MicroFab Technote 99-04
Orifice Diameter Effects

To examine the effect of orifice diameter variation on the performance of a drop-on-demand device, six devices (orifice diameters of 56, 63, 66, 80, 83, and 88 microns) were tested with butyl carbitol (viscosity = 5.3cp, surface tension = 30 dyne/cm). The pulse amplitude for each device was set to obtain a drop velocity of 4m/s at 2kHz. The amplitude required is shown in Figure 1 as a function of orifice diameter. Except for one device that had a significantly higher amplitude requirement, due to fabrication variations, the amplitude increases as the diameter increases, due to acoustic impedance effects. Figure 2 shows the resulting drop volume as a function of orifice diameter. As can be seen, the increase in volume is less than diameter squared relationship, again due to acoustic impedance effects.

Holding the pulse amplitude constant, the drop velocity and volume were measured as a function of pulse frequency for all six devices. Because it was known beforehand that this type of device operates below its resonant frequency so that the variations in drop velocity and volume occur at subharmonics of the resonant frequency, the data was taken at intervals of constant period. Figure 3 shown the drop velocity as a function of period for all six devices, and Figure 4 shows the drop volume as a function of period. Both indicate an increasing variation vs. period with increasing orifice diameter, again due to acoustic impedance effects.

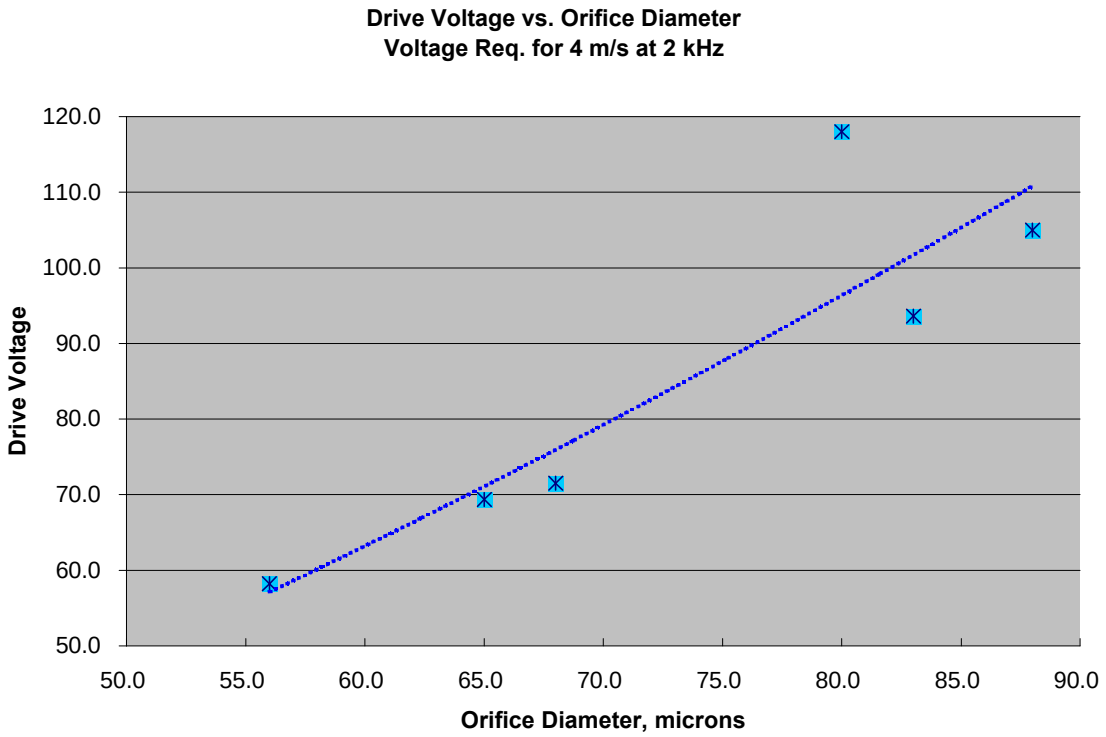


Figure 1

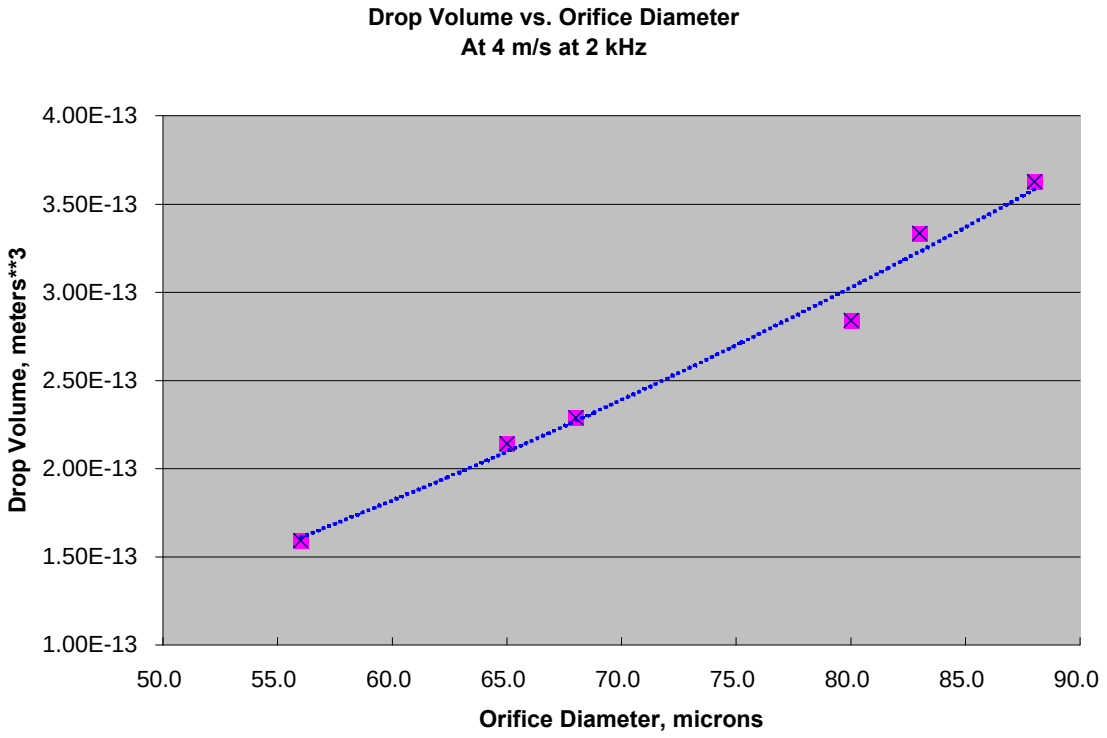


Figure 2

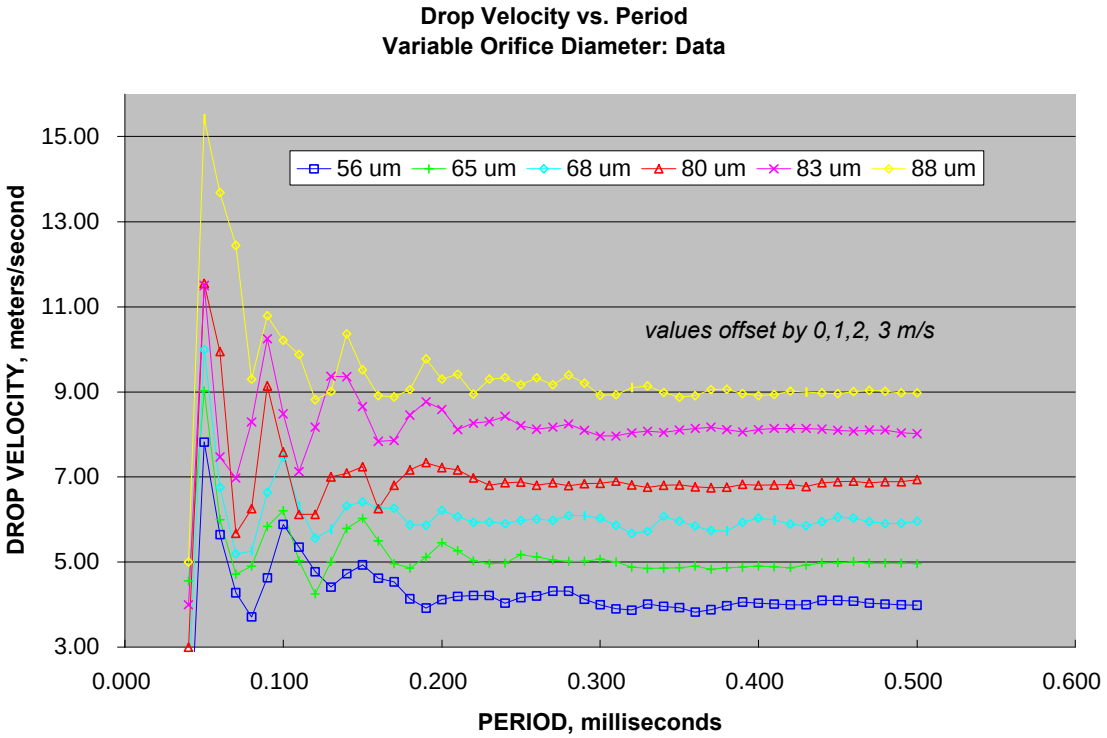
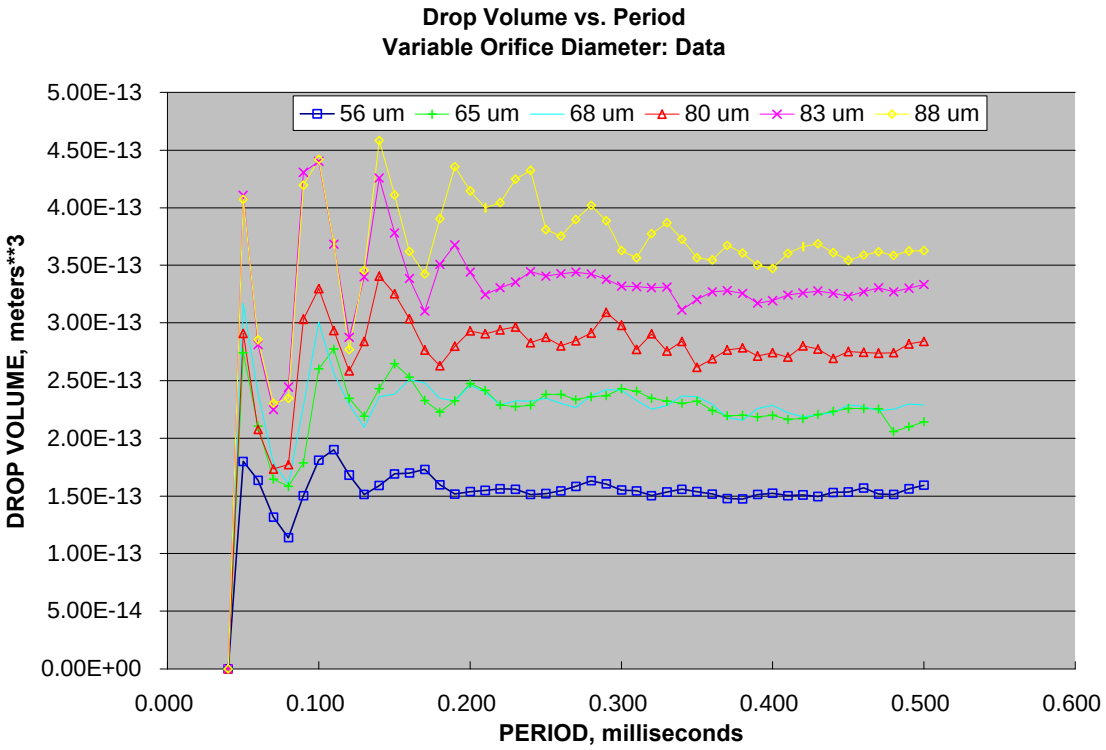


Figure 3


Drop Volume vs. Period
Variable Orifice Diameter: Data
56 um
65 um
68 um
80 um
83 um
88 um
DROP VOLUME, meters**3
5.00E-13
4.50E-13
4.00E-13
3.50E-13
3.00E-13
2.50E-13
2.00E-13
1.50E-13
1.00E-13
5.00E-14
0.00E+00
0.000
0.100
0.200
0.300
0.400
0.500
0.600
PERIOD, milliseconds