

## Use of the Thermogage Circular Foil Heat Flux Gage

When used properly, the Vatell Corporation Thermogage Circular Foil Heat Flux Gage will provide excellent heat flux measurement for a wide variety of applications. This document explains the use of the Thermogage products and important factors to consider while making measurements.

### *Operating Principles:*

The transducer is a differential thermocouple that measures the temperature difference between the center and the circumference of a thin circular foil disk. The disk is bonded to a circular opening in a cylindrical heat sink. The foil is made of Constantan and the heat sink is copper. These materials produce an output which is directly proportional to heat flux. The Thermogage products measure radiation and convective heat flux. The 9000 series radiometers only measure radiative heat transfer.

High convective heat transfers can skew measurements with a circular foil gage. If your application includes larger components of convective heat transfer your measurements may be shifted.

### *Installation:*

Mounting conditions for water-cooled Thermogage products are not as critical as conduction-cooled Thermogage units. The water removes the absorbed heat continuously, providing a good heat sink. Conduction-cooled units should be mounted so that the sensor is in good thermal contact with its surroundings. The heat sinking of the conduction-cooled unit should allow for heat to be removed from the unit for the duration of the test.

The normal 1000 and 2000 series Thermogage products have a 180° view. It is important to align the sensors so that the view of the sensor is appropriate for the measurements you intend to take. The 9000 series radiometers have a limited view angle. The 9000 series sensors should also be aligned so that the geometry of the view is appropriate for the measurements you wish to make.

### *Taking Measurements:*

When the Thermogage transducer is exposed to heat flux, a voltage will be produced that is proportional to heat flux. Each unit is calibrated by Vatell and the appropriate information is included with the sensor. You will record the voltage output from the transducer and convert them to their respective heat flux using the calibration information. All Vatell calibrations are performed with radiative heat sources because they are the most consistently repeatable. The transducers are calibrated for incident heat flux. So, for your measurement the incident heat flux is the output voltage divided by the sensitivity of the unit. This assumes radiative heat transfer. For convection you must factor in the emissivity.

There are 3 wires associated with standard Thermogage products. The red wire is (+) heat flux, the black is (-) heat flux and the silver wire is the ground. The ground wire is floating.

A range is specified when the Thermogage product is purchased. The top of the range is set for a 10 mV full scale output. Units may be over driven to 15 mV without damage or loss of calibration. Overdriving the units to 20 mV will damage the gage.

*Face Coating:*

Typically Thermogage products are coated with a high temperature black paint which has an emissivity of 0.94 and a fairly flat spectral response. Colloidal graphite is also commonly used for higher heat flux levels. Other coatings are available and include black velvet, and soot. The calibrated sensitivity of your transducer is dependent on the emissivity of the face of the sensor. Depositing material or removing coating can change the emissivity of the face of your sensor, changing the calibrated sensitivity. It is important to try to maintain the original coating on the face of the sensor as much as possible. You should regularly inspect the face of your sensor for physical damage or build up of material.

*Recalibration:*

Vatell Corporation recommends recalibrating your sensor at least once a year. More frequent calibrations are recommended for applications in which the sensor is placed directly in a flame or those applications which are known to deposit onto or remove material from the face of the sensor.

*Troubleshooting:*

If you are having problems with your sensor, you should check the resistance of the instrument. The resistance should typically not be above 5 ohms for sensors with the standard 2 meter leads. The face of the sensor should also be inspected. Any changes to the original coating that can be visually noted can effect the sensitivity.

*Water-cooled 1000 Series*

When using the 1000 water-cooled series it is important to use clean water. Deionized water is not necessary. The water itself does not need to be chilled, room temperature water is appropriate. Chilled water may cause condensation on the face of the sensor which will change the sensitivity of the product and alter your measurements.