



# FLOW MEASUREMENT AND CALIBRATION

## Liquid and Gas

### Three-Day Training Seminar

#### ABOUT THE SEMINAR

This Training Seminar is intended for individuals with responsibility to select, calibrate and use liquid and gas flowmeters.

It is designed to be an objective, independent review and evaluation of the current state of flow metering and calibration theory and technology for flowmeter users and metrologists.

The Seminar will:

1. Review in detail the fundamental concepts of liquid and gas flow measurement.
2. Building upon flow measurement theory and practice, introduce the principles of liquid and gas flow calibration.
3. Analyze in detail the differences between liquid and gas flow calibration.
4. Study sources of error and uncertainty in liquid and gas flow calibration.
5. Review practical methods for improving calibration reliability and accuracy.
6. Analyze currently available flow calibration technologies. Examine pros and cons.
7. Review commercial calibration laboratories and their capabilities.
8. Offer participants the opportunity to discuss their own flow calibration application problems.

A comprehensive manual (in English) containing all information presented in the seminar and other useful references will be presented to each participant.

#### ABOUT THE LECTURER

Tom Trigas is the Director of TrigasFI GmbH, an independent flow calibration laboratory in Munich, Germany. He has over 20 years experience in Flow Measurement and Calibration of Gases and Liquids and has authored many articles and papers in the field.

Expert guest speakers will also be available to present information on various flow measurement topics.

Presentations of this seminar can be scheduled on-site for large organizations upon request. Please contact our office for details.

#### PROGRAM OUTLINE

##### Introduction

Liquid vs Gas - Flow calculations  
History of Flow Calibration

##### Practical aspects of Flow Metering and Calibration

Review of different flowmeter technologies and their suitability for real life applications  
Methodology of Liquid and Gas Calibrations  
Installation effects / Flow conditioning  
Viscosity / Moisture effects  
Pressure, Temperature, Compressibility  
Reynolds, Strouhal and Roshko Numbers  
Environmental influence (P, T, Vibration)  
Response time considerations

##### Errors and Uncertainty

Traceability / Certification  
Interlaboratory comparisons  
Overall accuracy  
Statistical Methods

##### Liquid Calibration Technologies

Piston calibrators and provers  
Operation / Waterdraw  
Uncertainty analysis  
Ball Provers  
Catch-and-Weight

##### Gas Calibration Technologies

Closed Loop Piston Hi-Pressure Calibrator  
Operation / Uncertainty  
Bell Prover  
Mercury Seal Piston Calibrator  
Graphite Piston Calibrator  
Sonic Nozzle  
Catch-and-Weight / PVT method

##### Transfer Calibration Method for Liquids and Gases

Selecting and Using Master Flowmeters  
Operation / Uncertainty Analysis

##### Discussion