NUMERICAL INVESTIGATION OF TURBULENCE DEVELOPMENT IN THE CHANNEL WITH A SMALL CONE ANGLES

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We numerically investigate the phenomenon of laminar-turbulent transition in diffusers, of different cone angles and expansion ratios of the channel. The calculation was conducted by using a Lushchik-Pavel'ev-Yakubenko model of shear turbulence [1]. At the entrance of the channel, either a developed turbulent pipe flow or a flow with a uniform velocity profile with different turbulent energies was applied. The calculations were performed for channel expansion ratios of 1.65, 2.5, 3.4 and 6.8, with the cone angle varying from 0.01° to 4° and the Reynolds numbers changed from 1000 to 10,000 at the channel entrance. The results of the calculations were compared with previously obtained experimental data [2] for a diffuser with cone angle of ~ 0.6°. Experimental data are in good agreement with the calculated data. Calculations showed that with an increase of the diffuser length, the turbulent flow disappears and smoothly transforms into laminar flow. The critical Reynolds number Re* vs the diffuser cone angle θ is obtained (Figure 1).
This kind of diffusers can be used in industry, when designing various devices. As an example, such diffusers with sufficiently low speeds inside can be used in the new type of heat exchangers.

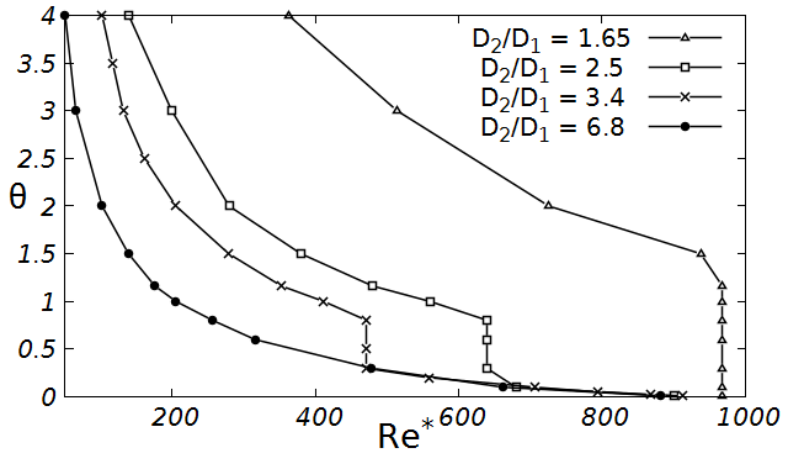

Figure 1.

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References

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[2] A.I. Reshmin. V.V. Trifonov. S.Kh. Teplovodskii. Turbulent flow in a conical diffuser with a small divergence angle at Reynolds numbers less than 2000. ASME: FEDSM2014-21597, 2014.