



Standard Practice for In-Situ Measurement of Heat Flux and Temperature on Building Envelope Components¹

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1. Scope

1.1 This practice covers a technique for using heat flux transducers (HFTs) and temperature transducers (TTs) in measurements of the in-situ dynamic or steady-state thermal behavior of opaque components of building envelopes. The applications for such data include determination of thermal resistances or of thermal time constants. However, such uses are beyond the scope of this practice (for information on determining thermal resistances, see Practice C1155).

1.2 Use infrared thermography with this technique to locate appropriate sites for HFTs and TTs (hereafter called sensors), unless subsurface conditions are known.

1.3 The values stated in SI units are to be regarded as the standard. The values given in parentheses are for information only.

1.4 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 ASTM Standards:²

C168 Terminology Relating to Thermal Insulation

C518 Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus

C1060 Practice for Thermographic Inspection of Insulation Installations in Envelope Cavities of Frame Buildings

C1130 Practice for Calibrating Thin Heat Flux Transducers

¹ This practice is under the jurisdiction of ASTM Committee C16 on Thermal Insulation and is the direct responsibility of Subcommittee C16.30 on Thermal Measurement.

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² For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

C1153 Practice for Location of Wet Insulation in Roofing Systems Using Infrared Imaging

C1155 Practice for Determining Thermal Resistance of Building Envelope Components from the In-Situ Data

3. Terminology

3.1 *Definitions*—For definition of terms relating to thermal insulating materials, see Terminology C168.

3.2 Definitions of Terms Specific to This Standard:

3.2.1 *building envelope component*—a portion of the building envelope, such as a wall, roof, floor, window, or door, that has consistent construction.

3.2.1.1 *Discussion*—For example, an exterior stud wall would be a building envelope component, whereas a layer thereof would not be.

3.2.2 *thermal time constant*—the time necessary for a step change in temperature on one side of an item (for example, an HFT or building component) to cause the corresponding change in heat flux on the other side to reach 63.2 % of its new equilibrium value where one-dimensional heat flow occurs. It is a function of the thickness, placement, and thermal diffusivity (see Appendix X1) of each constituent layer of the item.

3.2.2.1 Discussion—

$$t = \tau \text{ when } q(t) = q_1 + (q_2 - q_1)(1 - e^{-t/\tau})$$

where:

q_1 = is the previous equilibrium heat flux, and

q_2 = is the new heat flux after the step change.

3.3 Symbols Applied to the Terms Used in This Standard:

E = measured voltage from the HFT, typically in mV,

q = heat flux, W/m^2 ($\text{Btu/h}\cdot\text{ft}^2$),

S = heat-flux transducer conversion factor that relates the output of the HFT, E , to q through the HFT for the conditions of the test, $\text{W/m}^2\cdot\text{V}$ ($\text{Btu/h}\cdot\text{ft}^2\cdot\text{mV}$). This may be a function of temperature, heat flux, and other factors in the environment as discussed in Section 7. This may also be expressed as $S(T)$ to connote a function of temperature,

T = temperature, K ($^{\circ}\text{C}$, $^{\circ}\text{R}$, or $^{\circ}\text{F}$),