CONSIDER SUCTION ACCELERATION HEAD ("A.H.") LOSSES, + HOW MUCH DISCHARGE "A.H." YOUR SYSTEM WILL GENERATE.

ESTIMATE, HOW SMOOTH WILL IT BE, WITH NO DAMPERS AT ALL.

Before specifying a smoother system, you may wish to estimate how much improvement you need from the system as it will be. The calculation below is a rule of thumb that covers pressure pulsation generated to overcome system resistance to pump flow fluctuation only

EXPLANATION

Pressure pulsation generated by a system resisting flow fluctuation from your pump mostly depends on the mass of your liquid that has to follow the variations in velocity from your pump, the "flow fluctuations". This need to create head, or pressure, is often referred to as system "mass acceleration head". Flow "friction" also plays a part (see friction page) depending on system pipe size choice. To "visualise" what has to happen, first establish the weight of your liquid that has to fluctuate. Then consider the speed at which you intend to run your pump. The mass and time available for velocity change is where your system generates the pressure pulsation excitation. How much this is dissipated or amplified by the characteristics of your piping design, controls how much pulsation your system will cause.

Necessary Information to estimate acceleration head Pulsation.

- **SG** Specific Gravity - Grams per Cubic Centimeter gm/"cc" gm/cm3 Conversion from Lbs/Ft3, divide by 63
- **L** Length of pipe in feet, Ft.
- **Q** Volumetric flow rate, in US Gallons per hour. Consider 1 US Gallon to equal 3.8 Litres
- **N** Number of displacements per minute. RPM x Number of displacers per rev.
- **ID** Average Internal Diameter of the pipe that is full of the liquid.
- **Z** A figure of relative decrease in "pulsatiousness" by number of displacers - examples are crank driven plungers .

NOTE: SG, L & ID are nothing to do with the pump

RELATIONSHIP

$$\frac{SG \times L \times Q \times N}{27700 \times (ID^2) \times Z} =$$

Addition to system pressure, peaks from acceleration head, or on a suction supply system : the pressure loss that will prevent the pump from filling.

Typical values for "Z" for reciprocating sine motion driven machines.

Z	
1	For simplex (Single piston, plunger, or may be reciprocating oil to move a diaphragm)
2	For duplex (Two plungers etc. Flow still comes to a halt as one displacer takes over from the other)
4	For triplex (Three plungers etc. Flow still comes to a near halt unless the volumetric efficiency is well above 75%)
6.5	For quadruplex (Four plungers etc. phased at 90 - Sounds better, but chances of resonance are worse.)
9	For Quintuplex (Five displacers, overlap even with hot compressible liquids at high pressure)
18	For Septuplex (Seven displacers, smoother flow than a "Quin", but the frequency is high and may match the natural vibration frequencies or the acoustic or the mass oscillation frequencies of short pipe nodes)

For two displacers or more where the drive is a linear oscillation, from fluid power, the value for "Z" may be more than doubled. How much more than doubled, depends on the dwell that occurs on direction changeover. This is more affected by drive fluid compressibility than valve design.

TWO EXAMPLES

In these TWO EXAMPLES , the pumped flow rate, stays the same, the "jerk rate" - number of modulations per minute, and everything else stays the same, EXCEPT PIPE LENGTH "L" .

The formula is from general industry use by Milton Roy and Foster Wheeler etc. The "Z" factors are modified from empirical experience since 1963.

Example 1

- SG 0.9
- L 35'
- Q 73.5 G/hr
- N 70 spm
- ID 1"
- Z 1

$$\frac{SG \times L \times Q \times N}{27700 \times ID^2 \times Z}$$

$$\frac{0.9 \times 35' \times 73.5 \times 70}{27700 \times 1" \times 1} = 5.851 \text{ PSI}$$

peaks on top of system pressure

Example 2

- SG 0.9
- L 250'
- Q 73.5 G/hr
- N 70 spm
- ID 1"
- Z 1

$$\frac{SG \times L \times Q \times N}{27700 \times ID^2 \times Z}$$

$$\frac{0.9 \times 250' \times 73.5 \times 70}{27700 \times 1" \times 1} = 37.612 \text{ PSI}$$

peaks on top of system pressure

NOTE: Increased pipe length gives more pulsation. Therefore, pulsation depends on the system. Similarly, changing the density of the liquid, or the diameter of the pipe, will change the pulsation.

PUMPS make FLOW, - BUT - SYSTEMS make PRESSURE, PRESSURE PULSATION is a system response to flow fluctuation, and a SYSTEM RESPONSIBILITY, not a pump vendor liability - nor is the pump vendor necessarily qualified to address system piping and valve response pressure pulsation. PLEASE CALL 1-888-DAMPERS, not the pump vendor.

NOTE

As pulsation depends on pipe system length, diameter and the specific gravity of the system liquid, selecting a dampener without taking system details into consideration, is likely to lead to a less than suitable dampener specification.