction and discharge valves to facilitate removal of the pump head. During servicing, personnel must wear safety equipment to prevent injury.

Provide for pipe expansion and contraction. Support piping so that stress is not placed on the pump.

Suction and discharge piping runs should be as straight and short as possible. Piping should be sloped, if necessary, to eliminate vapor pockets. When suction tubing is used, a foot valve with sinker is needed.

A manual vent on the pump discharge line is desirable to facilitate removal of entrapped air, particularly during pump start-up.

No shut-off valve should be placed between the pump discharge and the system relief valve, thus making the relief valve ineffective.

Typical Pump, Tank & Piping Arrangement

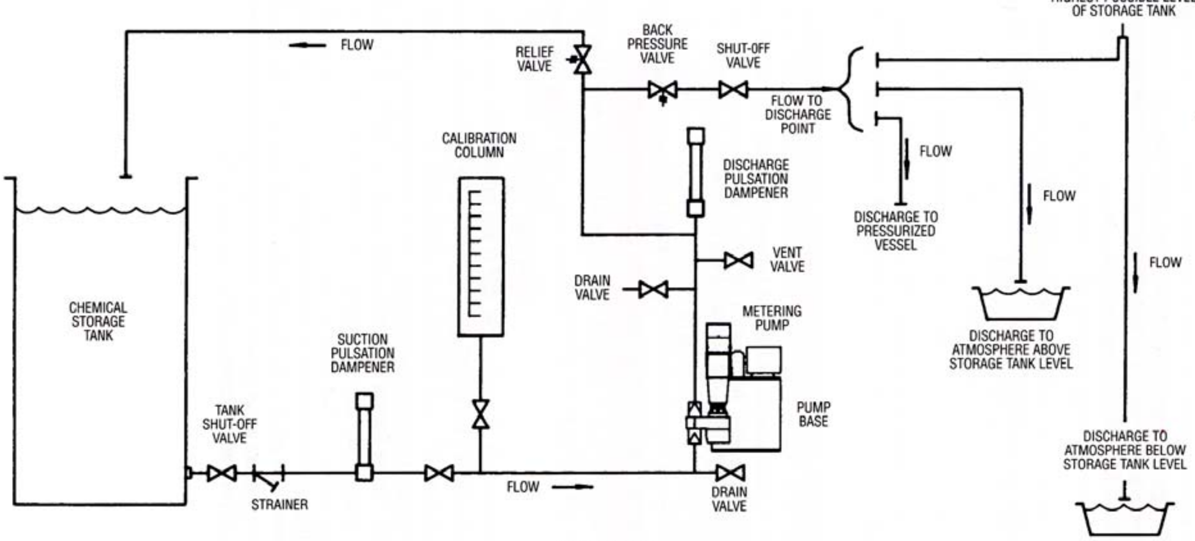

Figure 2

Do not weld nipples or pipe to valve bodies without first removing from pump head. If pipe is welded, be sure to use flanges near valve bodies for easy disassembly.

Remove burrs and sharp edges from all piping and avoid possibility of welding splatter from entering lines. Blow or flush out all lines before making final connections to pump.

Use of plastic piping requires careful attention to its design rating and the fact that the pump is a positive displacement device producing instantaneous pressure peaks in excess of the operating pressure. Improperly installed systems are subject to fatigue. It is recommended that all piping systems be protected against over pressure due to obstructions or inadvertent valve closure.

All lines should be tested for leakage using water prior to the start-up with actual process fluid. Afterwards, the test fluid must be completely purged if incompatible with the process fluid.

Suction Line

The suction line is a critical part of the system. To assure proper operation of the metering pump, the following recommendations should be followed:

- Keep suction lines short; locate the pump as close to the supply tank as possible. Long suction lines may require large diameter pipe. Long lines may result in poor performance, notably underfeed-ing, non linearity, noisy operation and vibration of piping.
- The suction line size for MAGDOS Series and 1200 Series pumps should not be less than the diameter size of the tubing or piping supplied by Lutz-JESCO. Suction line size for the 1700 and 5700 Series pumps should be the next diameter size larger than the suction connection. When a number of individual pumps are connected to a common supply, the suction line and/or header must be sized to accommodate the total flow volume required by all pumps running simultaneously.
- For purposes of calibrating, a pump calibration column should be installed in the suction line, suitably valved to shut off flow from the supply tank. The calibration column should provide sufficient volume for a 30-second test run.
- To minimize problems inherent in ling suction lines, a day tank or a pulsation dampener may be located close to the pump. Installation of a pulsation dampener at the pump suction can act as a day tank. Essentially the flow will be continuous in the long line between the supply tank and the pulsation dampener and discontinuous between the pulsation dampener and the pump. Should the requirements of the installation be such that a suction line of over 30 feet in length is needed and use of a day tank is impractical, a suction pulsation dampener must be installed. The pulsation dampener should be installed close to the suction connection, if possible within 1 foot.
- Flooded suction from the supply tank is preferred. The supply tank should have a low level switch to alarm operator and to prevent introducing air into the process.

