Heat Transfer and Fluid Flow in Rotating Coolant Channels

W. David Morris

This monograph deals with flow and heat transfer in coolant channels rotating about a parallel axis as in the windings of an electric generator and about an orthogonal axis as in the coolant passages of a gas turbine rotor blade. The rotating environment produces strong secondary flows due to coupling with entrance accelerations or with density variations in the flow. Such secondary flows occur in other situations of engineering interest, such as in flow passages between blades in compressors and turbines, but no general treatment of secondary flows in rotating environments is given. The secondary flows produce strong effects on pressure drop and heat transfer and since heat transfer design is very important in the applications quoted above there are significant economic incentives to improve quantitative information in this field.

After a brief introduction to the fundamental differential equations, chapters are devoted to laminar and turbulent flows in circular section tubes rotating parallel to their axes. Even in fully developed laminar flow where theoretical and numerical solutions are possible there is considerable added complexity with the influence of a Rayleigh number, a Rossby number and an eccentricity ratio (radius of rotation relative to tube radius) needing to be taken into account over and above the usual Nusselt, Reynolds and Prandtl number relationship. Further dimensionless groups can be found from combinations of these and also by replacing mean velocity by the pressure gradient, normally related via the friction coefficient. A plethora of dimensionless groupings results and the author could I believe, have been more careful in trying to avoid the inevitable confusion. The Nomenclature only gives verbal definitions of the symbols and does not refer to an equation or page number, let alone give an algebraic definition. The chapters on circular section tubes are followed by one on square sectioned tubes in parallel rotation and one on tubes in orthogonal rotation.

The monograph contains a large body of theoretical and experimental results collected by the author and other workers. It will prove to be a very good introduction to the subject for engineers and researchers who are interested in this rather specialised field. It is evident that there is a large amount of work yet to be done to satisfactorily tie up all the anomalies that remain.

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The Physical Principles of Heat Pipes

M. N. Ivanovskii, V. P. Sorokin, and I. V. Yagodkin

The book is a translation of a text originally published in Russian in 1978. Judging by the references, the authors completed writing the original in 1976; significant developments in heat pipe and thermosyphon technology have taken place since. It is, therefore, disappointing to see no attempt at updating, such as was successfully done in a recently-translated German text on heat pumps. Fortunately, this does not detract too much from this book which is based primarily on the work of the authors in the Soviet Union.

The three principal sections of the book, following on from an introduction and a short chapter on driving forces, cover hydrodynamics, heat and mass exchange, and the dynamics of heat pipes (in particular, start-up). Appendices include calculation procedures and working properties. These contents immediately label the book as being of interest to academics and those specialising in theoretical design of heat pipe systems. This satisfies one part of the market identified by the authors in their foreword, but the book's intended aim of being 'sufficiently popular for the non-specialist' is not, I believe, met. This, however, need not be a disadvantage as there are other established texts published in the UK and USA which cater adequately for this, possibly wider, market.

Insofar as the book treats in some depth the work carried out by the authors, its coverage is appropriate and will be useful to academics and heat pipe specialists. It seems, however, to be written in isolation of other work in the Soviet Union; in particular, the research at the Luikov Heat and Mass Transfer Institute receives little or no mention.

With a few minor exceptions, relating largely to terminology, the translation is excellent and editorial work has made it easily readable. The data contained in the book are presented in a logical order and are, as far as I can ascertain, accurate. Reproduction of computer programs in books is often unsatisfactory, and the program in this text is no exception, the original being reproduced directly. References are collected together at the end of the book, and total approximately 160, with about half being of Soviet origin. As mentioned above, they are now somewhat dated.

The book costs £30 (hardback). At this price, it is more likely to be found on library shelves. Its successor, *The Technological Basis of Heat Pipes*, should have a wider appeal if translated and edited with the skill applied to this text.

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