Thermodynamic Calibration Techniques

Course No. 133

FOR WHOM INTENDED: Individuals performing or preparing to perform hands-on bench work for thermodynamic measurement and calibration. Supervisors and managers of thermodynamic measurement and calibration personnel.

BRIEF DESCRIPTION OF COURSE: Course 133 commences by introducing physical measurement. After defining the different measurands, the course next covers units of measurement and measuring methods.

Students are introduced to the basic theory associated with each of the measurements/calibrations discussed. The course covers error propagation, dimensional equations, traceability and a brief introduction to probability and statistics, before proceeding with specific measurement/calibration techniques.

Measurement/calibration techniques covered include temperature, humidity, pressure/vacuum and flow. A procedure is provided for each of the measurement techniques covered, together with a sample of a specific measurement. For each measurement/calibration technique, tips and suggestions are offered to minimize error and obtain an accurate measurement/calibration.

Participants successfully completing this course will be able to understand, evaluate and use a variety of thermodynamic measurement and calibration techniques.

DIPLOMA PROGRAMS: This course is recommended for TTi's Metrology/Calibration Specialist (MCS) Diploma Program, and may be used as an optional course for any other TTi specialist certificate program.

PREREQUISITES: There are no definite prerequisites for this course. However, this course is aimed toward individuals involved in a related technical field.

TEXT Each student will receive 180 days access to the on-line electronic course workbook. Renewals and printed textbooks are available for an additional fee.

COURSE HOURS, CERTIFICATE AND CEUs Class hours/days for on-site courses can vary from 14–35 hours over 2–5 days as requested by our clients. Upon successful course completion, each participant receives a certificate of completion and one Continuing Education Unit (CEU) for every ten class hours.

For schedules, general information and to register, see TTi's web site.

Course Outline

Introduction, Definition of Terms
Quantities and their Measurement
- International System of Units • Dimensionless quantities
- Traceability • Classification of geometrical quantities

Traceability
- Achieving traceability though calibration & testing laboratories
- Determination and statement of uncertainty
- In-house calibration • NIST Calibration program
- Temperature critical parameters • Secondary parameters

Propagation of Errors in Indirect Measurements
- Propagation of error equations:
  - Algebraic summation, product, ratios, exponential
  - Square root, logarithm • Examples

Review of Statistical Analysis
- Uncertainty • Statistics of measurement
- Random data and the Gaussian distribution
- Cumulative Distribution Functions (cdf)
- Probability Density Functions (pdf) • Confidence Levels
- Purpose of a Measurement • Risk Decisions • Statistical Reasoning

Temperature Measurement
- Thermometer scales • Specific heat • Heat transfer
- Heat energy and thermal characteristics of materials
- How the Temperature Environment is Measured
- Temperature Sensors: Characteristics
  - Thermocouples • Thermistors • Temperature Effects
  - Thermoelectric Transducers

Thermodynamic Temperature
- International temperature scale of 1990 (ITS-90)
- Thermometer selection • Standard platinum resistance thermometry
- Triple point of water • Control charts

Thermometers and Thermistors
- Industrial Platinum Resistance Thermometers (PRTs)
- Reference Temperature Measurement System • Equations for IPRTs
- Thermistors (Thermal Resistor)—Advantages and Disadvantages
- Automated Thermistor Calibration • Resistivity vs. Temperature
- Typical Thermistor Measurement System
- Digital Thermometers • Digital Thermometer Calibration Service

Humidity Measurement: The nature of the environment
- Heat index • How humidity is measured
- Hygrometers • Psychrometers • Chilled-Mirror Hygrometers
- Dew point vs. Frost point • Typical general-purpose hygrometer spec.

Pressure/Vacuum Measurement Techniques
- Absolute, differential, gage and head pressures
- Types of pressure gages: Electro-Mechanical Sensors • U Tube Manometers • Cistern Manometers • Dead Weight Gages (DWG)
- Pressure sensor specifications • Potentiometric Transducers
- Vacuum Measurement • Calibration of Vacuum Devices

Flow Measurement: Calibrating Flow Measurement Instruments
- Typical Applications: Fuel Metering, Aerospace • Fluid Fill Systems
- Dispensing Systems • Well Injection Systems • Oil Flow Measurement
- Oil Flow Testing Calibration Lab • Blow-Out Preventors
- Water Filtration Equipment • Aerospace Fuel Management Systems
- Gas Detectors • Vacuum Testing a Valve • NIST Developments

Summary, Final Review
Award of certificates for successful completion

Technology Training, Inc.
(a tti group company)
Toll-free telephone:
866-884-4338 (866-TTi-4edu)
International Tel. 805-845-5050
E-mail: Training@ttiedu.com
www.ttiedu.com