Table 1

Minimum NPSHR (Req'd)	Model							
	MAGDOS Series	MEMDOS	3" - 4" 1200 Series	1700 Series	2000 Series	5700 Series w/Spring Assist	5700 & 5710 Series w/o Spring Assist	5720 Series w/o Spring Assist
PSIA	8	8-13	8	2	8-13	2	13	15

Suction Pressure

Meeting the suction requirement is a key to successful use of metering pumps. Although the pump selected must be capable of operating against a specified discharge pressure, equally important is the need for the system to supply the pump with the liquid at a certain minimum pressure. Knowledge of the system supplying the pump Is needed to determine Net Positive Suction Head (commonly designated NPSH). NPSH is the fluid pressure, above the limiting vapor pressure, available at the pump suction connection to move the fluid into the pump liquid end. When the pump plunger or diaphragm retracts, it creates a low pressure condition within the cylinder. The cylinder is filled with liquid moved through the suction line by the force created as a result of the difference in pressure between the inside of the cylinder and pressure available at the supply tank. If the NPSH is insufficient, the absolute pressure within the cylinder will drop blow the vapor pressure of the pumped liquid, which will result in flashing and cavitation, causing inaccurate pump delivery.

While all pumping systems are subject to both velocity and acceleration considerations, usually one or the other will predominate. The viscosity value, determined by liquid manufacturer, is established as a transition point such that fluids having viscosity above this value are subject principally to viscous drag loss or "Condition V" as the prime design factor. For fluids having viscosity lower than this value both viscous drag loss ("Condition V") and acceleration loss ("Condition A") must be evaluated (see page 6).

All metering pumps manufacturers provide specific minimum $NPSH_R$ requirements for their pumps. The requirements for Lutz-JESCO's pumps are listed in Table 1.

Head Losses

In determining NPSH, the user must calculate the head losses of the particular installation under the most adverse conditions. Pressure drop varies with the size and length of system piping. The failure to recognize proper pipe and size requirements lies in the erroneous comparison between the familiar continuous flow pump (centrifugal or rotary gear) and the discontinuous flow reciprocating metering pump.

Both suction and discharge piping must be adequate to handle peak flow. The flow generated by the reciprocating pumps follows an approximate sine curve due to the motion of the plunger. For simplex motor driven pumps, the peak flow rate is 3.14 (ð) times the average. The -r factor is usually accounted for when using formulas derived specifically for metering pump use.

Since high viscosity liquids present problems due to high friction losses in the suction piping and by impeding proper check valve action, the application of external heat may be employed to reduce viscosities to within acceptable limits.

The following methods may be used to determine the suitability of a proposed pump installation.

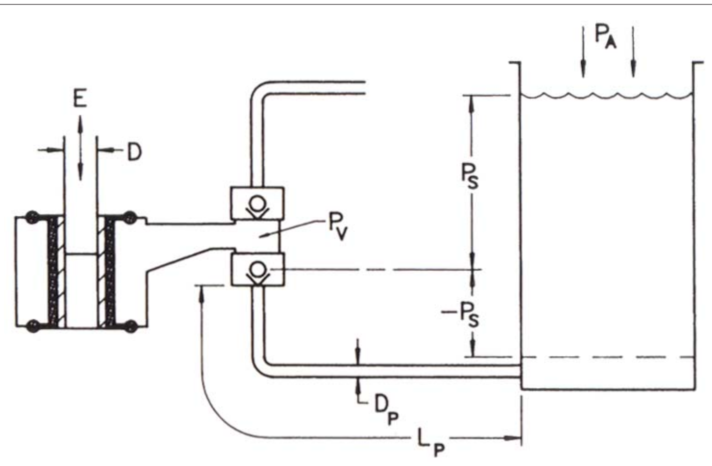

Figure 3

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A - Liquid Viscosity Less Than 1000 Centipoise

Open system with suction lift:

Minimum $NPSH_A = P_a - (P_v + P_s + \sqrt{P^2_{f\ max} + P^2_{i\ max}})$

Open system with submerged suction:

Minimum $NPSH_A = (P_s + P_a) - P_v + \sqrt{P^2_{f\ max} + P^2_{i\ max}})$

where (English units will be used in this section):

P_a = Absolute atmospheric pressure at site (psia)
P_v = Absolute vapor pressure at pumping temperature (psia)
P_s = Static suction lift or flooded head in psi (ft. of liquid x 0.434 x sp.gr.)
P_f = Suction friction losses (psi)
P_i = Suction acceleration losses (psi)

To simplify the use of these formulas in routine calculations P_f and P_i must be stated in terms of the system and fluid against which they are applied. Therefore,

$P_{f\ max}$ will be represented as $\dfrac{LFC}{45{,}000d^4}$ and $P_{i\ max}$ will be represented as $\dfrac{LRFG}{24{,}100d^2}$

where:

L = Length of pipe in feet (actual length not equivalent)
F = Flow or capacity in gallons per hour
C = Viscosity in centipoise
R = Pump strokes per minute
G = Specific gravity of liquid
d = Internal diameter of pipe in inches
45,000 = A derived constant
24,100 = A derived constant

By substitution, the following equation is formed:

$$\text{Minimum } NPSH_A = P_a \pm P_s - \left(P_v + \sqrt{\left(\frac{LFC}{45{,}000d^4}\right)^2 + \left(\frac{LFRG}{24{,}100d^2}\right)^2}\right)$$

In this form the formula accents the impact fluid properties (viscosity and specific gravity) and piping (diameter and length) have on $NPSH_A$. The following is an example of formula application[1].

