

Steam Heat Pipe **100°C**

Acetone Heat Pipe **20°C**

# Thermocouple Homogeneity Scanner

Model 881 Dual Heat Pipe Thermocouple Homogeneity Scanner

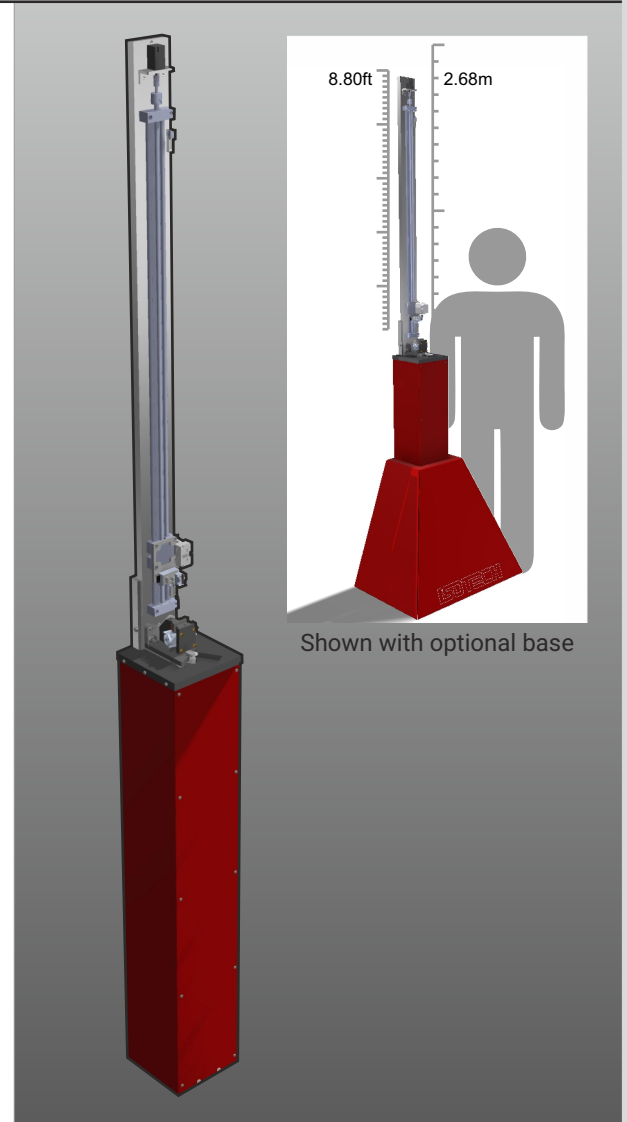
- Determine Uncertainty Due to Inhomogeneity
- Identify Contaminated Sections of Thermocouple Wire
- Assess Quality of Thermocouple Wires

The 'Isotech Model 881 Dual Heat Pipe Thermocouple Homogeneity Scanner' provides a fully automated solution to the problem of measuring thermocouple homogeneity.

The operation of a thermocouple relies on the Seebeck effect which causes an emf to be generated in any region of a thermo element that is exposed to a temperature gradient. Undesirably, nearly all thermocouples develop non-uniformities (inhomogeneities) in their thermoelements during normal use.

If one is to assess the accuracy of a thermocouple, then the inhomogeneity of the thermocouple is a major concern. Increasingly users and laboratories are wanting to be able to measure thermocouple inhomogeneity.

|  |  |        |         |       |       |              |       |       |       |              |       |
|--|--|--------|---------|-------|-------|--------------|-------|-------|-------|--------------|-------|
| Model                                  | 881  |        |         |       |       |              |       |       |       |              |       |
| Operating Temp.                        | 100°C  |        |         |       |       |              |       |       |       |              |       |
| Max. Immersion Depth (Steam Heat Pipe) | 1000mm   |        |         |       |       |              |       |       |       |              |       |
| Recommended T/C Diameter               | 1.5mm to 4.0mm   |        |         |       |       |              |       |       |       |              |       |
| Scanning Time                          | <20 minutes  |        |         |       |       |              |       |       |       |              |       |
| Scanning Resolution                    | 2 - 5mm  |        |         |       |       |              |       |       |       |              |       |
| Dimensions                             | <table> <tr> <td>Height</td> <td>2,685mm</td> </tr> <tr> <td>Width</td> <td>210mm</td> </tr> <tr> <td>(incl. base)</td> <td>795mm</td> </tr> <tr> <td>Depth</td> <td>212mm</td> </tr> <tr> <td>(incl. base)</td> <td>510mm</td> </tr> </table> | Height | 2,685mm | Width | 210mm | (incl. base) | 795mm | Depth | 212mm | (incl. base) | 510mm |
| Height                                 | 2,685mm  |        |         |       |       |              |       |       |       |              |       |
| Width                                  | 210mm  |        |         |       |       |              |       |       |       |              |       |
| (incl. base)                           | 795mm  |        |         |       |       |              |       |       |       |              |       |
| Depth                                  | 212mm  |        |         |       |       |              |       |       |       |              |       |
| (incl. base)                           | 510mm  |        |         |       |       |              |       |       |       |              |       |
| Weight                                 | 25kg (excl. base)  |        |         |       |       |              |       |       |       |              |       |
| Power                                  | 175 watts  |        |         |       |       |              |       |       |       |              |       |
| How to Order                           | 881 Thermocouple Homogeneity Scanner   |        |         |       |       |              |       |       |       |              |       |



