



Standard Practice for In-Situ Measurements of Heat Flux in Industrial Thermal Insulation Using Heat Flux Transducers¹

This standard is issued under the fixed designation C 1041; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ϵ) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This practice covers the in-situ measurement of heat flux through industrial thermal insulation using a heat flux transducer (HFT).

1.2 This practice estimates the thermal transport properties of thermal insulation materials in-situ in field applications under pseudo steady-state conditions. It is not intended that this practice should be used as a substitute for more precise laboratory procedures such as Test Methods C 177, C 335, or C 518.

1.3 This practice is limited by the relatively small area that can be covered by an HFT and by the transient effects of environmental conditions.

1.4 Temperature limitations shall be as specified by the manufacturer of the HFT.

1.5 While accurate values of heat flux are highly dependent upon proper calibrations under the conditions of use, manufacturer's calibrations may be used with confidence for comparative work between similar materials, aging, or other conditions of use.

NOTE 1—Further information may be found in the literature (1-6).²

1.6 *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:

C 168 Terminology Relating to Thermal Insulation³

C 177 Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus³

C 335 Test Method for Steady-State Heat Transfer Properties of Horizontal Pipe Insulation³

C 518 Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus³

E 220 Method for Calibration of Thermocouples by Comparison Techniques⁴

E 230 Temperature Electromotive Force (EMF) Tables for Standardized Thermocouples⁴

2.2 Other Standards:

ASHRAE Standard 101-1981; Application of Infrared Sensing Devices to the Assessment of Building Heat Loss Characteristics⁵

ISO/TC 163/SC 1WG N31E Thermal Insulation—Qualitative Detection of Thermal Irregularities in Building Envelopes—Infrared Method⁶

3. Terminology

3.1 Definitions:

3.1.1 *heat flux transducer (HFT)*—a rigid or flexible transducer in a durable housing comprised of a thermopile or equivalent for sensing the temperature drop across a thin thermal resistance layer which gives a voltage output proportional to the heat flux through the transducer.

3.1.1.1 *belt HFT*—a heat flux transducer having a belt-like configuration such that the unit can be wrapped helically around a section of pipe insulation (see Fig. 1).

3.1.1.2 *spot HFT*—a small heat flux transducer having a round, square, rectangular or other configuration for the sensitive area (see Fig. 1).

3.1.2 *pseudo steady state of HFT*—the criterion for pseudo steady-state condition is that the average HFT reading over two consecutive 5-min periods does not differ by more than 2 %. Since the time constant of an HFT is typically less than or of the order of 1 min, using a time interval of 5 min ensures that the transient effects in the HFT are averaged.

3.2 Symbols: Symbols:

3.2.1 Q —heat flow, W (Btu/h).

3.2.2 q —heat flux, W/m² (Btu/h·ft²).

3.2.3 C —overall conductance of the insulated section, W/m²·K (Btu/h·ft² · °F).

3.2.4 t_0 —process surface temperature, °C (°F).

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.

Current edition approved July 26, 1985. Published September 1985.

² The boldface numbers in parentheses refer to the list of references at the end of this standard.

³ *Annual Book of ASTM Standards*, Vol 04.06.

⁴ *Annual Book of ASTM Standards*, Vol 14.03.

⁵ Available from ASHRAE, Inc., 1791 Tullie Circle NE, Atlanta, GA 30329.

⁶ Available from International Standards Organization, 1 Rue de Varembe, Case Postale 56, CH-1211, Geneva 20, Switzerland.