

Hart Scientific temperature seminars

Do more with training from Hart Scientific.

Our seminars give you the skills you need to do your job better. The members of our faculty are the right people to learn from because they deal with tough temperature metrology questions on a daily basis. Whether you're a technician or a manager, these seminars will help you get ahead in your career. You'll love each of our courses: *Principles of Temperature Metrology*, *Advanced Topics in Temperature Metrology*, *Infrared Temperature Metrology*, and *Product Training*. Each course lasts two days. We sometimes offer two courses in the same week, so check our website to see if you can take two courses in just one visit: www.hartscientific.com/seminars/index.htm

Principles of Temperature Metrology

"It was one of the best training courses I have attended."

That's what Keith Decker from a company that is a leader in the development of innovative therapies for serious illnesses, had to say about our *Temperature Metrology* course. Come to our *Principles of Temperature Metrology* course to experience this training for yourself.

Topics for this course range from the selection and usage of calibration equipment to the theory behind good calibrations. This includes knowing how to use SPRTs and other high-accuracy standards and how to keep your working standards performing at their highest levels. Are you working on laboratory accreditation? In this course we also discuss accreditation and compliance, especially dealing with ISO 17025 issues.

Not only will we cover actual calibration techniques, we'll show you how various instruments such as readouts, dry-wells, and calibration baths work and the principles behind why they work the way they do. You'll learn to choose the most cost-effective approach for specific applications, and then we'll get into enough basic uncertainty analysis to get your feet wet.

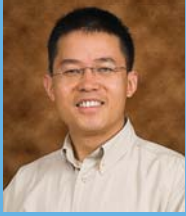
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Advanced Topics in Temperature Metrology

It's one thing to follow a calibration procedure and quite another to design one or provide technical support when things go wrong. If you really need to get training that can improve the way you work, attend our course *Advanced Topics in Temperature Metrology*. We've got the right faculty in place to answer all your toughest temperature questions. That's because they know the theory and practice of



Meet our faculty



Mingjian Zhao came to us in 1994 from the National Institute of Metrology (NIM, China) where he worked as a researcher for seven years. He has published over 40 papers worldwide and has an MS degree in Thermal Physics from Harbin Institute of Technology (P. R. China). He is currently Hart's director of primary standards engineering and an expert in the design of thermometers and fixed points.



Tom Wiandt, Hart's director of metrology, has been with us since 1995. He has been key in achieving and maintaining our NVLAP accreditation in American Fork, Utah and UKAS accreditation in Norwich, England. His knowledge in temperature metrology is backed by his experience at Northrop Corporation, Southern California Edison, and the US Air Force. He is a frequent speaker at MSC, NCSLI, and international metrology organizations. He is currently the ASTM chair for committee E20.07, Fundamentals in Thermometry.



Mike Hirst, one of the original founders of Hart Scientific, has worked in the engineering of high-performance temperature sources since 1970, including dry-well calibrators, fixed-point furnaces, and baths. He received his BS degree in design technology from Brigham Young University.



Rick Walker has been with us since 1988 and has had a leading role in the development of a majority of Hart's thermometer readouts, including the Tweener, *Black Stack*, and Super-Thermometer. He holds an MS degree in electrical engineering.



Frank Liebmann has been with us since 2003. He is an expert in infrared temperature measurement and works as an engineer in the design of IR thermometer calibrators and other temperature calibration equipment. Frank has a BS in Electrical Engineering from the University of Utah.



Ron Ainsworth, marketing manager for Hart Scientific, was formerly the calibration laboratory manager and has been with the company since 1999. He holds a BS in Physics from Brigham Young University and has published his research through TEMPMEKO, the American Institute of Physics, and NCSLI, where he is also a section coordinator.

calibrating everything you see on a daily basis. Some of them even designed the stuff!

This course covers advanced temperature metrology topics, including instruction on the ITS-90, procedure design, mathematical models, and serious uncertainty analysis. Bring your questions; we'll answer them.

Attendees should have completed *Principles of Temperature Metrology* or its equivalent previously. This course lasts two days. We sometimes offer two courses in the same week, so check our website to see if you can take two courses in just one visit: www.hartscientific.com/seminars/index.htm

Infrared Temperature Metrology

So your customers want to use their infrared thermometers and it's time to figure out how to deal with the mysteries of IR thermometer calibration. Unfortunately, books written on the subject of infrared thermometry might as well be written in a foreign language, so why not make it easy on yourself and hear it all explained in clear, understandable terms?

Our *Infrared Temperature Metrology* course covers the basics of using infrared thermometers, performing radiometric (IR) calibrations, and determining measurement uncertainties.

You'll get your questions answered about black bodies, grey bodies, size of source effect, emissivity, spot size, background temperature effects, and apparent temperature, to name a few. We'll discuss what calibration means for infrared thermometers and how to do it right. Don't miss this chance to get ahead of the game on the next big thing in temperature calibration.