Example: A High-Specific-Gravity Solution[1]

Atmospheric Pressure at Pump Location	Min. Feet of Liquid in Supply Tank	Fluid Vapor Pressure	Length of Pipe in Feet	Pumping Capacity	Viscosity in Centipoise	Stroking Speed of Pump	Specific Gravity	Inside Diameter of Pipe
psia	psi	psia	ft.	gpm		spm		in.
P_a	P_s	P_v	L	F	C	R	G	d
14.6	1.58*	0.00003	20	5.0 (300 gph)	48	116	1.83	2.469

Fluid to be pumped is 65° sulfuric acid at a minimum pumping temperature of 40°. $NPSH_R$ for proposed pump is 8.5 psi.
*Minimum feet in liquid in supply tank is 2 ft. above pump inlet connection.

$$NPSH_A = 14.6 + 1.58\left(0.00003 + \sqrt{\left(\frac{20 \times 300 \times 48}{45{,}000 \times (2.469)^4}\right)^2 + \left(\frac{20 \times 116 \times 300 \times 1.83}{24{,}100 \times (2.469)^2}\right)^2}\right)$$

$$= 16.18 - (0.00003 + \sqrt{0.0296 - 75.16})$$

$$= 16.18 - 8.67$$

$$= 7.51 \text{ psi}$$

The result, 7.51 psi, representing $NPSH_A$, does not satisfy minimum pump requirements of 8.5 psi.

B - Liquid Viscosity 1000 Centipoise or Greater

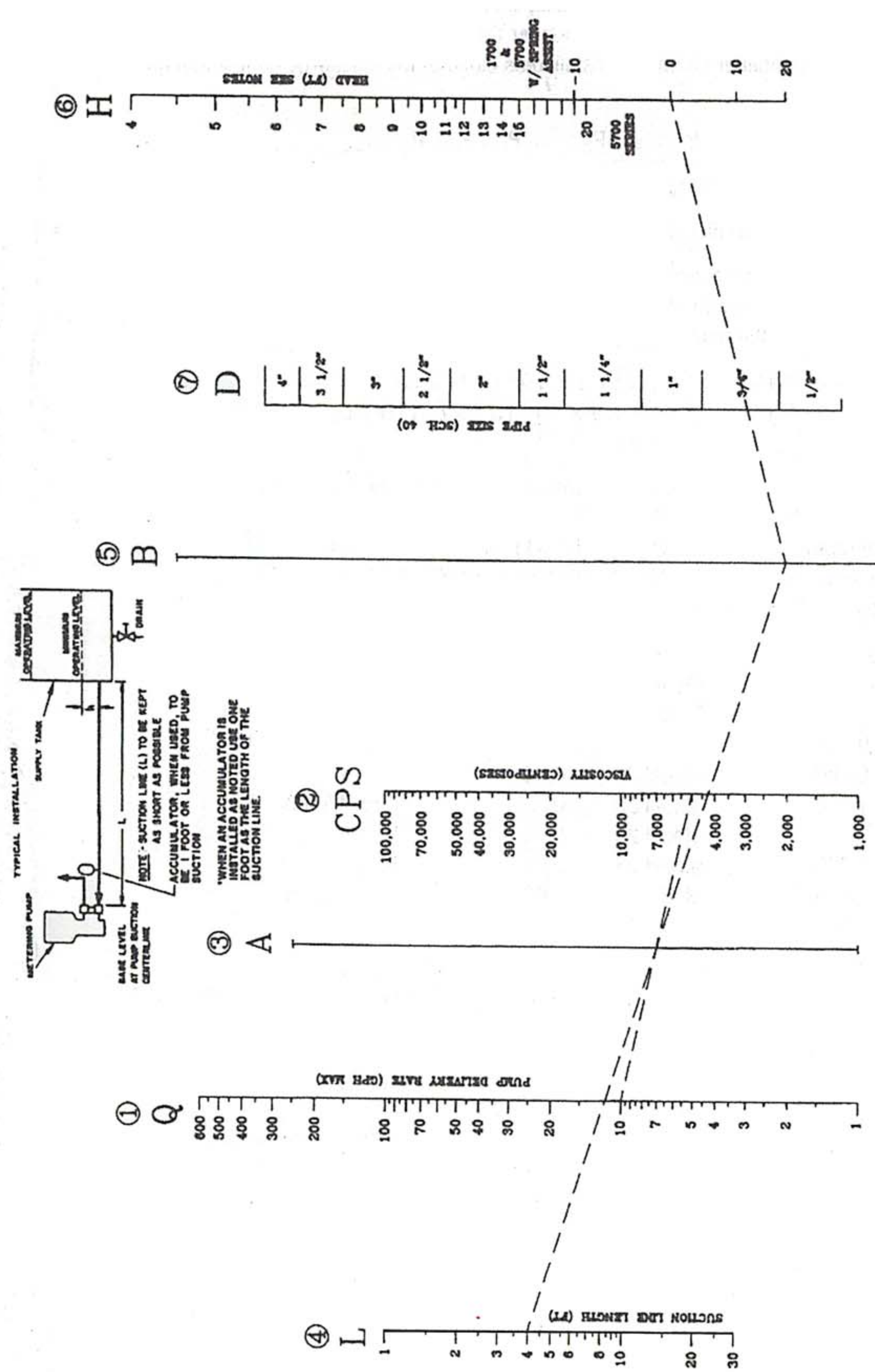

Figure 4

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Discharge Line

The discharge line should be as short and as free from bends as possible. It is unlikely in all installations that the pump can be located with both short suction and discharge lines, emphasis should be on keeping the suction line short. Sizing of the discharge lines becomes more important when the length exceeds 30 feet. Long lines create higher pressure drops and are subject to mass inertia effects which may result in hydraulic shock (commonly called "water hammer"). Longer discharge lines must have a pulsation dampener installed. The pulsation dampener should be installed as close to the discharge connection as possible.

