



Temperature Indicating Device – Design and Selection

Jim Eldridge

Product Development Manager

jeldridge@palmerwahl.com

*The World's Finest Manufacturers of
Temperature, Pressure & Humidity,
Test and Calibration Instruments*

Electronic TID's

Electronic TID's are much more complex than the current MIG's being used, thus they require greater attention to detail when selecting.



Block analogy of MIG and Electronic RTD TID

Sensing

MIG
Bulb

Conditioning

MIG
Tube

User Interface

Scale

Sensing
Probe

Cond. Elec,
A/D, & μ

μ -Controller &
Display

Key Specifications

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- Ambient Temperature Coefficient - the relative change of an instrument's displayed value when the instrument's ambient temperature is changed by a specified temperature.

Key Specifications

Ambient temperature coefficient example:

- specified ambient TempCo = $.02^{\circ}/^{\circ} \text{C}$,
- calibrated at 23°C (73.4F)
- operated at 38°C (100.4°F)
= $(38-23) * .02 = .3^{\circ} \text{C}$ ($.54^{\circ}\text{F}$) possible error

Potential Sources of Error

- Probe and wiring
- Electronics
- Environmental
- Calibration

Probe and wiring

Probe sensing element accuracies

Type K Thermocouple Accuracy (ASTM E230)

Standard limits of error	greater of $\pm 2.2^{\circ}\text{C}$ (3.96°F) or $\pm 0.75\%$
Special limits of error	greater of $\pm 1.1^{\circ}\text{C}$ (1.98°F) or $\pm 0.4\%$

100 ohm Thin-film platinum RTD accuracy (IEC/DIN 60751)

Temp	Class A	Class B	1/3 Class B
@ 0°C (32°F)	$\pm .15^{\circ}\text{C}$ ($.27^{\circ}\text{F}$)	$\pm .30^{\circ}\text{C}$ ($.54^{\circ}\text{F}$)	$\pm .10^{\circ}\text{C}$ ($.18^{\circ}\text{F}$)
@ 100°C (212°F)	$\pm .35^{\circ}\text{C}$ ($.63^{\circ}\text{F}$)	$\pm .80^{\circ}\text{C}$ (1.4°F)	$\pm .26^{\circ}\text{C}$ ($.48^{\circ}\text{F}$)
@ 121°C (249.8°F)	$\pm .39^{\circ}\text{C}$ ($.71^{\circ}\text{F}$)	$\pm .90^{\circ}\text{C}$ (1.6°F)	$\pm .30^{\circ}\text{C}$ ($.54^{\circ}\text{F}$)

Probe and wiring - Solution

Methods for overcoming sensor/probe error:

- Calibration – perform complete system calibration. Meter must be calibrated with probe.
- Programmable Coefficients – enter predetermined coefficients (could be done automatically from probe)

Probe and wiring

Sensor Drift Error - Drift that occurs between calibration cycles will introduce unknown errors into the system.

Probe and wiring - Solution

Methods for overcoming Sensor Drift error:

- Use low drift RTD's. 5-year drift specification on thin-film platinum RTD's is 0.04% when exposed to 200C continuous. (250°F error would = 0.18°F max over 5 years)

Probe and wiring - Solution

Methods for overcoming Sensor Drift error:

- Use low drift RTD's. 5-year drift specification on thin-film platinum RTD's is 0.04% when exposed to 200C continuous. (250°F error would = 0.18°F max over 5 years)
- Use multiple sensors. Compare readings and insure they track within specified limit, reporting any errors to the operator.

Probe and wiring - Solution

Mis-wired, broken wires, shorted or open wire.

- Unit should test wiring at frequent intervals and alert operator of any errors.
- Look for robust connector system.

Electronics

Errors in readings may occur due to electronic component failures or drift.

Electronics - Solution

Method for overcoming electronic component errors:

- Self-diagnostic electronics using internal, high-precision source to alert operator of any circuit errors or drift.

Electronics - Solution

Method for overcoming electronic component errors:

- Self-diagnostic electronics using internal, high-precision source to alert operator of any circuit errors or drift.
- Use redundant systems - Compare readings and insure they track within specified limit, reporting any errors to the operator.

Electronics

Thermocouple thermometer – Cold junction compensation

- If using t/c thermometer, make certain to add the manufacturers published uncertainty for cold junction compensation if specified separately.

Environmental

Ambient Temperature effects

- Unit should use low ppm components
- CHECK specifications!
- Mount electronics module in environmentally controlled area

Environmental

- Moisture and Contamination – Use NEMA 4 enclosures and IP65 rated connectors.
- EMI – Unit should meet CE requirements.

Calibration

Improper calibration methods can be a major source of error

Calibration - Solution

To minimize calibration errors:

- Stable bath - $>0.05^{\circ}\text{C}$ stability
- Standard instrument test accuracy ratio of 4:1 or better
- Probe immersion of 5 to 10 times the probe diameter
- Stable calibration environment

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Questions?

Thank You!

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