Experimental study of ultrasonic flow measurement in non-developed flows

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Introduction

The use of transit-time ultrasonic flow meters has increased significantly over the past two decades. We can mention three main reasons for this growth: the inherent advantages of ultrasound against other measurement techniques, advances in ultrasonic technology and the publication of specific standards for this technique. Many studies have been made both by manufacturers, users and research institutions for a better understanding the factors that influence the flow measurement with ultrasound [1-2]. Among the factors studied, the flow profile is considered essential. In order to evaluate the influence of flow profile in the flow measurement, experiments have been carried out which will be described below [3]. The experiments were performed in the Water Loop of the Nuclear Engineering Institute.

Experimental setup

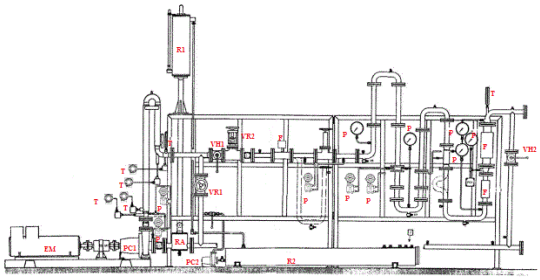


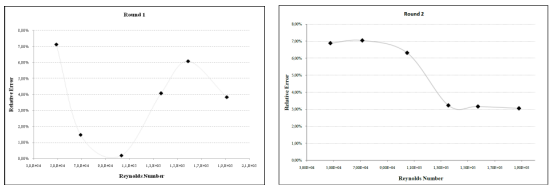
Figure 1. Plant of water loop

Figure 2. Ultrasonic flowmeter

Experimental procedure

The experiments have been performed in two sections of the Water Loop: a straight section approximately 19D downstream to a 90° bend and a second section immediately after a bend of 90° approximately 4D downstream to the curve. In the straight section, the distance 19D is enough that the flow is fully developed according to manufacturer manual. In the second section, due to its proximity to the curve, the flow is not developed. Non-intrusive measurements have been performed alternately in each of the two pipe sections, attaching the transducers with the belt. It is essential to exchange the location of the meter, because there is only one, nevertheless the flow remains the same in the Water Loop. This operation is repeated for each value of the reference flowrate of the circuit. It is the flowrate measured in the section 1 because there is a straight section enough upstream to the meter which the flow is developed. For each reference flowrate, 60 measurements have made at intervals of 1s in each of two sections.

Results



Figur 3. Relative error as a function of Reynolds number: comparison between the average flowrates.

References

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