Discharge pressure P_D may be determined as follows: $P_D = P_P + P_H + P_L$

P_P = Process pressure at end of discharge pipe (psia) - if open end use atmospheric.

P_H = Head of liquid between pump discharge connection and end of discharge pipe (psi).

P_L = Piping head loss; this may be either viscous drag loss or acceleration head loss. The loss for each of these two conditions, previously identified as Conditions V and A, should be calculated and the higher of the two used in the calculation (psi).

$P_{f\ max}$ will be represented as $\frac{LFC}{45{,}000d^4}$ = Viscous Lines

$P_{i\ max}$ will be represented as $\frac{LRFG}{24{,}100d^2}$ = Acceleration Loss

where:

L = Length of pipe in feet (actual length not equivalent)
C = Viscosity in centipoise
G = Specific gravity of liquid
45,000 = A derived constant

F = Flow or capacity in gallons per hour
R = Pump strokes per minute
d = Internal diameter of pipe in inches
24,100 = A derived constant

**Refer to Figures 4 & 5 for equivalent pipe length values.*

How to use Nomograph

Refer to Notes 1, 2 & 3

1. Locate pump delivery rate on Scale Q. Use manufacturer's maximum GPH figure for the particular pump.
2. Locate viscosity on Scale CPS.
3. Connect points on Q and CPS Scales. Note intersection with Scale A.
4. Locate suction line length on Scale L.
5. Connect Scale L with point on Scale A (Step 3). Note intersection with Scale B.
6. Locate head on Scale H. Use left side of scale for standard 5700 pumps and right for 1700 units and 5700 units with spring assist.
7. Connect Scale H with point on Scale B (step 5). Read pipe diameter on Scale D.

Example - Shown by broken line on Nomograph

Q = 10
CPS = 5000
L = 4
H = 0
D = 3/4" pipe

Note 1 Value of H (head is determined by multiplying the actual value of H in feet (as shown on typical installation) by specific gravity of the liquid.

Note 2 If the vapor pressure is greater that 1.0 psia, correct H as follows:
H corrected = H + 2.31 - 2.31(P_V)

Note 3 Nomograph is based on liquid in an open tank and atmospheric pressure of 34 feet. If pressure above the liquid in the tank is other than 34 feet, a corrected value of H should be calculated as follows and used in Step 6:
H corrected = H + (actual pressure in feet of water) - 34

Resistance of Valves and Fittings to Flow of Fluids

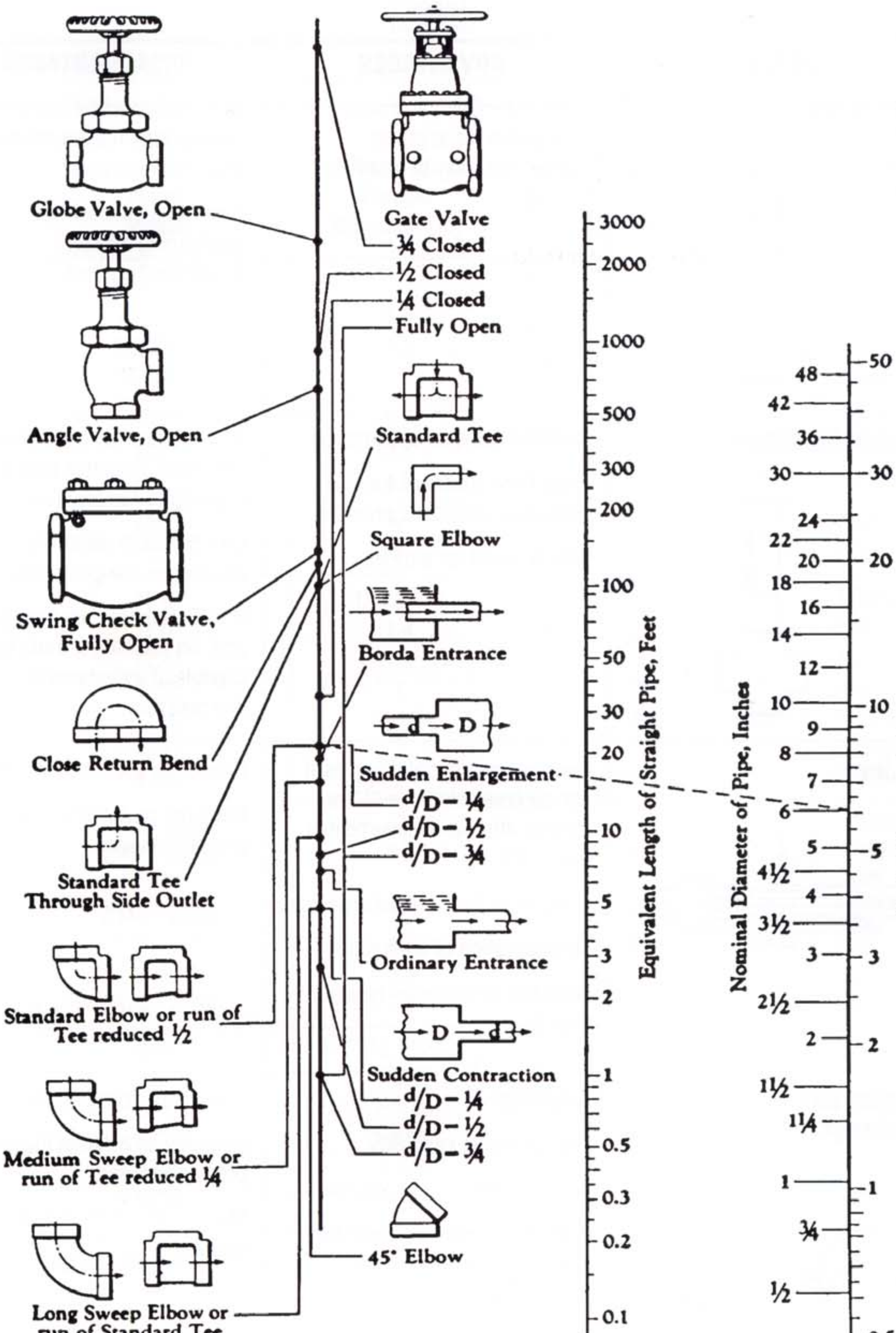
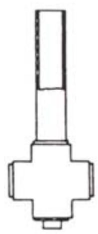
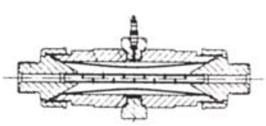
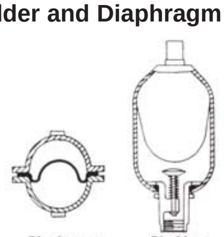


