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ALLOW FOR "OVERLAP" Of one displacement to the next. This is dependent on the volumetric efficiency, due to compressibility of your system liquid.

This may radically effect the the level of flow fluctuation, and pressure pulsation.

1. Input data:

VE := 77.512 % Actual displacement divided by 100% Volumetric Displacement

L := 450 mm Connection rod length

R := 60 mm Crankshaft radius

2. Calculations

$VI := \frac{100 - VE}{100}$ VI = 0.225 Volumetric Inefficiency*

X := VI x 2 x R X = 26.986 Stroke before valve opening

$\psi := 1.5$ Parameter for calculation purposes

$\phi := root\left[X - \sqrt{L^2 - (R \times \sin(\psi))^2} + L - R \times (1 - \cos(\psi)), \psi\right]$

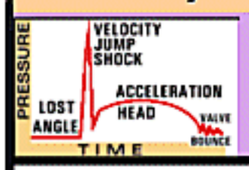
Angle := 57.3 x ϕ Phase delay, degree 59.9999° say 60°

If in this example, left, the pump was a triplex then the flow would come to a complete halt between strokes. This is because a rotary driven reciprocating pump sucks & discharges for 180^0 of rotation and the next displacement begins after 120^0. The overlap on triplex at 100% efficiency is therefore 60^0. At 77.512 % the calculation shows that the 60^0 has been lost, hence with no overlap the flow will come to a halt between displacements. It will be as "pulsatious" as a duplex.

By the same calculation as the example; if the efficiency was 85% then the lost angle would become 48^0. With a "Quin" a new displacement should begin every 72 degrees (360/5), and as discussed above a triplex should displace every 120^0. 120^0 minus $72^0 = 48^0$. But at 85% efficiency, 48 has been lost, so a Quin can cause as much flow fluctuation as a perfect Triplex if the quin has low volumetric efficiency.

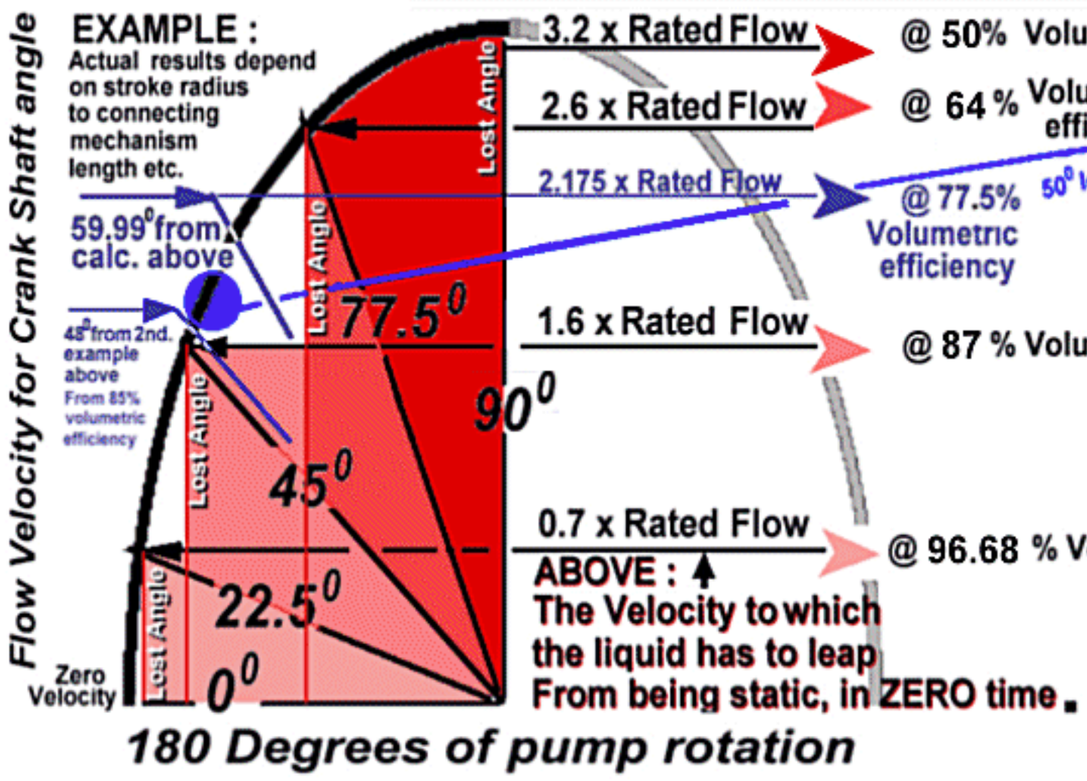
∴ ***A three headed diaphragm metering pump may produce flow fluctuations as bad as,or worse than, a duplex pump or double acting simplex pump. A quintuplex, or 5 plunger pump, may produce flow fluctuations as good as, or worse than,a good triplex pump, it all depends on volumetric efficiency.***

