

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

- 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.

SG	0.9		$\frac{SG \times L \times Q \times N}{27700 \times ID^2 \times Z}$	
L	35'			
Q	73.5 G/hr			
N	70 spm			
ID	1"		$\frac{0.9 \times 35' \times 73.5 \times 70}{27700 \times 1" \times 1}$	= 5.851 PSI
Z	1			peaks on top of system pressure

SG	0.9		$\frac{SG \times L \times Q \times N}{27700 \times ID^2 \times Z}$	
L	250'			
Q	73.5 G/hr			
N	70 spm			
ID	1"		$\frac{0.9 \times 250' \times 73.5 \times 70}{27700 \times 1" \times 1}$	= 37.612 PSI
Z	1			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, determining a dampening need without taking system details into consideration, is likely to lead to a less than suitable specification.