Figure 5

Pulsation Dampeners

Several styles of pulsation dampeners are used with metering pumps. These are categorized in Table 2.

Table 2

Style	Advanges	Disadvantages
Open Riser 	Simplest - open end pipe installed in tee at pump connection. May be used for slurries.	Open end must be higher than storage tank maximum level and discharge point. Cannot be used when discharging into a pressurized system.
Capped Standpipe 	Installed same as open riser. Height not critical as long as necessary volume is provided. May be used for slurries.	Air cushion may be absorbed in operation. Requires periodic draining to replace air. Low pressure capability due to air volume compresibility. If PVC, requires rigid support and, on discharge, must be capable of withstanding line pressure.
In-Line 	Requires no special fitting as it can be connected in a "T" or directly into the line, vertical or horizontal. Used in suction & discharge lines. No absorption of air cushion. Available in corrosion reistant material.	Cannot be used for calibration. Requires an external loading prssure source.
Bladder and Diaphragm  Diaphragm Bladder	Small size. High pressure capability. No absorption of air cushion. Available in corrosion resistant material.	Costly depending on materials. Requires an external loading pressure source. May be unsuitable for some slurries.

Pulsation Dampeners

Pulsation dampeners must be of sufficient volume to accept the pump delivery and provide the desired cushioning effect. The relationship of pulsation dampener volume to pump single cycle displacement should be a minimum of 6 to 1 to reduce to 10% fluctuations. The proper selection of Lutz-JESCO pulsation dampeners and their typical pump relationship are shown in Table 3.

.

Table 3

Pump Series	Pump Model	Diaphragm/ Plunger Diameter (in)	Minimum Pulsation Dampener Volume (in^3)	Recommended Lutz-JESCO Pulsation Dampener* @10%
MAGDOS	DE/DX 01 - 12 LC LT	<2.0	<1.7	PDS80
MAGDOS	20 40 100	2.5 3.5 4.7	4 11 25	PDS80 PDS80 PDS250
1200	1210 1210	3 4	1.5 11	PDS80 PDS80
MEMDOS	E/DX 4 - 8 E/DX 15 - 50 E/DX 76 - 156 E/DX 160 - 200 E/DX 300	2 2.5 3.5 4.7 5.9	3 8 19 34 54	PDS80 PDS80 PDS250 PDS250 PDS750
1700	1710 1710 1730 1730 1730 1740	1/2. 3/4. 1 1.4 1/2 1 1-1/2 2	<10 25 5 20 44 155	PDS80 PDS250 PDS80 PDS250 PDS750 PDS2500
2300	2310 - 2330 2340 - 2350 2360 2370 - 2390	3.5 4.7 5.9 7.3	19 34 54 151	PDS250 PDS250 PDS750 PDS2500
5700	5700 5710 5710 5720 5720	7/16, 23/32 19/32 1-1/16 1-3/16 1-5/8	<5 5 15 25 47	PDS80 PDS80 PDS250 PDS250 PDS750

*For maximum pressure rating up to 150 psig. Higher pressure pulsation dampeners are also available.

Relief Valve

A process line relief valve is required for system protection and should always be installed in the discharge line close to the pump. This valve will protect the line from damage due to plugging or accidental valve closure. Never install a shut off valve between the discharge side of the pump and the relief valve, as the relief valve would not protect that section of the system. It is desirable to pipe the relief valve discharge back to the supply tank above the fill level so the operator can see the system relieving due to excess line pressure (shown in Figure 6). If the distance and/or cost of the relief valve return line precludes its being piped to the tank, this line may be piped into the line suction. If there is a source of system pressure other than the metering pump, and the relief valve is piped back to the pump suction piping, there cannot be a check valve between the supply tank and the relief connection point of the suction line. Sight flow indicators can be installed in discharge or relief lines for visual confirmation of delivery/relief.

All Lutz-JESCO hydraulically balanced diaphragm pumps are provided with a hydraulic relief valve for pump protection in the event of downstream blockage. This internal pump relief valve is used to protect the pump only and is factory set. It is not a substitute for the process line relief valve. The process line relief valve should be set for a pressure 10-20% higher than the operating pressure of the system.

Back Pressure

All reciprocating metering pumps require some amount of positive system pressure or back pressure to assure accurate metering. This required pressure prevents overfeed resulting from the inertial force of the suction line liquid due to the hydraulic characteristic of the pump design. Without adequate back pressure the pump delivery characteristic could appear as Curve No. 1 in Figure 7 while proper back pressure would appear as Curve No. 2. Adequate back pressure allows for proper seating and closure of the pump suction and discharge check valves. This results in a more linear delivery to the system.

