



# Successful Measurement of Dynamic Force, Pressure & Acceleration

A Training course offered by PCB Piezotronics, Inc.

August 17-19, 2010 • Buffalo, NY



## At this training, participants will learn to:

- Understand the physics and operating characteristics of dynamic force, pressure, and acceleration transducers and constraints associated with their use
- Interface transducers effectively with intended test environments
- Condition transducer signals to maintain their fidelity through selection of appropriate cabling, amplifiers, analog filters, sampling rates, DAQs, etc.
- Document extraneous measurands (e.g., strain, temperature, ionization products of a detonation, magnetic fields) that superpose as noise on the desired transducer response
- Apply corrective action for elimination of these noise levels
- Validate that final, recorded signals contain only the desired (force, pressure, or acceleration) data
- Perform “back of the envelope” checks to assure the bandwidth of the recording system did not impose constraints on recorded data
- Perform sensor and system calibration, data analysis, and data utilization

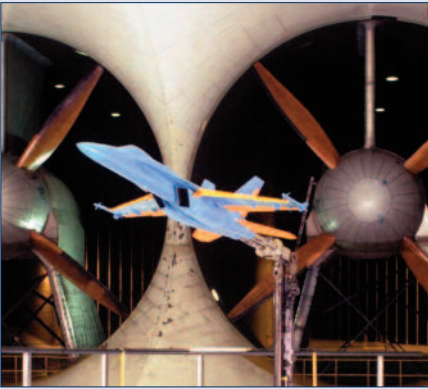
*The training will also include in-house demonstrations by PCB® staff of sensor component manufacturing, as well as sensor assembly, testing, and calibration*

## Who Should Attend:

Test personnel and their managers; design and analysis staff who use test measurements for model, component, and full-scale system verification; calibration laboratory staff; data reduction personnel; and more generally anyone whose work depends on the output from force, pressure, and acceleration measuring systems to support either test and analysis or control applications.

## About the Event:

The training will begin Tuesday, August 17th at 8:00 a.m., and will conclude on Thursday, August 19th at approximately 2:00 p.m. The cost is \$650.00 USD per person, which includes all meals, entertainment, and a sightseeing tour of Niagara Falls. Class size is limited to the first 40 paid registrants. To reserve your space, complete and submit the registration form or contact Alyson Grande at 866-816-8892 ext. 2628, or via E-mail at [agrande@pcb.com](mailto:agrande@pcb.com).



Training attendees enjoy a sightseeing tour including spectacular views of Niagara Falls. This photo was taken during the May 2009 event.

## About the Speaker:

Patrick L. Walter, Ph.D., Senior Measurement Specialist, PCB Piezotronics and Professor, Texas Christian University (TCU), will serve as training facilitator. Dr. Walter was employed for 30 years at Sandia National Laboratories, with the majority of his tenure spent managing flight, field, and laboratory test activities. The commonality of his work activities involved testing in hostile environments. In 1995, Dr. Walter joined the Engineering Department of TCU, where he teaches and has served as Chair.



Patrick L. Walter, Ph. D.

Dr. Walter also holds the position of Senior Measurement Specialist at PCB®, where he consults on dynamic force, pressure and acceleration measurement, primarily for aerospace and defense applications. Dr. Walter's technical articles and papers have appeared in numerous publications. He has served on and chaired various United States Department of Defense and Department of Energy committees, is active in many professional societies, and teaches Measurement System Engineering through TCU's Extended Education Department. He is a licensed professional engineer.

## Program at a Glance:

### Tuesday August 17, 2010

(breakfast, lunch and dinner provided)

#### **Lecture #1:**

##### **Program Introduction**

- Measurements for test vs. controls
- Impedance considerations: electrical, acoustic, mechanical
- Differences between design/analysis and measurements problems

#### **Lecture #2:**

##### **Introduction to Structural Dynamics**

- Structural loads, response, and modeling

#### **Lecture #3:**

##### **Measurement System Requirements: Linearity, Flat Amplitude Response, Linear Phase Response**

- Basic guidelines for measurement system design
- Case studies

#### **Lecture #4:**

##### **Dynamic Transducer Models**

- Dynamic models for force, pressure and acceleration transducers

#### **Lecture #5:**

##### **Signal Types and Acquisition**

- System requirements for measuring deterministic vs. random data
- Data sampling and aliasing

#### **Lecture #6:**

##### **Data Filtering**

- Terminology
- Differentiators/integrators
- Detailed analog filter selection criteria

#### **Lecture #7:**

##### **Dynamic Force, Pressure, and Acceleration Measurements**

- Transducer physics, cables, signal conditioning and calibration

##### **Demonstration: Accelerometer Calibration**

### Wednesday, August 18, 2010

(breakfast, lunch, and dinner provided)

#### **Lecture #8:**

##### **Validating Time-varying Transducer Signals: Help for the Analyst**

- Rules of thumb for assessing data
- Data validation
- Case studies

#### **Lecture #9:**

##### **Analyzing and Using Shock and Vibration Data**

- Examples of how acquired data impact design
- Measurement system requirements

#### **Lecture #10:**

##### **Measurement System Design: Dynamic Force, Pressure and Acceleration**

- Interfacing to the test environment
- Application examples

#### **Lecture #11:**

##### **The Future: Smart Transducers, Wireless Transmission**

##### **Demonstration: Basic Piezoelectric Sensor Measurements**

##### **Wrap-up, questions and answers**

##### **Sightseeing Tour of Niagara Falls (included)**

### Thursday, August 19, 2010

(breakfast and lunch provided)

Factory tour and demonstrations by PCB® staff of sensor component manufacturing, as well as sensor assembly, testing, and calibration.

Opportunity to discuss unique issues and application requirements with factory personnel.

##### **End of program**

**Please submit completed form via fax to 716-206-2605 to the attention of Alyson Grande.  
For further assistance, call 866-816-8892, ext. 2628 or E-mail agrande@pcb.com**

## **Training Registration Form**

Training: "Successful Measurement of Dynamic Force, Pressure and Acceleration"  
Presented by: Patrick L. Walter, Ph. D.  
Dates: Tuesday, August 17th through Thursday, August 19th, 2010  
Location: Buffalo, New York, USA  
Venue: Millennium Hotel Buffalo - 866-866-8086  
2040 Walden Avenue, Cheektowaga, NY 14225

## **Attendee Registration Form**

Name: \_\_\_\_\_ Title: \_\_\_\_\_  
Company: \_\_\_\_\_ Primary Industry: \_\_\_\_\_  
Address: \_\_\_\_\_  
City, State, Zip: \_\_\_\_\_  
Phone: \_\_\_\_\_ E-mail: \_\_\_\_\_

## **Payment Details**

Cost: **\$650.00** per person (includes training materials, meals, and entertainment)

Select Payment Type:  Company Check (Payable to PCB Piezotronics, Inc.)  
 VISA  MasterCard  American Express

Credit Card Number: \_\_\_\_\_

Name on Card: \_\_\_\_\_

Exp. Date: \_\_\_\_\_

Company PO PO # \_\_\_\_\_

(attach copy of company purchase order with billing instructions)

**Mail payment or PO to: Alyson Grande, PCB Piezotronics, Inc. 3425 Walden Ave., Depew, New York 14043 USA**

## **Lodging**

A block of specially discounted rooms (\$99.00 per night) has been set aside at the Millennium Hotel Buffalo. Should you desire lodging, contact the hotel directly by calling 866-866-8086. Free shuttle service is available to this hotel at the Buffalo Niagara International Airport. Car rental is not necessary.