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Experimental Investigation of Turbulent Heat Transfer in Circular Pipes

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Turblent heat transfer in circular pipes has been subjects of considerable interests both from a theoretical and an experimental point of view. Many papers have been presented since the original work of Pannell in 1917. To make analysis easy, they were done in most cases under either of two hydrodynamic conditions. (a) fully established velocity distribution at the heated entrance or (b) uniform velocity distribution at the entrance of heated section, and either of two thermal boundary conditions, (c) uniform wall temperature or (d) uniform wall heat flux.

Major consideration has been taken to the investigations on condition of (c) and few are reported for the uniform heat flux boundary condition because of difficulties of satisfying the condition.

This experimental report was made about cross sectional temperature and velocity distribution under conditions of (a) and (b) for the flow of air in a 42.7 mm OD., 35.7 mm ID., 1,885 mm—long brass tube over the range of Reynolds number, 1,500-5,800.

Test tube was consisted of two parts, test section I, 225 mm—length, and test section II, 1,660 mm—length. For test section I, 6 tubes of 40 mm—length and 7 teflon heat insulation packings were sandwitched to make radial heat conduction less. Taps were placed to each pieces to guide the measurement apparatus.

Cross sectional Temperature and velocity distributions were measured with each taps using 1 mm OD. pitot tubes and copper-constantan thermocouples.

For approximately fully developed temperature distributions, velocity distributions were agreed with the theoretical ones derived from the equation of R. G. Deissler within the deviation of 15%.

Local heat transfer coefficients were calculated and graphed at each Reynolds number. The thermal entrance length is about 10-15 diameters in this experiments.

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