Adjustable in-line or nonadjustable internal pump mounted back pressure valves can provide this supplementary pressure. Misuse of back pressure devices can cause serious system problems. Some points to check are:

- A back pressure valve should not be used to prevent a positive liquid level from draining or siphoning through the pump to an atmospheric discharge. As the valve wears, some minor leakage must be expected. In addition, the valve can jam open due to contaminants in the pumped fluid. While this condition will affect the linearity of the pump and possibly allow overfeeding, it would also allow tank drain down if the back pressure valve was used as an anti-siphon device. The sole purpose of the back pressure valve is to assure accuracy of the pump delivery, not to confine the contents of the supply tank.
- Do not use a back pressure valve to prevent the siphoning of fluid into a below grade normally pressurized main that has depressurized. Use an anti-siphoning device, see page 17.
- Most external back pressure valves cannot be used in a line handling a slurry. Consult Lutz-JESCO for appropriate equipment required for slurry applications.
- Pressure loss created by long distance discharge lines cannot be considered as required back pressure as the pressure loss varies with the velocity of the flowing fluid. Similarly, a throttling or other fixed orifice will not be usable unless a pulsation dampener is installed.
- In order to overcome inertia pressure in the lines to and from the pump, a minimum of 30 psig back pressure is required. Refer to Figure 8 for specific minimum back pressure based on plunger diameter and suction line inside diameter.

Relief Valve for System Protection

(see Figure 2 for all equipment required to complete system)

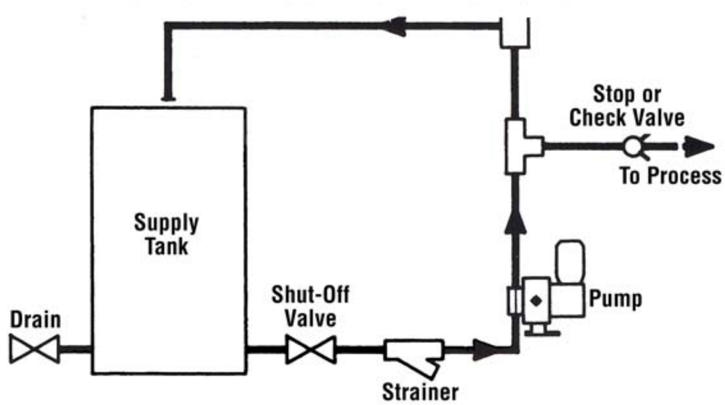


Figure 6

Siphoning

Static siphoning may occur in situations where suction pressure is high relative to discharge pressure (typically when pumping into open tanks).

An anti-siphon device is required in any system which has a positive suction head in excess of the pressure at the discharge of the system. Without such a restriction, flow will pass from the tank through the pump to the end of the pipe.

Anti-siphon valves are usually spring loaded valves whose long-term reliability depends upon frequency of operation.

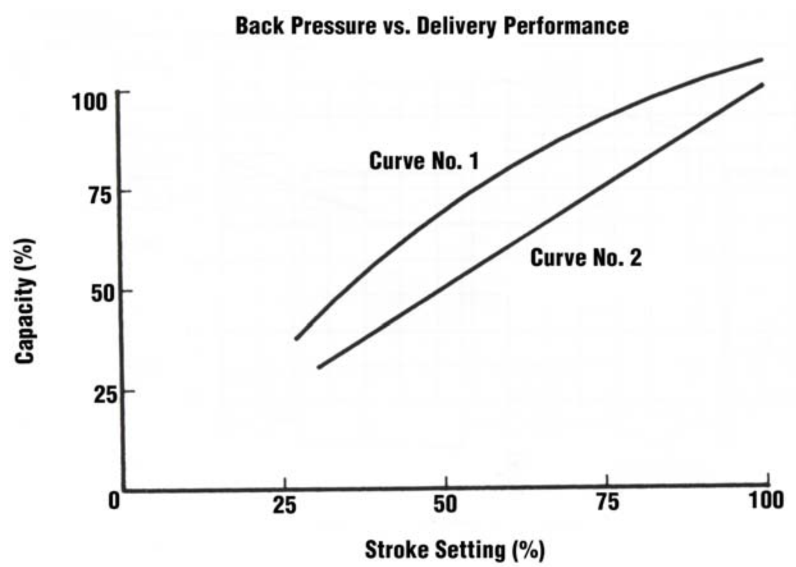
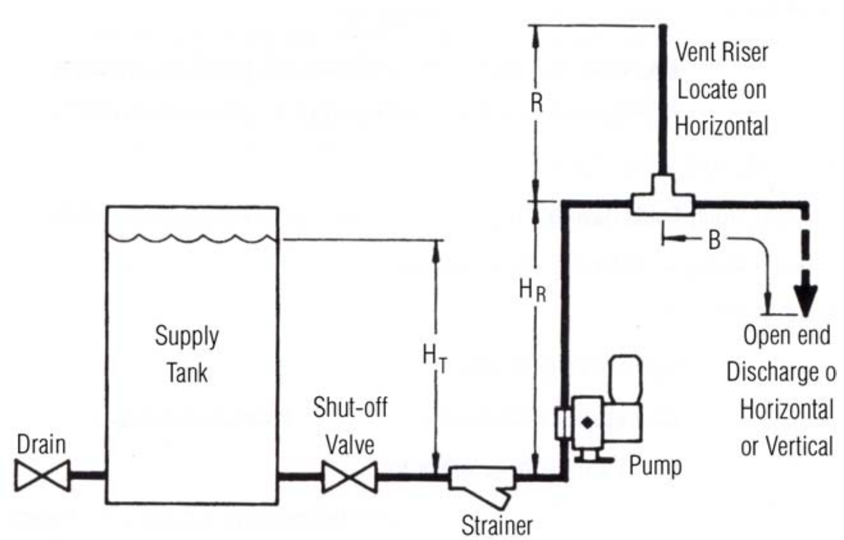


