

February 25 – 27, 2019

The Florida Hotel & Conference Center | Orlando, Florida

1500 Sand Lake Road, Orlando, Florida 32809

1-800-588-4656

TE- 7 | February 25 & 26 | 8:00 AM - 5:00 PM | 2-Day (16 hours)

Course Title: Flow Measure and Uncertainties

Instructor: Dr. John Wright, National Institute of Standards and Technology (NIST)

Course Description: We will cover background metrology and fluid mechanics subjects that are important for flow measurement including:

- the transition from laminar to turbulent flow
- pipe flow profiles and boundary layer concepts
- the continuity equation and conservation of mass
- fluid and gas properties and their calculation
- Pressure and temperature measurement

The operating principles and equation of flow for the commonly used flow measurement techniques will be derived and explained including:

- Differential pressure devices (laminar flow meters, orifice plates, venturi tubes)
- Critical flow venturis and nozzles
- Ultrasonic flow meters
- Turbine and positive displacement meters
- Electromagnetic flow meters
- Coriolis flow meters
- Thermal meters
- Rotameters

Methods of flow meter calibration used in laboratory, including NIST standards, will be covered. Field conditions will be discussed as well as installation effects and how distorted velocity profiles affect flowmeter accuracy.

Flow calculations and uncertainty analyses for certain flow meter types will be taught.

Our goal is cover topics with a range of physics and mathematical difficulty so that the course will be of interest to students with a wide range of mathematical backgrounds and flowmeter experience. Distributed throughout the course, there will be optional, advanced sections of interest to only extreme flow geeks.

Instructor Biography: Dr. John Wright is the Project Leader for flow measurements in NIST's Sensor Science Division. Currently, he is studying the effects of heat transfer on the accuracy of critical flow Venturi meters. Dr. Wright developed a Pressure-Volume-Temperature and time gas-flow standard that has an uncertainty of 0.025%, an accomplishment that earned him the US Department of Commerce Bronze Medal. In 2011, he earned the US Department of Commerce Silver Medal for helping to quantify the flow and uncertainty of the

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Deep Water Horizon oil spill in the Gulf of Mexico. Dr. Wright is also responsible for measurements of hydrocarbon liquid flow, liquid density, and liquid volume (for petroleum traceability). Dr. Wright piloted the first international key comparison for low-pressure gas flow (completed in 2007), and he is presently the Chairman of the Working Group for Fluid Flow, a committee organized by the Bureau International des Poids et Mesures (BIPM) to coordinate calibration measurement capabilities and comparisons for national metrology institutes. Before moving to NIST in 1995, Dr. Wright designed and constructed a volumetric water flow standard and he has two flow measurement patents from this period of his career.