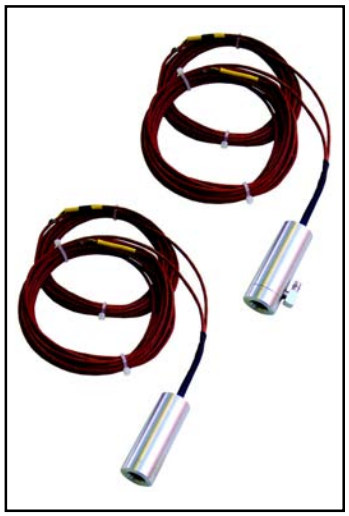
apogee instruments inc.



SENSOR DE TERMOPAR DE PRECISION POR INFRAROJO

Modelo IRTS-P: Dual thermcouple output; 3:1 FOV

Modelo IRTS-P3: Same as above, but with the addition of an air purge

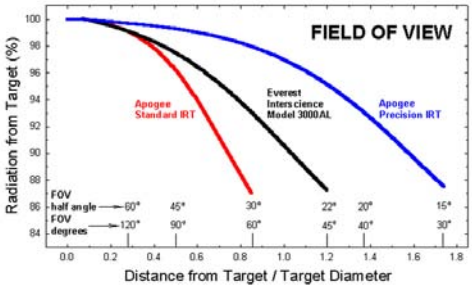
Measurement of surface temperature is a crucial component of energy transfer. Accurate measurement of the leaf-to-air temperature gradient is essential to the determination of transpiration rate and stomatal conductance in both single leaves and plant canopies. This gradient is often less than 3 oC, which means that leaf temperature should be measured to within 0.3 oC. To achieve this accuracy, the Apogee Instruments precision IRTs use two, type-K thermocouple outputs. The primary thermocouple is used to measure the target temperature; the secondary thermocouple is used to measure the sensor body temperature. Errors caused by changes in the sensor body temperature are corrected in software with a 12-step subroutine originally designed for Campbell Scientific dataloggers.

In August 2004, we introduced three levels of accuracy for Model IRTS-P and IRTS-P3. Generic coefficients are developed by averaging data from many sensors (accuracy = ± 0.50 °C). Batch coefficients are based on a subset of sensors and are applicable only to the sensors in that group (± 0.24 °C). Custom coefficients are optimized for each individual sensor (± 0.12 °C). See the graphs below to view the uncorrected IRT error and the comparison of generic, batch, and custom coefficients. With the further development of our calibrator, we were able once again to extend the calibrated range of these models to -10 to 55 °C.

Model IRTS-P / IRTS-P3 = ± 0.50 °C:
Model IRTS-Pb / IRTS-P3b = ± 0.24 °C:
Model IRTS-Pc / IRTS-P3c = ± 0.15 °C:

Calibration procedures and performance details are described in:
Evaluation and Modification of Commercial Infra-Red Transducers for Leaf Temperature Measurement.

FIELD OF VIEW For some applications, a narrow field of view (FOV) is important (smokestack temperatures), but a wider FOV has a better signal-to-noise ratio and more appropriately averages the leaf temperature of plant canopies when the sensor is mounted on a weather station. The FOV of infrared sensors is typically specified by other manufacturers as the half angle, but all sensors are center-weighted and there



SPECIFICATIONS

POWER REQUIREMENTS:
None; self-powered

OPERATING ENVIRONMENT:
designed for continuous outdoor use

ACCURACY:
Model IRTS-P / IRTS-P3: ± 0.50 °C
Model IRTS-Pb / IRTS-P3b: ± 0.24 °C
Model IRTS-Pc / IRTS-P3c: ± 0.15 °C

REPEATABILITY:
0.05 °C from 15 to 35 °C

RESPONSE TIME:
Less than 1 second

OUTPUT SIGNAL:
2, type-K thermocouple wires

OPTICS:
Silicon lens

WAVELENGTH RANGE:
6.5 to 14 microns

DIMENSIONS:
6 cm long by 2.3 cm diameter

MASS:
Less than 100 g

:

is not a sharp cut-off at the edges.

For 90% of the signal, the FOV is 1.6 to 1, or 39° full angle, or 17° half angle.
For 98% of the signal, the FOV is 1 to 1, or 52° full angle, or 26° half angle.

EXAMPLE DATA The graphs below show the difference in corrected and uncorrected data over a range of sensor body temperatures.