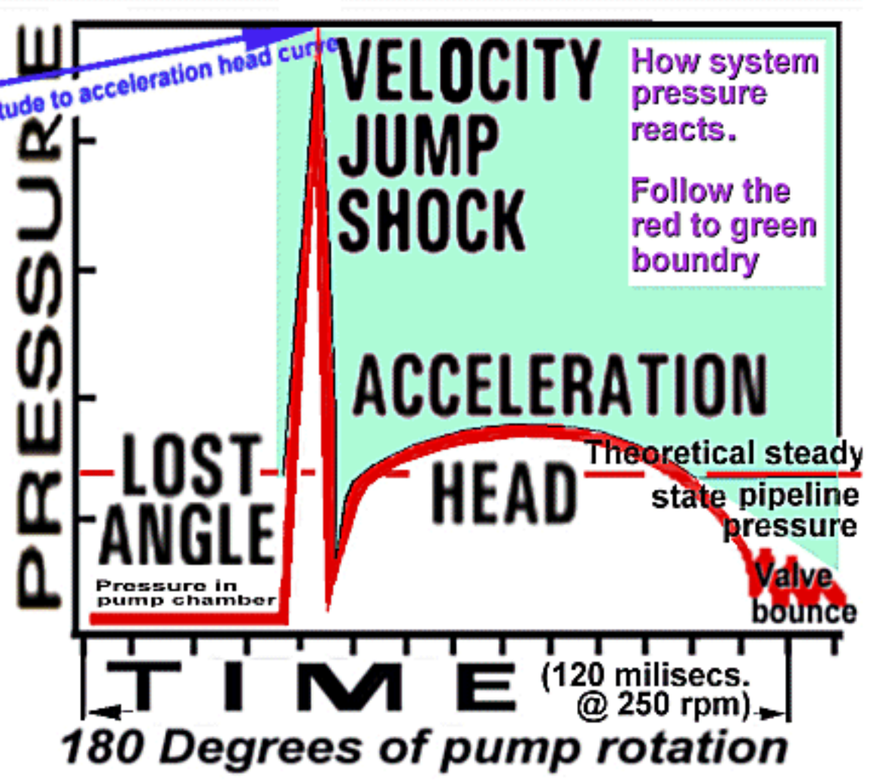
Consequently, on page 34 where N^2 is a divisor, you would have to treat a triplex N^2 as 2x2 =4 , not 3x3=9.



CHECK THE AMPLITUDE OF ANY HIGHLY EXCITATIONAL PRESSURE SPIKES

In pump literature aka "Velocity Jump" causing "Joukowsky shock"





You can reduce "Velocity Jump Shock to a generally insignificant figure, in 4 simple steps :- 1. Select a damper with an ID 12 times the diameter of the inlet connection. 2.Have an outlet 1/2 the area of the inlet. 3. Increase the volume by 3 x the in-efficiency. 4. Decrease the cushion pre-fill pressure proportionately to the volume increase, from 80% of system pressure to as low as 50%.

The combined effect of mass acceleration, velocity jump, pressure wave acoustics, fittings and pipe resistance all in a time dependant frame, along with valve action, and pump characteristics may be modelled for you by :- **LDi PULSEVIEW** *software. This is not a free service. Please complete input data set tabulation.*