LOW VELOCITY FLOW MEASUREMENTS AROUND A HOT SPHERE ANEMOMETER PROBE

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Heated Sphere Anemometers (HSA) are the most common low velocity measurement instruments in the HVAC industry. Recent investigations of this type of probe have employed an empirical approach with limited consideration of the fluid dynamics of flow around the probe and sensor. Experiments were designed and conducted to characterise the flow field around the spherically shaped sensor of a HSA and the rest of the probe assembly. The flow field was found to be substantially different from classical results for flow around spheres. Directional sensitivity was also investigated and shown to be determined in good measure by modifications to the flow field around the instrument.

Particle Image Velocimetry (PIV) was the main quantitative experimental technique employed during the investigation. Measurements of the flow field around a HSA probe and a 2:1 scaled-up model were performed in uniform isothermal axisymmetrical jet airflow. A compressed air driven jet producing facility was developed and characterised for this purpose. Results allowed the topology of the average flow field around the HSA probe to be characterised. In addition to PIV studies, extensive flow visualisation studies around scaled-up models of the HSA probe were performed both in air and in water.

It was concluded that vortex shedding phenomena are present in the wake of the HSA at certain velocity ranges. These phenomena are determined not by the spherical sensor but the cylindrical stem of the probe. The figure shows a typical vorticity field in the wake of the HSA sensor. Flow visualisation studies in the water tunnel have revealed the presence of a combined mode of vortex shedding from a sphere-cylinder configuration.

The flow field around the HSA probe was shown to be quite complex, unsteady and three-dimensional. The effects of this three-dimensional character of the flow field were examined with respect to the accuracy of the PIV measurements. The flow field was shown to be influenced strongly by probe support and other probe elements.