

Fluid Baths vs. Dry Block Calibrators

Engineer's Notebook

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Which one is better for industrial temperature calibration?

Both fluid baths and dry block calibrators can be used for industrial temperature calibration successfully. Each one has advantages to consider for calibrating industrial RTDs and thermocouples. When choosing, there are three aspects of the heat source to consider:

- 1. Temperature Range
- 2. Performance (i.e. stability and uniformity)
- 3. Throughput

Temperature Range

A heated calibration bath is limited in its upper range primarily by the medium, or fluid used. Most silicone oils top out at around 300°C due to their flash point. The flash point is the lowest temperature at which fluid vapor would ignite if a spark were introduced. In a refrigerated system that is designed for maximum stability, the refrigeration gases have temperature limits that are restrictive at the upper end as well.

A dry block, on the other hand, does not have these constraints on the hot end. Typical metals used in dry blocks can withstand temperatures of 1200°C (2200°F). Cooling is performed by use of thermoelectric cooling technology and generally has limits around -40°C, whereas refrigerated systems can maintain a tank of fluid down to -100°C.

Performance

A stirred bath is more uniform throughout its temperature controlled well. Fluid is being vigorously mixed and agitated creating ideal calibration conditions. A dry block, however, is plagued by uniformity limitations that, if not considered, can introduce temperature gradients and inaccuracies. A dry block will not be as uniform as a bath when comparisons are made between drilled holes in the temperature block and variations in immersion depth are introduced.

Most calibration baths feature a large volume of working area and are slow to heat and cool. Heating and cooling are most often introduced slowly into these systems in order to maintain ultra high stability, which creates a trade-off between speed to temperature and a more stable temperature profile when at set-point. A block is more susceptible to ambient variations. The smaller volume of metal changes rapidly and is therefore less stable.

Throughput

For high-volume calibration work, a bath is clearly the better approach. With a larger working volume and more flexibility, a calibration bath will get more probes calibrated in the same amount of time. A dry block is limited by the number of bores in the metal and the limited number of probes that will fit side by side.

Another limitation of dry blocks is probe fit. In order to calibrate accurately, the probe sheath must be snug against the well. In a bath surrounded by fluid, contact errors are eliminated.

| Specification | Bath (24510T) | Block (22462T) | Micro-Bath (23059T) |
|--------------------------|-------------------|------------------|---------------------|
| Temperature Range | 35°C to 300°C | 50°C to 650°C | 35°C to 200°C |
| Stability | ±0.005°C at 100°C | ±0.05°C at 100°C | ±0.02 at 100°C |
| Uniformity | ±0.007°C | ±0.1°C | ±0.02°C |
| Throughput (1/2" probes) | 12-20 | 6 | 6-10 |
| Heating Time to Max | 250 minutes | 12 minutes | 40 minutes |

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