Shown with optional base

<http://www.isotech.co.uk>

The scanner can be used to determine:

- The uncertainty due to inhomogeneity
- The location of damaged regions that should be avoided
- Whether an annealing procedure has been successful
- If wire/cable manufacturing processes meet quality standards or tolerances
- Whether a thermocouple is damaged or faulty and unfit for use or calibration

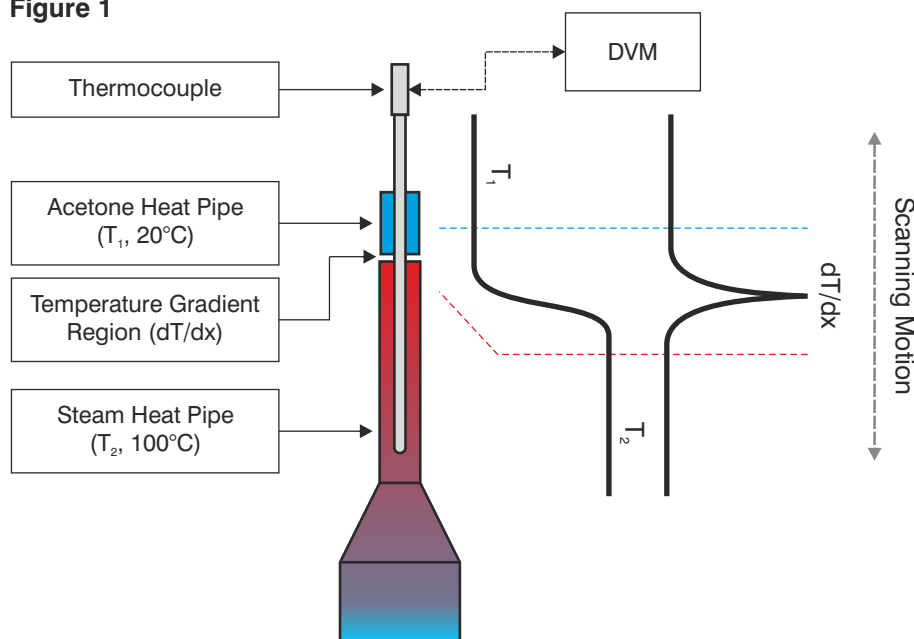
## Homogeneity Scanner Basics

A homogeneity scanner is a device used to interrogate the Seebeck coefficient of thermocouples. The Model 881 uses a single narrow temperature gradient. By moving the test thermocouple through this gradient, only the region exposed to the temperature gradient will generate an emf as demonstrated in Figure 1. Any deviations in this emf from the reference function will indicate the presence of an inhomogeneity. Clearly, the width of the temperature gradient will determine the scanners resolving potential and its ability to detect inhomogeneities. The Model 881 has a scanning resolution of 2 - 5mm depending on the diameter of the thermocouple.

This high resolution is achieved by using two closely spaced heat pipes operating at different temperatures, T1 and T2. The bottom, high-temperature heat pipe uses steam whereas the top low-temperature heat pipe uses acetone. The speed of the scanning operation is chosen to match the speed of thermal conduction occurring within the thermocouple, allowing effective scanning of both ceramic sheathed and metal sheathed thermocouples.

A benefit of using steam is that it is non-contaminating. Therefore, the thermocouple can be in direct contact with the heating medium allowing the thermocouple temperature to be rapidly raised to that of the steam temperature. Consequently, thermocouples can be scanned at far higher speeds than traditional oil-bath based scanners. Oil-bath scanners will often employ a re-entrant tube, used to prevent contamination, but which inherently limits heat transfer.

**Figure 1**



## Development of the Model 881

The device was developed at the Measurement Standards Laboratory of New Zealand and the manufacture and commercial sale has been licensed to Isothermal Technology Ltd, UK (Isotech). The scanner has been in development for more than 10 years and is based on world leading research [1].

Compared to previous work, this design offers faster operation and higher resolution from a single gradient scan. In this new version the hardware, electronics and software have been optimised and integrated to create an easy-to-use high-accuracy thermocouple scanner that is suitable for measuring inhomogeneities in both base and rare metal thermocouples.

### Benefit from the Scanner

As well as the rapid and accurate scanning system, the user benefits from the unique software that takes the results and processes the data into information that the user needs to assess the acceptability of the thermocouple being investigated. The software also makes it easy for the user to calculate an uncertainty component due to inhomogeneity when calibrating thermocouples.

### Digital Volt Meter

The 881 Thermocouple Homogeneity Scanner requires the use of a DVM (Digital Volt Meter) which is not supplied as standard. Isotech recommends the Keithley 2182A Nanovoltmeter.

### Mounting the Scanner

The scanner is not self-supporting and it is essential that the scanner is attached to a wall or an appropriate stand in order to support it and prevent it from toppling over.

We recommend wall mounting, If this is not convenient there is an optional support base available.

