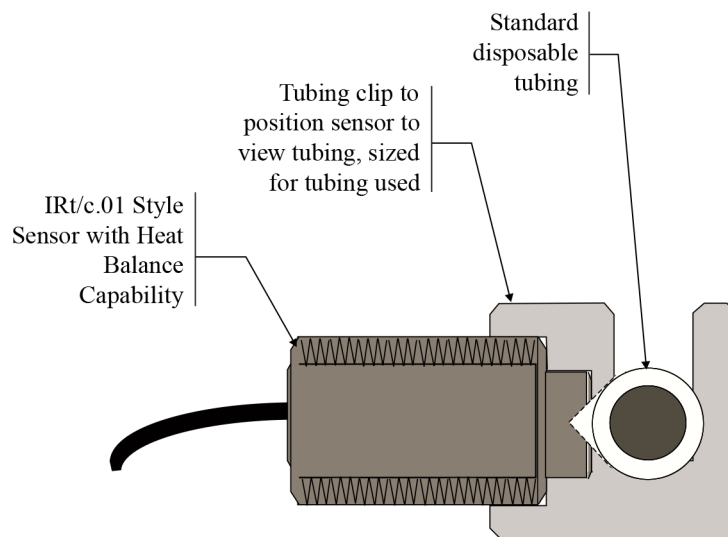
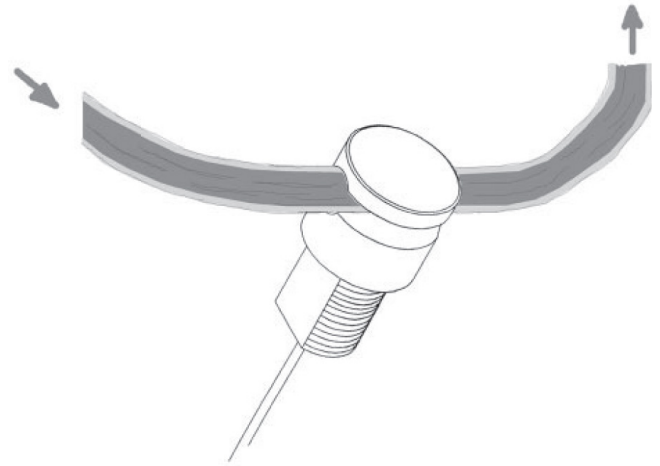


## IRT/CTM HEAT BALANCE SERIES FOR MEDICAL APPLICATIONS

The Heat Balance (HB) Series of IRt/c infrared thermocouples have the ability to measure the internal temperature of the target material, noninvasively, by employing a patented heat balance technique. A typical application in medical equipment is monitoring or controlling the temperature of fluid transported through disposable tubing when warming or cooling:

- Transfusion systems
- IV warming systems
- Dialysis systems
- Cardio-pulmonary bypass systems
- ECMO systems
- Blood analyzers



The IRt/c.01HB model pictured, actually measures the internal fluid temperature by measuring both tubing surface and ambient temperatures then calculating the internal temperature necessary to maintain the heat balance. A convenient clip head provides a reproducible mounting location for the sensor and can be quickly attached to new tubing and removed from used tubing.

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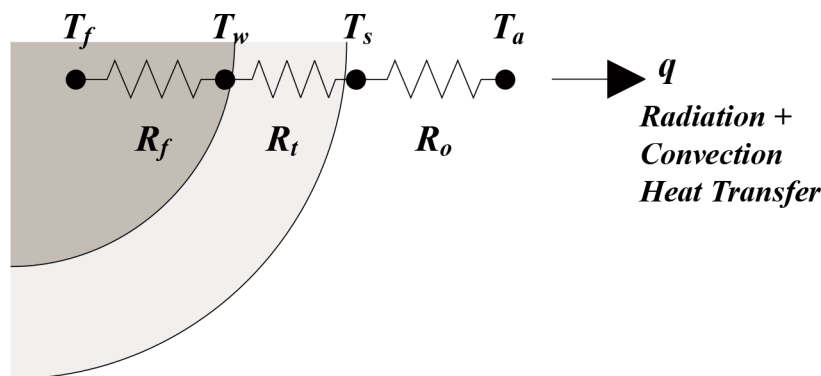
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## IRT/CTM HEAT BALANCE SERIES FOR MEDICAL APPLICATIONS

### Principles of Operation

Fluid at temperature  $T_f$  flowing in tubing transfers heat via convection through thermal resistance  $R_f$  to the tubing inside surface, which in turn conducts heat to the tubing external surface through thermal resistance  $R_t$ , which then transfers to the environment via radiation and convection thermal resistance  $R_o$ . The temperatures of the wetted surface of the tubing, outside surface of the tubing, and the local ambient are given by  $T_w$ ,  $T_s$ , and  $T_a$ , respectively.



Employing the method of thermal analysis with electrical analogs: current = heat flow, and voltage = temperature, the heat transfer equation may be written as follows:

$$q = \frac{1}{R_f + R_t + R_o} (T_f - T_a)$$

and via heat balance:

$$= \frac{1}{R_o} (T_s - T_a)$$

Accordingly,

$$T_f = \frac{R_f + R_t + R_o}{R_o} (T_s - T_a) + T_a$$

The IRT/c-HB Series measures both  $T_s$  and  $T_a$ , and solves this equation automatically for fluid temperature  $T_f$ , providing a highly accurate method of monitoring or controlling the temperature of interest.

The configuration shown above is the model IRT/c.01HB-J-37C with its convenient tubing clip. Any of the IRT/c models can be configured for the HB calculation. Contact the factory for further details.

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