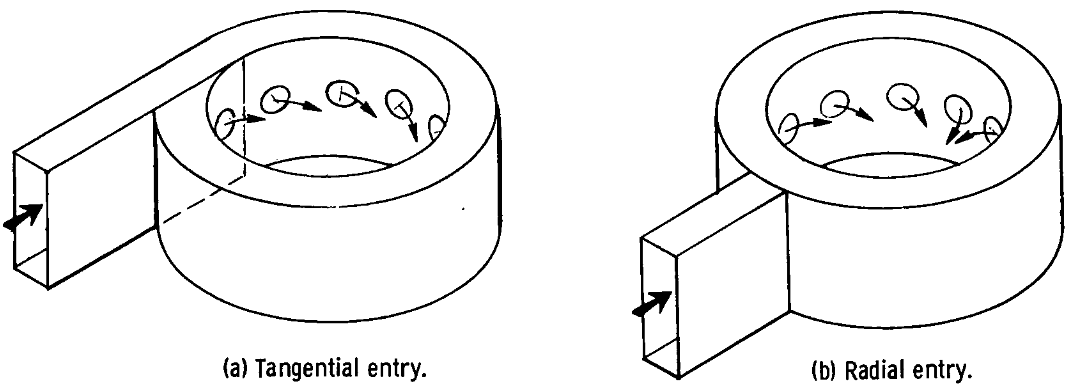
NASA TECH BRIEF

Lewis Research Center

EXPERIMENTAL STUDY OF FLOW DISTRIBUTION WITH CIRCUMFERENTIAL MANIFOLDS



(a) Tangential entry. (b) Radial entry.

Circumferential manifold.

An experimental investigation to determine factors affecting fluid flow distribution and pressure loss in circumferential manifolds has been completed. The results should be applicable to all sizes and may be applied to either evaluation or design of curved inlet and outlet manifolds for such equipment as boilers and other types of heat exchangers.

Water flow tests were conducted with the circumferential manifolds surrounding a 15.1 cm (6 inch) diameter simulated heat exchanger shell. By reversing the flow direction through the test section, the manifolds were studied both as inlet and outlet manifolds. Flow distribution, discharge coefficient and pressure loss data are presented in the referenced report for different orifice sizes, manifold velocities, and manifold geometries.

This study was carried out under a program to develop compact, efficient shell-and-tube heat exchangers for advanced space electric power plants. Efficient performance requires uniform circumferential flow distribution. Factors affecting flow distribution include: discharge coefficients of orifices in curved walls, orifice to manifold area ratio, manifold geometry, and friction and orifice throttling pressure losses. The investigation was undertaken to evaluate these factors and to identify other significant factors. The figure shows two circumferential manifolds investigated; one with a tangential entry and the other with a radial entry.

With inlet manifolds having negligible friction loss, the flow distribution is related directly to the orifice discharge coefficients. A correlation of orifice discharge coefficients with orifice-to-manifold velocity head ratios indicated that for a range of flow conditions, the discharge coefficients were relatively constant. A nonuniform flow distribution resulted when velocity head ratios were not in the range of constant discharge coefficients.

With outlet manifolds, orifice flow is related to manifold local static pressure. Variations in static pressure along the manifold result in nonuniform flow distribution. Orifice flow is a minimum at the orifices located farthest from the manifold outlet connection. The static pressure variations result from the combined effects of changes of local mass flow rate and losses caused by jet penetration and mixing. The relative magnitude of the pressure variation diminishes with an increase in orifice pressure drop (a decrease in orifice area).

Pressure losses with outlet manifolds were appreciably greater than with comparable inlet manifolds. With both inlet and outlet manifolds, the tangential type of manifold connection had lower total pressure loss than did the radial type.

(continued overleaf)

NOTES:

1. The following documentation may be obtained from:
   National Technical Information Service
   Springfield, Virginia 22151
   Single document price $3.00
   (or microfiche $0.95)
   Reference: NASA TN-D-6697 (N72-18608), Experimental Study of Flow Distribution and Pressure Loss with Circumferential Inlet and Outlet Manifolds
2. Technical questions may be directed to:
   Technology Utilization Officer
   Lewis Research Center
   21000 Brookpark Road
   Cleveland, Ohio 44135
   Reference: B72-10738

PATENT STATUS:

NASA has decided not to apply for a patent.

Source: Ralph T. Dittrich
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