Figure 7

Vent Riser as Anti-Siphon Device
(see Figure 2 for all equipment required to complete system)



R = Vent Riser Height (ft.)
$R = H_L + 2$
H_L = Friction loss in discharge piping (B) due to flow (ft).
Refer to Discharge Line Section to determine H_L * $H_L = 2.31P_L$ (V)
H_R= Height to center line of vent riser tee above center line of pump suction.
H_T= Maximum height of liquid in supply tank above pump suction.
H_R- Must be greater than H_T.

Figure 9

Failure of an anti-siphon valve will not be detrimental to the pump operation although the system may be subject to overfeed or uncontrolled flow.

The pump back pressure valve must not be used as an anti-siphon valve. A separate anti-siphon device must be installed and must provide a greater capability than the system differential between supply tank and discharge point. Locating the anti-siphon device at the end of the discharge line will prevent line drainage.

Note that the addition of an anti-siphon device in no way affects the value of Pacc in the discharge line. Its set pressure value is, however, the static pressure in the discharge system as “seen” by the pump.

Installations which could produce siphoning should be reviewed for possible alternatives to increase static discharge pressure.

It is strongly recommended that in place of a mechanical valve, a vented riser be used in a manner as shown in Figure 9.

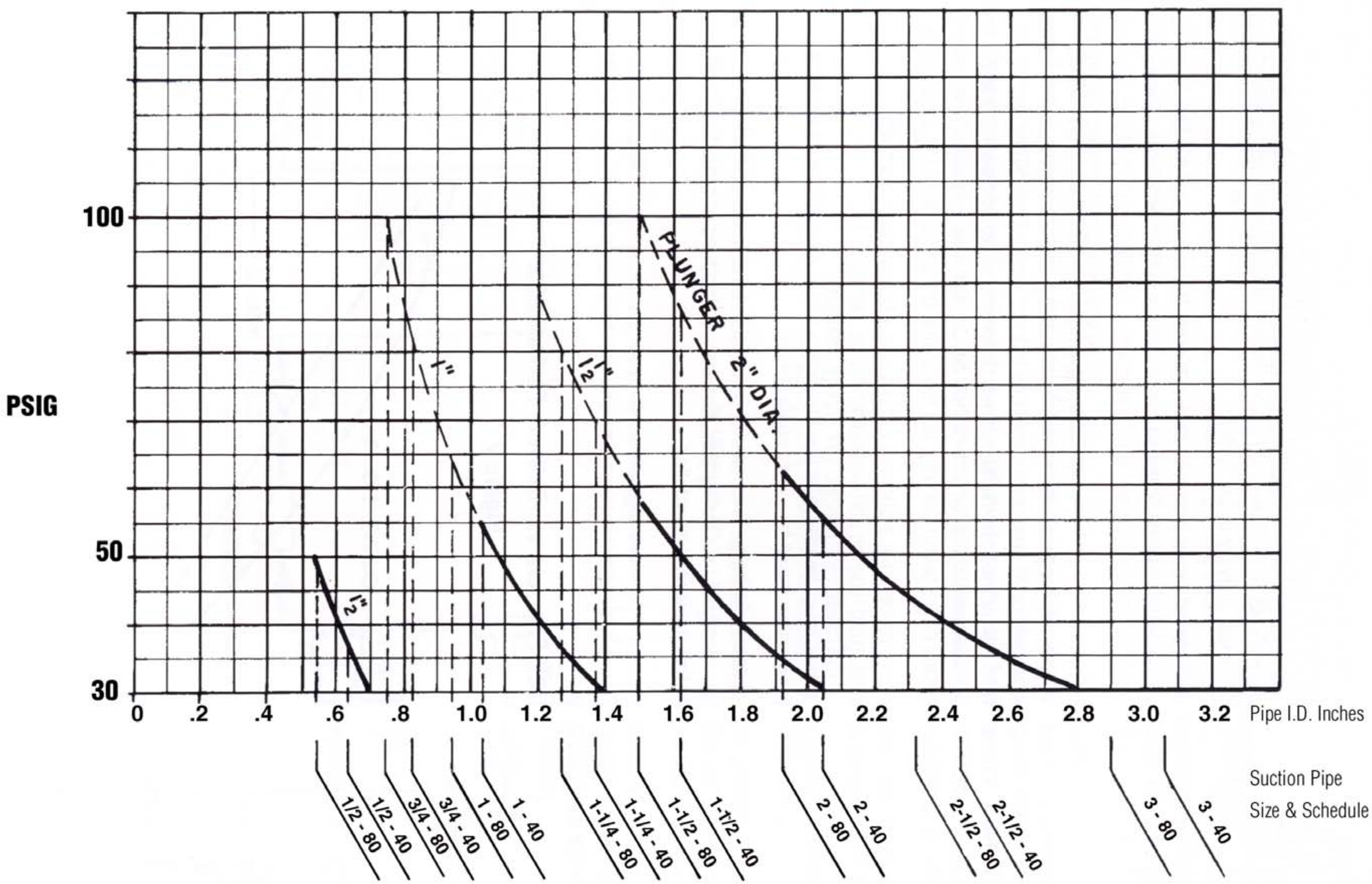


Figure 8

Note: To use curves, select pipe size & schedule. Follow vertical broken line to intersection of plunger curve. Read back pressure on left side. If system does not provide this pressure, a back pressure valve is required. The above curve is created to represent only the Lutz-JESCO 1730 and 1740 pumps, however, similar characteristics will apply to all Lutz-JESCO positive displacement metering pumps.

