Pressure drop through a nozzle

Some of our customers have asked us in the past which is the pressure drop through a nozzle, since they consider a nozzle one of the parts in a piping, like a valve or an elbow, which causes a given pressure drop along the line.

The reality is different, and can be easily understood when considering the Bernoulli formula [2] as given at page 19 of this manual: the formula says that the total energy of a liquid flow is made from the addition of three factors:

- Potential energy due to elevation
- Pressure energy
- Velocity energy

When we apply the formula at the entrance and at the outlet (the orifice) of a nozzle, and we neglect the influence of turbulence losses in between, we can easily see that:

- The potential energy variation can be neglected because of the limited dimensions of the nozzle, since the distance between the nozzle entrance and the nozzle orifice plays no role.
- The pressure energy variation is important, since the liquid pressure value falls abruptly from the pressure inside the feed pipe to the ambient pressure.
- The velocity energy variation is also consistent, since the liquid is ejected from the orifice at high speed.

In other words the pressure energy of the liquid flowing through the orifice is suddenly transformed in liquid drops velocity, which is exactly what a nozzle is designed to do.

This is shown from equation [3] at page 19, which allows the exit velocity from the nozzle to be calculated from the pressure inside the pipe (we actually consider the pressure difference between the inside of the pipe and the ambient pressure in this formula).

In other words all the energy still available at the nozzle is converted into velocity, or if you so prefer, you have a total pressure fall. The system designer shall therefore evaluate all the pressure drop between the pump outlet flange and the nozzle entrance in order to be sure that the nozzle flow pressure is sufficient to assure the desired capacity for the liquid being sprayed.