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C2Po1E-01: Combined Single and Two-Phase Cryogenic Flow Sensor: Experimental Results with Nitrogen

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The increasing industrial use of cryogenics for fuel, refrigeration, and energy storage demands the development of advanced metrology to effectively design systems and accurately meter fluid transfer operations. However, the storage and transport of cryogenics near saturation conditions frequently results in multiphase flow, precluding the use of existing single phase only cryogenic flow meters. Furthermore, industry requirements of low pressure drop, and low heat-in-leak requirements make many intrusive designs infeasible for general applications as well. In this paper we present the results of a prototype combined single and two-phase cryogenic flow sensor that combines a capacitance-based multiphase flow measurement technique with a thermal mass-based single-phase measurement technique for both the liquid and vapor single-phase flow regimes. The combined prototype is tested in a cryogenic nitrogen flow loop through a variety of phase and flow rate conditions to assess the performance of the two sensing methods and determine the optimal switching method between them.

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