ABSTRACT

The plate fin heat exchanger occupies a special position among heat transfer devices because of the compactness, efficiency and flexibility it offers to the designer. Its unique style of construction also allows accommodating more that two fluid streams with intermediate entry and exit. These advantages have led to widespread application of these devices, particularly in automobile, aerospace and cryogenic industries.

The dimensionless heat transfer coefficient **j** and friction factor **f** of the finned surfaces constitute the most important parameters for heat exchanger design. These parameters are functions of surface geometry, fluid properties (Prandtl number) and flow velocity (Reynolds number). In principle, **j** and **f** characteristics of a surface can be determined by numerical modelling of the flow field through CFD. But, even with present day computing power, satisfactory results cannot be generated for complex heat transfer surfaces. Experimental determination of **j** and **f** characteristics of surface geometries of interest remains the only practical approach.

An experimental apparatus, based on the steady state method, has been built in our laboratory for study of plate fin surfaces and generation of **j** and **f** data over a Reynolds number range of 1000 to 5000. A cross-flow heat exchanger of specified dimension serves as the experimental core. On one channel of the cross-flow exchanger, room air is blown at the desired flow velocity while condensing steam flows in the other side. Inlet and exit temperatures and pressures, as well as the air flow rate, are measured and recorded using appropriate instruments and data acquisition system.

The apparatus has been used to study **j** and **f** characteristics of several wavy and offset strip fin surfaces. The experimental data have been combined with CFD results of another worker in the laboratory to generate a new set of heat transfer and flow friction correlations that may be employed in design of plate fin heat exchangers in industry.

Unlike two stream heat exchangers, performance of multistream units cannot be expressed in terms of simple parameters like Ntu or LMTD. Design of multistream plate fin heat exchangers demands use of numerical techniques for solving the governing equations. A design methodology based on a new scheme of partitioning the exchanger in both axial and transverse directions has been developed. In the axial direction, the exchanger is partitioned successively into smaller segments till further division has marginal effect on the predicted performance. In the transverse direction, the multistream exchanger is imagined as a combination of several overlapping two-stream exchangers interacting through their common streams. The resulting conservation