



#### Uses:

- Measures Operative Temperature
- Provides input for thermal comfort evaluations

#### Features:

- Complies with ISO7726
- Same ratio between heat loss via convection and radiation as the human body
- Same angle factor to its surroundings as the human body
- Absorbs the same proportion of long- and short- wave radiation as the human body
- Handy size

## Introduction

The Operative Temperature Transducer enables you to evaluate the effect that objects/surfaces of varying temperatures have on the body.

Normally, the amount of heat given off by a human body through radiation is approximately the same as the amount of heat given off by convection. Therefore, a simple air temperature measurement is a bad indication of the thermal environment. Operative temperature takes both radiation and convection into account and is therefore a much better indicator. Many of the standards used today recommend measuring the operative temperature.

Operative temperature ( $^{\circ}\text{C}$ ) is defined as the uniform temperature of a radiantly black enclosure in which an occupant would exchange the same amount of heat by radiation and convection as in an actual non-uniform environment.

The transducer is designed for use with INNOVA instruments: 1221, 1303 and 1309.

## Transducer Design

Four major factors were taken into consideration during the design of this transducer:

### Size

The size has been chosen so that the ratio between heat loss by radiation and by convection is similar to that of the human body.

The human body has an effective radiation area of only 0.7 times its surface area (due the insides of the arms and legs radiating against the body). If the transducer had the same surface area as the human body, its simple shape would lose 1.4 times more heat by radiation than a human body.

However, the convection heat loss per unit surface area increases as the size of an object is reduced. By reducing the size of the transducer, the mean radiant temperature and air temperature have the same weighted influence on the transducer as on a person.

### Shape

The shape of the transducer is determined by the need to obtain the same angle factor to the individual room enclosures as for a human being. This has been achieved by using an ellipsoid shape.

### Color

The transducer's Color and emission coefficient have been chosen so that the long-wave radiation absorbed by the transducer is the same as that of both a naked and a dressed person. It is not possible to simulate people in both dark and light colored clothing for short-wave radiation. The grey Color chosen simulates both naked people and people dressed in light colored clothing.

### Orientation

People do not maintain the same posture. For this reason, the transducer has three settings: vertical,  $30^{\circ}$  from the vertical, and horizontal, which represent the body in the standing, sitting and lying positions respectively.

# Operative Temperature Transducer – INNOVA MM0060

## Cable Connections

The integral cable supplied with the transducer is fitted with a standard 4-pin DIN plug. When the transducer is used with an Thermal Comfort Data Logger, it is normally plugged into the Temperature socket, but it can in fact be used in any socket designed to receive temperature information. Electrically, the transducer is equivalent to a Pt100 resistor in a four-wire configuration.

This means that extension cables can be used without a loss of accuracy.

## Evaluation of Thermal Comfort

The temperature value from this transducer ( $t_o$ ) enables you to evaluate the thermal comfort and calculate PMV values according to ISO7730. PMV values are calculated using humidity, air velocity, Clo. and Met. rates without having to measure the mean radiant tempera-

ture ( $\bar{t}_r$ ) (which is often a difficult parameter to obtain).

## Evaluation of Heat Loss

When you evaluate the energy consumption of a building, you must measure the temperature difference between the indoor and outdoor environments. The operative temperature is commonly used to provide the indoor temperature.

## SPECIFICATIONS:

### Measurement Range and Accuracy:

5 to 40°C range  $\pm 0.3^\circ\text{C}$   
(41 to 104°F range  $\pm 0.5^\circ\text{F}$ )  
-20 to 50°C range  $\pm 0.5^\circ\text{C}$   
(-4 to 122°F range  $\pm 0.9^\circ\text{F}$ )

### Electrical Output:

A Pt100 signal in a 4-wire connection

### Response Time:

1 min. to 50% of step change, 10min. to 90% in still air

### Integral Connection Cable:

Length 3m; connected to associated equipment via a 4-pin DIN plug

### WEIGHT:

230g (8oz.)

### DIMENSIONS:

**Length:** 160mm (6.3in) excluding handle  
**Diameter:** 54mm (2.1in)



### COMPLIANCE WITH STANDARDS

CE-mark indicates compliance with EMC Directive and Low Voltage Directive.

#### Safety

EN 61010-1 (1993) & IEC 1010-1 (1990): Safety requirements for electrical equipment for measurement, control and laboratory use.

#### EMC Emission

EN 50081-1 (1992) : Generic emission standard. Part 1: Residential, commercial and light industry.  
EN 50081-2 (1993): Generic emission standard. Part 2: Industrial environment.  
CISPR 22 (1993): Limits and methods of radio disturbance characteristics of information technology equipment. Class B Limits.  
FCC Class B limits.

#### EMC Immunity

EN 50082-1 (1992): Generic immunity standard. Part 1: Residential, commercial and light industry.  
EN 50082-2 (1995): Generic immunity standard. Part 2: Industrial environment.  
**Note:** The above is guaranteed using accessories listed in this Product Data sheet only.

#### Temperature

IEC 68-2-1 & IEC 68-2-2: Environmental Testing. Cold and Dry Heat.  
Operating Temperature: -20 to +50°C (-4 to 122°F)  
Storage Temperature: -25 to +70°C (-13 to 158°F)

#### Humidity

IEC 68-2-3: 90% RH (non-condensing at 40°C).

#### Mechanical

IEC 68-2-6: Vibration: 0.3 mm, 20m/s<sup>2</sup>, 10-500 Hz.  
IEC 68-2-27: Shock: 1000 m/s<sup>2</sup>.  
IEC 68-2-29: Bump: 1000 bumps at 250m/s<sup>2</sup>.

## Ordering Information

MM0060 Operative Temperature Transducer

### Optional Accessories

1221 Thermal Comfort Data Logger  
1303 Multipoint Sampler and Doser  
1309 Multipoint Sampler  
DH0492 Tripod Mounting Adaptor for 3 Transducers  
UA1347 Tripod Mounting Adaptor for 4 Transducers

KE0357 Transducer Carrying Case  
UA0803 Tripod  
UA1348 Tripod Extension Rods (3)  
UA0588 Transducer Mounting Adaptor  
WL0690 Extension Cable  
WL0690/y Extension Cable (definable length up to 100m; y is length in meters)

LumaSense Technologies reserves the right to change specifications and accessories without notice.

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