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Suction Lift

Although many metering pumps will operate with a negative suction (i.e. a suction lift from a level below the suction check valve), it is preferable that whenever possible the pump be installed with a flooded suction.

Although the self-priming capabilities of metering pumps vary, installation with suction lifts greater than those indicated below should be avoided.

Do not run suction piping in an inverted "U" where suction lift conditions exist. If the piping cannot be run vertically, it must slope upward in the direction of flow. This helps remove air on start-up and prevents accumulation of entrained air or gas released in the suction line.

Pumps with high suction lift and threaded pipe suction lines are more prone to loss of prime because of leakage at joints. Priming a pump feeding against discharge pressure is more difficult than a pump working against low pressure. A bypass line to the supply tank or a vent valve upstream of a check valve must be used in applications having high discharge pressures.

When operating a pump with suction lift, the following guidelines should be followed:

- For any fluid having a specific gravity exceeding 1.0, determine the lift in terms of feet of water.
- Install a foot valve, if practical.
- Avoid lifting fluids having a high vapor pressure or at elevated temperatures.
- Avoid lifting fluids having entrained gas.
- Avoid lifting slurries.
- Avoid lifting high viscosity liquids.
- Install the back pressure valve beyond a vent valve which should be adjacent to the pump discharge.
- Prime only against atmospheric pressure.
- Avoid air leaks in suction line by using a continuous line (tubing is preferred) if possible.
- Observe any specific recommendations made by Lutz-JESCO America Corporation.

Lutz-JESCO Pump Series	Recommended Max. Suction Lift in Ft. of Water
MAGDOS 01-4	10
MAGDOS 8	6
MAGDOS 12-100	4
MEMDOS 4-156	10
MEMDOS 160-300	6
1200 Series	3
1600 Series	4
1700 Series	16
2200 Series	4
2300 Series	4
5700 Series*	4
5710 Series*	4
5720 Series*	0
5730 Series	0

**Capable of 16 ft. lift with spring assisted diaphragms*

Slurries

To assure successful and reliable operation of metering pumps used to pump slurries, it is important to recognize certain aspects which differ from handling clear liquids.

Pump Selection

Select high speed pumps for slurries. The higher liquid velocities aid in maintaining a slurry suspension. During shutdown, slurries will settle into the pump valves and requires flushing during the next start-up.

For fast settling materials such as slaked lime, avoid speeds less than 144 SPM. For slurries such as hydrated lime, speeds down to 96 SPM may be used. Consider using the Lutz-JESCO pump model with a horizontal diaphragm especially designed for slurry applications.

Piping System Layout

Careful consideration should be given to the piping layout in order to avoid the slurry settling out. Decreasing line diameters increases liquid velocities and helps overcome settling in piping. Coarse material in a long vertical run, then settling during long shutdown periods can clog the discharge check valve when flow ceases. To avoid this, offset the vertical discharge line by using an elbow followed by a horizontal run of at least one foot into a tee to permit rodding. Minimizing vertical runs is the best solution to avoid settling in piping.

Any 90 degree direction change in piping should be accomplished by using plugged tees or crosses. These fittings permit rodding out deposits and also provide temporary flushing connections.

If the deposits are likely (i.e. calcium carbonate scaling from lime slurries), flexible plastic tubing or a rubber hose should be used rather than rigid pipe. Normal flexing from pump pulsations will dislodge scale. A flexible discharge line also allows long radius bends and direction changes with few fittings.

Valves

Always use a relief valve to protect pump against dead-ending or from severe plugs in long vertical runs. In cases where siphoning will occur, do not use a mechanical valve. To prevent siphoning, pump to an elevated atmospheric break from which the slurry flows to the application point by gravity (refer to Figure 9).

Flushing

As settlement during shutdowns is unavoidable, a flushing connection should be provided between the supply tank and the suction check valve. The flushing operation should occur immediately before or after the shutdown. Flushing systems can be manual or automatic. If automatic, a timed sequence flushing cycle can be established and consequent plugging will be significantly reduced.

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Check List

Reviewing and acting upon the design parameters of a metering pump system can make the final installation trouble free. Use this check list to assist you with your installation.

	Refer to Page	✓
Has installation been reviewed to assure good design practice?	3	
Has suction line been sized to assure adequate NPSH?	4	
Has discharge line been evaluated for head loss?	8	
Has system been reviewed for need of pulsation dampener?	10 - 11	
Have provisions been made for over pressure protection (relief valve)?	12	
Has back pressure requirement been met?	12	
Has the system been reviewed for siphoning and suction lift conditions?	14 - 15	
Is process liquid a slurry? If so, have special slurry conditions been reviewed?	16	

[1] McCabe, Robert E., Lanckton, Philip G., Dwyer, William V., *Metering Pump Handbook*, New York, Industrial Press Inc., 1984

Accessories

Chemical Feed Systems

Measuring and Control Technology

Transfer Pumps

Metering Pumps

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