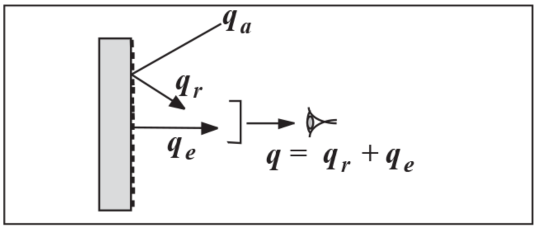
ADJUSTABLE MODELS COMPENSATE FOR REFLECTIVE ERRORS

For high precision temperature control in applications where the ambient temperature varies, reflective effects may cause unacceptable errors under some operating conditions. For example, an incubator is designed to warm a baby by measuring the child's skin temperature, and modulate the ambient temperature inside the incubator to maintain the skin within the desired range. Even though skin has a high emissivity (> 0.9), there is potentially an error of ±1°F (0.6°C) caused by changes in the reflective component of the radiation as the ambient is modulated ±10°F.



The basic principles can be understood by considering the radiation leaving a surface, as measured by any detector (including an eye). The total radiation *q* is made up of the reflected and emitted radiation components as follows:

$$q_a = \text{ambient radiation} = \sigma(T_a)^4$$
$$q_r = \text{reflected radiation} = \rho q_a$$
$$q_e = \text{emitted radiation} = \varepsilon\sigma(T_s)^4$$

where r is reflectivity, ε is emissivity, σ is the *Stefan-Boltzman* constant, and T_a and T_s are absolute ambient and surface temperature respectively.

Since emissivity plus reflectivity is always unity for non-transparent surfaces, the total radiated energy can be written as:

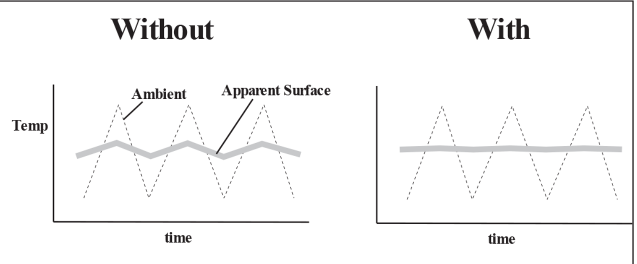
$$q = q_r + q_e = (1-\varepsilon)\sigma(T_a)^4 + \varepsilon\sigma(T_s)^4$$

This expression can be further simplified into a linear approximation that applies to the ambient temperatures over which the IRt/c can operate uncooled:

$$T = (1-\varepsilon)T_a + \varepsilon T_s$$

where *T* is the apparent surface temperature measured by radiation. As indicated by the final result, if the emissivity is 1.0, the effect of ambient temperature is zero. If the emissivity is 0.9, the effect of ambient temperature is 10%, etc. (As an aside, this expression can be used to obtain the actual emissivity.)

Non-adjustable IRt/c's are designed and calibrated to automatically compensate for this effect when the emissivity is 0.9, a good general assumption for most non-metallic materials, and sufficient for good accuracy under most conditions. With the adjustable models, however, when the IRt/c is calibrated in place it automatically compensates for the reflective errors as indicated in the above equation for any emissivity within its normal operating range. This patented automatic ambient compensation feature significantly improves the IRt/c control accuracy under real world conditions of varying ambient temperatures.



Effect of IRt/c Automatic Ambient Compensation

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