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BOOK REVIEWS

J. VILEMAS, B. CESNA and V. SURVILA, **Heat Transfer in Gas-cooled Annular Channels** (Edited by A. Zukauskas and J. Karni). Hemisphere, Washington, DC (distributed outside of North America by Springer, Berlin).

THIS BOOK contains the results of a series of experiments on heat transfer to air in turbulent flow in annular passages, carried out by the authors at the Institute of Physical and Technical Problems of Energetics, Kaunas, Lithuanian SSR. This is not a new subject, and the authors provide a very good summary of the rather extensive literature that existed prior to their experiments. The resulting book is probably the most comprehensive treatise on the subject that exists today.

The greater part of the experiments were concerned with flow in concentric circular tube annuli for diameter ratios of 0.108, 0.205, 0.373, and 0.585. However, data are also reported for two types of helically shaped inner tubes—a three-lobe twisted tube and a two-lobe twisted tube. For a few of the experiments free-stream turbulence intensity was varied by introducing surface roughness at the entrance, and a flow obstruction was used as another method of increasing turbulence intensity.

Most of the experiments were carried out at Reynolds numbers, based on hydraulic diameter, of around 200 000. However, some of the data are for Reynolds numbers of as high as 300 000 and as low as 70 000.

All of the experiments were accomplished using electric resistance heating, and thus a constant heat rate per unit of tube length. Data are reported for the inner tube only heated, the outer tube only heated, and then both tubes heated such that both the inner and outer tubes have the same local temperature. An important objective of these experiments was to investigate the influence of variable gas properties. Thus heat flux was systematically varied over a range sufficient to provide temperature ratios (absolute surface temperature divided by absolute fluid bulk temperature) from, in most cases, about 1.1 to 2.0, although temperature ratios as high as 3.0 were obtained in a few cases. The result is a very welcome set of data with varying properties. However, it must be noted that all of the data, because of the nature of the experimental apparatus, was obtained for heating only, that is, for the case where the surface temperature is greater than the fluid bulk temperature. Thus the inverse problem has yet to be systematically investigated.

The primary emphasis of this work is on heat transfer, and therefore the Nusselt number was the most significant measured parameter. However, pressure drop was also measured, and thus friction coefficients were reported.

Given the several experimental variables discussed above, the experimental program was then subdivided into an investigation of two regimes—the entry region, and the fully developed flow region. In the entry region it was decided not to investigate the boundary layer forming on the inside of the outer tube, since this differs little from the similar problem in a simple circular tube. The boundary layer forming on the outside of the inner tube was fairly thoroughly investigated, and these results are of interest quite aside from the annulus application because they provide information on a turbulent boundary layer forming with axial flow along a circular cylinder for cases where the boundary layer thickness relative to the cylinder diameter may not be neglected.

The data for the fully developed flow region, where the two boundary layers have met and coalesced, constituted the other major part of the results. It probably should be remarked that for a gas being heated there is actually no real 'fully developed' flow because the gas is continually accelerating. However, for turbulent flow there is certainly a region where changes are small, and this could at least be called a 'pseudo-fully developed' flow.

As is the custom in the U.S.S.R., considerable attention is devoted to developing algebraic empirical correlation equations for the results, so the data are available in both raw tabular form and in equation form.

The book is well written with little that is not easily understood by any worker in the field. In the opinion of the reviewer the experimental program was well conceived and carried out. The experimental uncertainty reported for the Nusselt number ranged from 0.5 to 1.2%. The reviewer is somewhat sceptical of this very small uncertainty, but the results certainly would fall in the 3–5% range typical of good experimental convective heat transfer data.

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TARIT KUMAR BOSE, **Computational Fluid Dynamics.** Wiley Eastern Limited.

THIS MONOGRAPH was written by Professor T. K. Bose for students and teachers of the Indian Institute of Technology in Madras, India. The material in the book is derived from a series of lectures given by the author to students of the institute, in the Aeronautical and Mechanical Engineering Departments.

Although entitled *Computational Fluid Dynamics*, the book sits in reality on the fence between numerical techniques and fluid dynamics. The material in it has an aeronautical bias. As a consequence most of the examples relate to subsonic or supersonic flow around streamlined bodies and the techniques described are those traditionally used in aircraft design. The book would be of limited use to chemical or mechanical engineers. The reader is assumed to have at least a basic background in fluid dynamics. Nevertheless, a useful introductory section gives the basic equations of fluid flow (mass, momentum and energy) in both Cartesian and generalized coordinate form. This is followed by some solved problems which exemplify the use of difference techniques and then by a chapter dealing with specialized techniques used in transonic flows.

A major section in the book is devoted to panel methods, the traditional technique for solving inviscid flows around streamline bodies or body combinations. Two- and three-dimensional methods are discussed.

Finite element techniques, the mainstay of stress analysis codes, are also discussed in some detail starting from the variational principles that historically lead to their development, through to the more general Galerkin procedure. Examples are rather basic, restricted to two-dimensional channel flow with a lifting body.

The book terminates in two brief chapters dealing with the creation of tracks for flow visualization using Lagrangian techniques.

As a general remark, this book is rather old fashioned, in spite of its modern title. For example the word computer is mentioned often enough but not a single subroutine is given in the text, neither a computer generated diagram. It is very disappointing that the most important and most modern CFD technique, in the reviewers opinion, the finite volume or domain method is only mentioned in passing. Yet it is the method that has shown the greatest expansion in the last decade, with the emergence of a large number of powerful general purpose codes used widely in industry. It is also surprising that the question of turbulence models, basic to CFD is not even mentioned!

The print and paper quality used in this Wiley Eastern edition is finally not to the standard expected in the West.

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