



Designation: C 680 – 89 (Reapproved 2002)

Standard Practice for Determination of Heat Gain or Loss and the Surface Temperatures of Insulated Pipe and Equipment Systems by the Use of a Computer Program¹

This standard is issued under the fixed designation C 680; 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 The computer programs included in this practice provide a calculational procedure for predicting the heat loss or gain and surface temperatures of insulated pipe or equipment systems. This procedure is based upon an assumption of a uniform insulation system structure, that is, a straight run of pipe or flat wall section insulated with a uniform density insulation. Questions of applicability to real systems should be resolved by qualified personnel familiar with insulation systems design and analysis. In addition to applicability, calculational accuracy is also limited by the range and quality of the physical property data for the insulation materials and systems.

1.2 *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 Insulation²
- C 177 Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded Hot Plate Apparatus²
- C 335 Test Method for Steady-State Heat Transfer Properties of Horizontal Pipe Insulation²
- C 518 Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus²
- C 585 Practice for Inner and Outer Diameters of Rigid Thermal Insulation for Nominal Sizes of Pipe and Tubing (NPS System)²
- E 691 Practice for Conducting an Interlaboratory Study to Determine the Precision of a Test Method³

2.2 ANSI Standards:

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 Jan. 27, 1989. Published May 1989. Originally published as C 680 – 71. Last previous edition C 680 – 82 ϵ ¹.

² Annual Book of ASTM Standards, Vol 04.06.

³ Annual Book of ASTM Standards, Vol 14.02.

X3.5 Flow Chart Symbols and Their Usage in Information Processing⁴

X3.9 Standard for Fortran Programming Language⁴

3. Terminology

3.1 *Definitions*—For definitions of terms used in this practice, refer to Terminology C 168.

3.2 *Symbols: Symbols*—The following symbols are used in the development of the equations for this practice. Other symbols will be introduced and defined in the detailed description of the development.

where:

- h = surface coefficient, Btu/(h·ft²·°F) (W/(m²·K))
- k = thermal conductivity, Btu·in./(h·ft²·°F) (W/(m·K))
- k_a = constant equivalent thermal conductivity introduced by the Kirchhoff transformation, Btu·in./(h·ft²·°F) (W/(m·K))
- Q_t = total time rate of heat flow, Btu/h (W)
- Q_l = time rate of heat flow per unit length, Btu/h·ft (W/m)
- q = time rate of heat flow per unit area, Btu/(h·ft²) (W/m²)
- R = thermal resistance, (°F·h·ft²)/Btu (K·m²/W)
- r = radius, in. (m)
- t = local temperature, °F (K)
- t_i = temperature of inner surface of the insulation, °F (K)
- t_a = temperature of ambient fluid and surroundings, °F (K)
- x = distance in direction of heat flow (thickness), in. (m)

4. Summary of Practice

4.1 The procedures used in this practice are based upon standard steady-state heat transfer theory as outlined in textbooks and handbooks. The computer program combines the functions of data input, analysis, and data output into an easy-to-use, interactive computer program. By making the program interactive, little operator training is needed to perform fast, accurate calculations.

4.2 The operation of the computer program follows the

⁴ Available from American National Standards Institute (ANSI), 25 W. 43rd St., 4th Floor, New York, NY 10036.