Model 881 Thermocouple Scanner
NEW

Dual Heat Pipe Thermocouple Homogeneity Scanner

How does your laboratory identify thermocouple homogeneity effects?
Now there is a solution!

› Fully Automated
› Scans Thermocouples with full control of position and speed
› Identify Uncertainty due to Inhomogeneity

For more details visit:
www.isotech.co.uk/ths

Developed by the Measurement Standard Laboratory, New Zealand - licensed to Iotech
Thermocouple Theory: Seebeck Effect

Consider a wire in a bath at 100°C
Gradient of 80°C
Mainly where the wire exits bath
The heat flow arising from the temperature gradient results in a Seebeck voltage

The Seebeck coefficient of a material is a measure of the magnitude of an induced thermoelectric voltage in response to a temperature difference (gradient) across that material
Thermocouple Theory

If we add a wire of a different metal we get a different voltage
Different Seebeck coefficient
Thermocouple Theory

To measure the voltage we need to connect the wires to make a circuit
Thermocouple Theory

To measure temperature we need to know the temperature of the “cold junction”
Seebeck Effect

KEY POINT: Voltage is not generated at the junction!

Seebeck Effect, wherever heat flows in a conductor, emf is generated

If the wire is not homogenous we will get errors
How to Check Homogeneity

Very important!

The EURAMET guide

“Guidelines on the Calibration of Thermocouples EURAMET Calibration Guide No. 8 Version 3.” was updated last year and has new information about “the effect of inhomogeneity on the uncertainty”

Section 9.2

9.2 Inhomogeneity can be quantified by moving the measuring junction in an environment with homogenous temperature distribution (e.g. a stirred liquid bath or a fixed point cell, or specialised single gradient scanner [12]).

Thermocouple Homogeneity Scanner

Isotech have licensed the thermocouple scanner designed by Emile Webster of the Measurement Standards Laboratory, New Zealand

Benefits of the Thermocouple Scanner

When Calibrating Thermocouples -

Identify performance to allow uncertainty to be calculated rather than guessed (Type A uncertainties)

Allow a lower uncertainty to be offered to a thermocouple that has good performance

Determine if thermocouples submitted for calibration are worth calibrating

Be able to check if annealing of a thermocouple has been successful
Benefits of the Thermocouple Scanner

When Using Thermocouples -

Have confidence in your laboratory thermocouple standards
Know when to calibrate
Check if a thermocouple has gone bad
Check when and how often to anneal your thermocouples
Know what region of your thermocouple to avoid
Benefits of the Thermocouple Scanner

When Manufacturing or Selecting Thermocouples -

Identify failures and defects in batches of thermocouples

Easily determine thermocouple quality

Identify variations in thermocouple wire when sourced from different suppliers or batches
ISOTECH Model 881 Thermocouple Scanner

Designed by Measurement Standards Laboratory, NZ
Utilises a unique dual heat-pipe arrangement
Scanning times reduced to less than 20 minutes
Scanning resolutions of between 2 mm and 5 mm
Fully automated motion and logging
More than 10 years in development

First MSL Prototype: 2008 – 2010
- Single water heat-pipe
- Continuous scanning using capstan roller
- Direct immersion into steam

- Second acetone heat-pipe added
- Worm driven linear actuator added
- Fully automated software system

- Modelling of temperature gradients
- Validation of single, rather than double gradient
- Use of convolution theory

Commercial Prototype: 2017 – 2018
- Development of Peltier unit for upper heat-pipe
- Use of isothermal connector block
- Optimisation of septum design


How bad could thermocouples be?

MIMS 3 mm Type K, low temperature drift between 5 min and 200 h.

Difference in performance from reference function

Changes in metallurgy with temperature and time causing drift

Heat damaged region caused by tip welding

As-received state

After 200 h

Temperature (°C)

Seebeck, %
How bad could thermocouples be?

MIMS 3 mm Type N, low temperature drift between 5 min to 200 h

Difference in performance from reference function

Large damaged region caused by swaging defects

Changes in metallurgy with temperature and time causing drift

As-received state

After 200 h

Seebeck, %

Temperature (°C)

www.isotech.co.uk
Achieve at least a three fold improvement in measurement accuracy

Most thermocouple uncertainty budgets rely on indicative type B assessments of inhomogeneity.

Inhomogeneity is normally the largest uncertainty component, and therefore has the greatest effect on accuracy.

Make real measurements of inhomogeneity to minimise its effect and maximise the potential of your thermocouples.
Identify bad thermocouples from a batch

Use the thermocouple scanner to rapidly pass or fail thermocouples

Don't unnecessarily pay for bad thermocouples

Using regular scanning to help decide when to replace thermocouples before the failures occur

Use the scanner to help you decide who provides the best thermocouples for your application.
A separate control box contains the electronics

Also Required

- DVM
  - Recommend Keithley 2182A Nanovoltmeter
- PC
  - Windows 10

Scanner requires wall mounting

Or there is an optional base
How does your laboratory identify homogeneity effects?

Now there is a solution

Can you afford to be without it?
Automatically Scan Thermocouples

The test thermocouples are lowered and raised through a compressed knife edge gradient.
Automatically Scan Thermocouples

The software automatically controls the test, whilst recording the thermocouple voltage.
Some Results

Type K MIMS – change in temperature over length
Some Results

Type K MIMS – change in Seebeck Coefficient
More info?

www.isotech.co.uk/ths
World Leader in Temperature Metrology

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