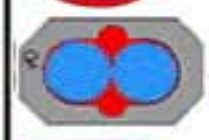
Estimating the Volume "V" of one movement of one displacer.

"Displacer" means one vane, 1 gear tooth, 1 lobe, one cavity, one piston, plunger, or diaphragm
From this figure, & according to the pump type "F" number, a damper volume may be estimated.

***Note :** These estimates ignore all of the dynamics , delta time / "dt" considerations, so are quasi static and do not take into consideration pipe system responses. The answers can be valid for residual acceleration head flow fluctuation purposes , but not for pressure pulsation system response, (for which flow through multi connection pressure pulsation dampers are essential above 5 Hz.)*

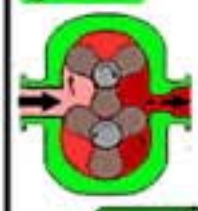
EXAMPLES : Volume Of One Movement Of One Displacer or "One Flow Fluctuation."

A centrifugal pump has 11 blades, at 725 RPM it Displacers 500 gpm, **@ 133 Hz**
500 gls. x 231 in3 per Gallon ⁄ 11 blades x 725 rpm = 14.5 in3 displacement *& Use F=7*



A gear pump has 17 teeth, @ 440 rpm it produces 2 Kg per second. **@ 125 Hz.**
2 Kg per second x 60 secs per minute x 1000 gms per Kg ⁄ 17 teeth per rev x 440 rpm x SG 1.35 = 12 cm3 per tooth *& Use F=3*

A vane pump with 23 vanes, driven at 2,900 rpm, pumps 380 barrels per day **@ 111 Hz.**
40 Liters x 1000 cm3 per Liter ⁄ 23 vanes x 2900 rpm = 0.6 ml displacement *& Use F=5*



A tri-lobe pump at 173 rmp, discharges 3 tons per hour **@ 8.7 Hz.**
100 lbs per minute x 25 in3 per pound ⁄ 3 lobes per rev x 173 rpm = 4.8 in3 per lobe *& Use F=1*

A quintuplex plunger pump turned at 880 rpm, generates 60+ M3 per 8 Hr shift **@ 73.5 Hz.**
2000 gls per hour x 3,800 ml per gallon ⁄ 60 minutes per Hr. x 5 piston per rev x 880 rpm = 28.8ml / stroke *& Use F=0.6*

F for duplex diaphragm heads also = 0.8
A simplex diaphragm head pump is pushed by a 100mm diam. piston with a 150mm stroke @ 205 spm **@3.4 Hz.**
5 cm Piston Radius x 5 cm pist. rad. x (Pi) 3.142 x 15 cm stroke = 1.18 Liters per stroke *& Use F=0.8*

The F figure assumes that the air supply to the A.O.D.D. is enough to ensure no return stroke delay.
An air operated double end diaphragm pump empties a 40gl drum in 4 mins., on a 2 second cycle . **@ 1.0Hz.**
10 gls per minute x 231 in3 per gallon ⁄ 2 diaphragms per cycle x 30 cycles per min. = 38 in3 per end *& Use F=1.8*

The F figure assumes that the size of the shoe or wheel is approx one third of the volume between shoes or wheels.
A hose pump squelches out 150 liters of effluent sludge per minute, with 3 shoes revolving 15 times per minute.
150 litres ⁄ 3 shoes x 15 revs = 3.33 Liters between shoes *& Use F=0.4* **@ 0.75 Hz.**

Additional "F" correction factors, for Progressive cavity, Screw, Packed Plunger, Dosing, and Intensifiers, please see page 28 .

Using the estimated volume of one pulse to find approx damper volume

$$\frac{100 \times \text{Volume Of One Movement Of One Displacer}}{\text{Number of displacers}^2 \times F \times \text{The percentage figure of allowable residual flow fluctuation}}$$

Abbreviation $\dfrac{100 \cdot V}{N^2 \cdot F \cdot \%\text{ age fig.}}$

"F"** is a correction Factor on the square of number of displacers, Example , Centrifugals are intrinsically good - have a high F, Sandwich diaphragm metering pumps **have a low F.

***N :** N Squared, N^2, N Exponent 2, means multiply the Number of displacers by that same number.*
Example N^2 : 1 Diaphragm head 1x1=1, 11 Blades 11x11=121, 2 Lobes 2x2=4, 3 Plungers 3x3=9

***"%age figure" :** 0.5% allowable residual fluctuation - use the figure 0.5 in the equation, for a residual fluctuation of say +&- 3% , 3 positive plus 3 negative = 6 - use 6 in the equation, ± 5% total 10, use the figure 10.*

EXAMPLE $\dfrac{100 \times 90\text{ml per stroke}}{\text{[From a triplex] 9 x [plunger factor] 0.6 x 0,75 [For 3/4\% residual]}}$ = **2,222 ml = 2.22 Litres = 0.59 US Gls.**
Use a 135 in3 or greater Damper

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