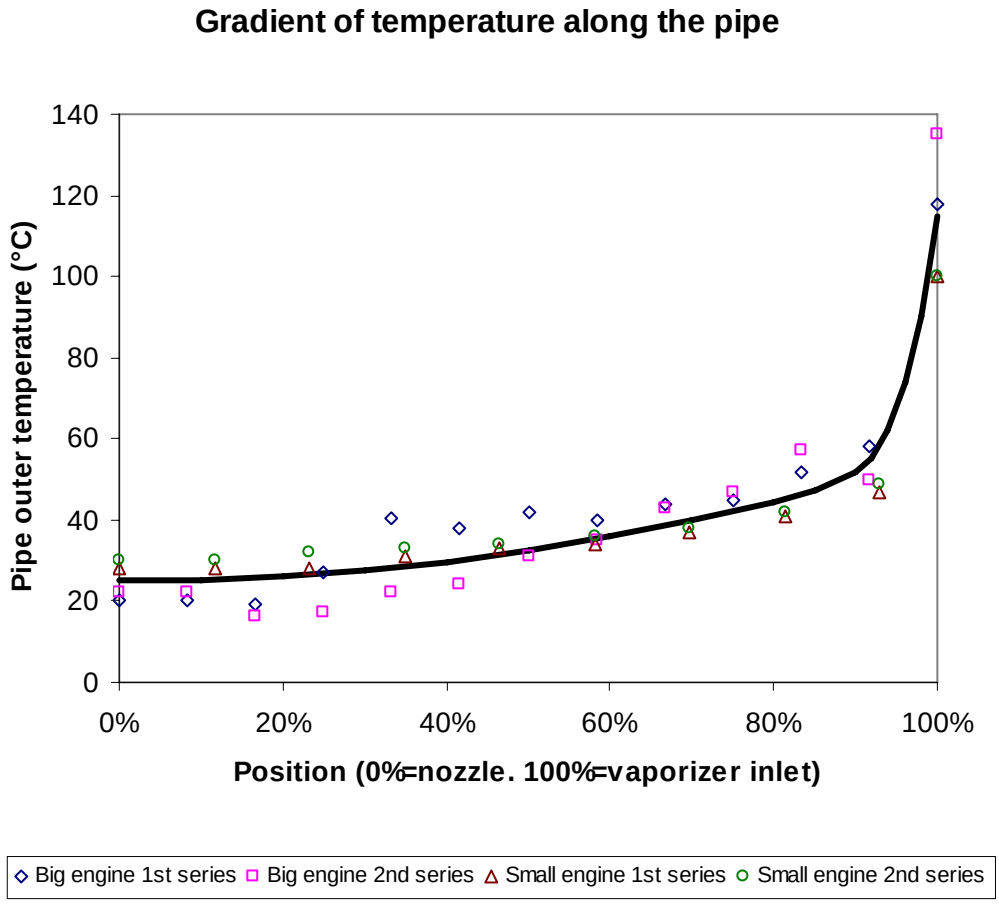
Temperature gradient along the pipe of a pop-pop engine

By Jean-Yves

Those who played with pop-pop engines know that the temperature of the pipes is rather cold (we can touch with fingers) except very close to the evaporator.

Thanks to transparent engines we could observe the water movements inside the pipes. This gave us an idea of what could be the mean temperature inside the pipe, but unfortunately the transparent engines were made of rather good insulating materials and the outside temperature was not easy to measure and was probably not the same as the mean inside temperature.

Therefore, to get a confirmation of our theoretical approach, some measurements were taken on two (very !) different engines. The first one was a small diaphragm engine with a pipe inner diameter of 3.5mm. The second one was a big rigid engine with a pipe inner diameter of 40mm. On the first one the temperatures were measured by means of a thermocouple. On the second one we used an infrared thermometer. All the results are plotted on the following graph.



Conclusion: the general shape of the 4 series of dots (and the one recorded on a pipe of ID 23.5mm) is the same and can be easily analysed. The outside temperature corresponds to what happens inside.

- Where there is always liquid water (lower part of the pipe) the temperature is rather cold.
- Where there is always steam (close to the evaporator) it is warm.
- In between, the temperature is influenced by the alternation of steam and liquid water. Hence, the heat transmission by the water (density approx 1) is much more than by steam (of which the density is approx 1200 times less). However, when approaching the top of the pipe the cyclic ratio steam/water increases, and this explains why the temperature rises drastically, but without “break” on the curve.