ORIFICE THEORY

An orifice is "any hole that a fluid flows through"….both gasses and liquids. It can be any shape instead of round, with a totally rough interior.

All fuel systems, carbs, constant flow injection, and EFI, use orifices for metering the liquid flow, so they should have very stable flow for consistent metering. We achieve this by making them with a precise diameter and entrance radius that are very smooth, with a long length vs the hole diameter. Even though we machine our nozzles and jets with extreme care, they don't all flow just right because of microscopic flaws. We flow virtually every piece we make at 30, 55, and 100 psi, * note the errors in flow vs the master for that diameter, then use scrapers and polishing tools to bring the flow within 1% of the master. We work on the entrance and/or the exit. Even after this special effort, about one out of twelve pieces doesn't conform to the master flow curve, so we discard it. We use brass because it is one of the better metals for achieving close tolerances and a smooth finish. While this extreme attention to detail costs more, we don't believe you can find this quality anywhere else.

The pressure increases as the square of the flow; see the graph below: to flow 200 lb/hr takes 20 psi; to flow 400 lb/hr takes 80 psi, so to get twice the flow takes four times the pressure. Why? If we want to flow twice as much through a fixed hole size, we will have to push twice as many fuel particles through it at twice the velocity, so we will have to do 2 x 2 or 4 times the work. We use the pressure to do this work.

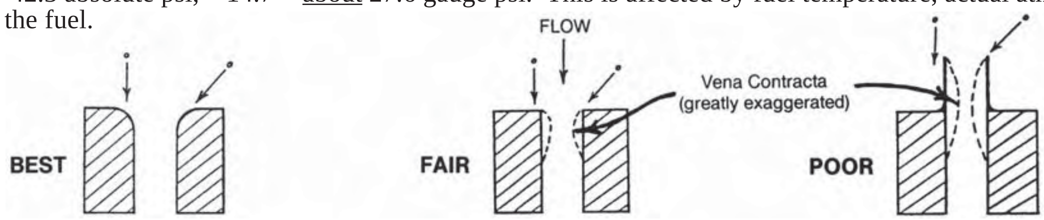
If you want to flow more through an orifice, but keep the pressure the same, then you must use a larger orifice. The flow increases as the area of the orifice increases. Since the area is Pi x diameter squared / 4, the area increases as the square of the diameter, so twice the diameter is four times the area. See the area and flow vs orifice size on the next page. (Pi is 3.1416).

* We use these test pressures because 55 psi gives about 1.35 the flow as 30 psi, and 100 psi gives about 1.35 the flow as 55 psi…. we like having the flow ratios about the same. See the very bottom of this page for the formula that we use to calculate these ratios.

THREE ORIFICE EXAMPLES BELOW

A sharp edge at the orifice entrance (middle example) causes the flow stream to converge, forming a vena contracta, which is a narrowing-in of the flow path of the particles. The diameter of the vena contracta becomes the effective flow diameter of the hole, thus the flow is reduced. At very low flows there is no vena contracta, while at very high flows there is a large vena contracta causing as much as a 20% flow loss, so it varies with flow and is unstable. It is always ideal to use the "BEST" design, which we use in all of our metering pieces.

CHOKED FLOW Example: Injecting fuel into a supercharged manifold. If your nozzle pressure is 70 psi and your boost is 10 psi, you might expect the flow to be what the nozzle is rated to flow at 60 psi. It will actually flow at a 70 psi rate, because the downstream pressure has no affect on flow until its absolute value (gauge reading + 14.7 psi atmospheric pressure) is about ½ of the upstream absolute pressure. To find the downstream pressure that will just start to reduce the flow when there is 70 psi upstream: 70 + 14.7 = 84.7 ½ x 84.7 = 42.3 absolute psi, – 14.7 = about 27.6 gauge psi. This is affected by fuel temperature, actual atmospheric pressure, and properties of the fuel.



The particle of fuel coming straight down a bit off to the left or in at an angle at the right both find their way into the orifice.

This design is the least sensitive to machine marks, but the blend of the radius to the main diameter is very important. Not easily damaged, as nicks from handling tend to be on the top surface.

The particle a bit off to the left hits the top surface; may bounce off to the left, or into the orifice. The particle coming in from the right will go into the orifice.

This design is quite difficult to make properly as the sharp edge must be the same on all the orifices, with no nicks. It is easily damaged by nicking the edge.

The particle a bit off to the left will not enter the orifice. The particle coming in from the right may not enter the orifice.

This design would never really be seen in a jet, but it is exactly like a ramtube without a bell. The top edge is easily damaged.

FLOW THROUGH AN ORIFICE

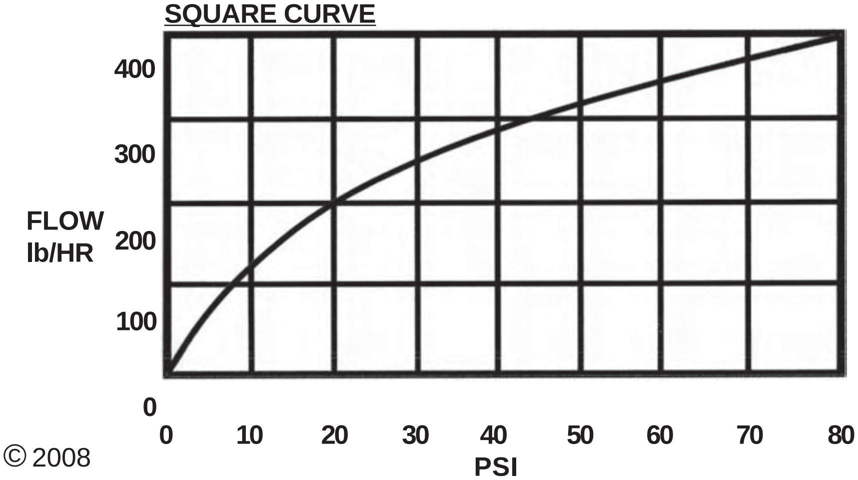
Pressure rises as the square of the flow through an orifice, so to double the flow through a jet or nozzle takes four times the pressure :

$$\text{New Press} = \text{Old Press} \times \left(\frac{\text{New Flow}}{\text{Old Flow}}\right)^2$$

Knowing the flow of a jet or nozzle at some pressure, the flow at a new pressure can be calculated:

$$\text{New Flow} = \text{Old Flow} \times \sqrt{\frac{\text{New Press}}{\text{Old Press}}}$$

SQUARE CURVE



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