This course lasts two days. We sometimes offer two courses in the same week, so check our website to see if you can take two courses in just one visit: www.hartscientific.com/seminars/index.htm

Product Training

It's time to get the most out of your Hart products. While our seminars offer theory, demonstrations, hands-on exercises, and panel discussions, *Product Training* provides additional hands-on experience.

The course is broken into four sessions covering thermometers, baths, dry-wells, and software. These sessions offer the perfect opportunity to learn to maximize the advantages you get from Hart products. You will leave knowing exactly how to use your favorite temperature calibration products, how to achieve the best results from them, and how to get the most productivity out of your calibration work.

An experienced product group expert at Hart Scientific guides each product training session. Enrollment is limited and you're guaranteed to get all your questions answered.

Each session includes experience with a large number of products that represent Hart's entire line for that particular product group. In the thermometer session, for example, you'll get to work (and play) with a Little Lord Logger, a DewK, a Chub-E4, a *Black Stack*, and a Super-Thermometer. Likewise for the other sessions.

You just need to register to enjoy using the best temperature calibration products in the world. Try them out and you'll understand what we mean.

This course lasts two days. We sometimes offer two courses in the same week, so check our website to see if you can take two courses in just one visit: www.hartscientific.com/seminars/index.htm

Principles of Temperature Metrology, Course Outline

A principles-based course in practical lab skills for comparison calibration of thermistors, RTDs, thermocouples, and other thermometers.

Introduction to temperature

- ITS-90 and other temperature scales
- Traceability
- Uncertainty
- Calibration

Temperature sensors, indicators, and sources

- Types (advantages/disadvantages)
- Characteristics
- Sources of error
- Effective (proper) use
- Evaluation

Calibration systems

Measurement techniques and procedures

Uncertainty budgets

Quality assurance

- Check standards
- Control charts
- ANSI/NCSL Z540
- ISO 17025
- Accreditation
- Audits
- Lab inter-comparison

Advanced Topics in Temperature Metrology, Course Outline

A higher-level course for those who really need to get into the details.

ITS-90 overview

- Fixed points
- SPRTs
- Infrared thermometry
- Interpolating equations

Metrology engineering

- Process design
- Mathematical models
- Curve fitting

Uncertainty analysis

- Common components: thermocouples, PRTs and thermistors, SPRTs, and infrared
- GUM
- Tools of the trade (statistics)
- Mathematical model analysis
- Propagation of uncertainty

Mathematics of infrared

Advanced procedures for reducing uncertainties

- Ratio measurements
- Potentiometric techniques
- Maintaining standard resistors
- Bridge measurements
- Low-level voltage measurements for reference thermocouples

Infrared Temperature Metrology, Course Outline

IR thermometry theory

- What is radiation?
- IR spectrum
- Radiation equations
- Emissivity
- Gray bodies
- Size of source effect (SSE)
- Background temperature and effect

Using the IR thermometer

- Spectral response
- Emissivity
- Spot size
- Background temperature and effect
- Imagers

Using the IR calibrator

- Plates vs. cavities
- Emissivity (how to account for emissive effects)
- Reference IR thermometer
- IR calibrator specifications
- Spot size and target size
- Background temperature and effect
- Alignment

Uncertainty budget

- Traceability
- Reference IR thermometer
- Measurement equation
- Accuracy
- Repeatability
- Elements of an IR uncertainty budget
- ASTM guidelines

Product Training, Course Outline

Bath Training

- Profile a bath to minimize uncertainty
- Use different types of bath fluids
- Use Hart bath controllers
- Get the most from a reference thermometer

You'll use...

- Deep-well Compact Baths
- Standard Baths

Dry-Well Training

- Use all dry-well controller functions
- recalibrate your own dry-well
- Use a reference thermometer
- Maximize dry-well productivity

You'll use...

- Metrology Wells
- Field Dry-Wells

Thermometer Training

- Use the menu systems for each readout
- Match a probe to a readout
- Select the best probe and handle it correctly
- Avoid calibration pitfalls
- Get the most productivity from your readout

You'll use...

- 1522 Little Lord Logger
- 1529 Chub-E4
- 1620A DewK
- 1560 Black Stack
- 1590 Super-Thermometer II

Software Training

- Automate Control of your heat sources
- Automate calibrations entirely
- Generate probe data easily
- Log temperature data and analyze it

You'll use...

- 9930 Interface-it
- 9938 MET/TEMP II
- 9933 TableWare
- 9935 LogWare II
- 9936A LogWare III

Call your Hart representative today. Or visit Hart on the web at www.hartscientific.com

Fluke. *Keeping your world up and running.*®

How Do I Register?

Call us at...

800-438-4278

Fax us at...

801-763-1010

E-mail us at...

seminars@hartscientific.com

or register online at...

www.hartscientific.com

Remember, you can check our web site for dates and times of classes. Once you register, we'll send you the necessary visitor information on where to stay and how to get here. We're located just 40 minutes from Salt Lake City International Airport with plenty of inexpensive hotels nearby.

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