# Numerical investigations to design an experimental set-up for material characterization of micro tubes for micro hydroforming

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**Abstract**. With the development of technology, authors have focused on the small sized components. Micro tube hydroforming as a micro manufacturing process could also present an interesting alternative to microelectronics manufacturing process for several applications such as microfluidics, microbiology, biomedical, etc.
By analogy with previous works done in the macroscopic domain, they highlight the main difference for the technological choices and the necessary adaptation in the semi-analytical model to calculate the stress-strain curve from the pressure-bulge height measurements. In the hydroforming process of microstructures, certain parameters become more sensitive (boundary conditions, process control, and size effects). In the design of process control, the internal pressure is treated as an essential parameter and its evolution is simulated by two methods. The first is to apply directly the pressure on the surface of tube and another is that the pressure is defined by the volume of the fluid in tube. The evolutions like bulge pressure-height curve, pressure-time and stress-strains curves, obtained by these two methods supply information to define the load for experiment. With our micro tube, we try to trace the geometrical stress-strain curve and compare with the curve of macro tube in order to study the size effects in the bulge test. In addition, the boundary conditions influence the form of bulge tube as well as the pressure-bulge height tube. Its influence on the bulge height is quantified according to the different lengths of tube to bulge. The optimal test we want to obtain is that the tube has a high bulge height and uniform thickness after the bulge test.
In other words, the authors present the experimental device developed for material characterization in micro tube from free bulging test. In addition, numerical simulation have been performed to investigate the evolution of the results with experimental conditions (tube dimensions) and numerical parameters (boundary conditions, element size, etc) to help in the design of the experimental device.

Reference:

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**Key words:** material characterization, micro tubes, micro hydroforming