

Advances in

HEAT TRANSFER

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Heat Transfer to Newtonian and Non-Newtonian Fluids in Rectangular Ducts

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1. Introduction

A. SCOPE AND OVERVIEW

The fluid dynamics and heat transfer behavior of laminar and turbulent flow through noncircular ducts is of special interest because of the wide application of such geometries in compact heat exchangers. Consequently, extensive analytical and experimental studies have been carried out on such geometries. The analysis of the hydrodynamics and heat transfer of noncircular duct flows is generally more complicated than in the case of circular pipe flow. For example, the determination of the fully developed friction factor and the fully developed heat transfer in noncircular ducts requires a two-dimensional analysis in contrast to the usual one-dimensional analysis for fully established circular pipe flow. For developing flows in noncircular channels the analysis becomes three-dimensional.

The usual boundary condition on the velocity for a fluid flowing through a noncircular channel is the relatively simple nonslip condition (i.e., the velocity goes to zero on the boundaries), the same as for circular pipe flow. However, the thermal boundary conditions encountered in noncircular duct flows are generally more complex than in the case of pipe flow. In the case of circular pipe flow, under conditions where forced convection dominates, the temperature and velocity profiles are usually symmetric. Unfortunately, noncircular

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