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Measurements of flow pattern in a wavy duct; secondary and turbulent flow

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Abstract: Laminar and turbulent flow characteristics for the axial mean flow velocity in a wavy duct with a square cross section were investigated. The comparison between the laminar and turbulent flow pattern showed an alternating position for the maximum axial mean flow component in both laminar and turbulent flow cases. The secondary flow measurements for the laminar case showed that four vortices are formed in the duct corners. In the turbulent flow case, the noticeable distortion for the velocity profiles was accompanied by high levels of turbulence due to the increased rate of shear and the streamlined curvature. Shear stress in terms of the correlation coefficients is also presented. These profiles show an enhancement for the rate of momentum transfer due to the curvature, and demonstrate that the velocity fluctuations are strongly correlated in all directions. As a measure for anisotropy of the velocity scales, the ratio between the turbulent fluctuations in two perpendicular directions are given and it is found to be always greater or less than unity over a large portion of the duct cross section. (A)