Designation: E1423 – 21

Standard Practice for Determining Steady State Thermal Transmittance of Fenestration Systems[1]

This standard is issued under the fixed designation E1423; 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 standard test specimen sizes and test conditions as well as the calculation and presentation of the thermal transmittance and conductance data measured in accordance with Test Method C1199. The standard sizes and conditions are to be used for fenestration product comparison purposes. The specifier may choose other sizes and conditions for product development or research purposes.

1.2 This practice deals with the determination of the thermal properties of a fenestration system installed vertically without the influences of solar heat gain and air leakage effects.

NOTE 1—To determine air leakage effects of fenestration systems, Test Method E283/E283M or E1424 should be referenced.

NOTE 2—See Appendix X1 regarding garage doors and rolling doors.

1.3 This practice specifies the procedure for determining the standardized thermal transmittance of a fenestration test specimen using specified values of the room-side and weather-side surface heat transfer coefficients, h_h and h_c, respectively.

1.4 The values stated in SI units are to be regarded as standard. The values given in parentheses after SI units are provided for information only and are not considered standard.

1.5 *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, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

1.6 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Referenced Documents

2.1 *ASTM Standards:*[2]

C168 Terminology Relating to Thermal Insulation

C1199 Test Method for Measuring the Steady-State Thermal Transmittance of Fenestration Systems Using Hot Box Methods

C1363 Test Method for Thermal Performance of Building Materials and Envelope Assemblies by Means of a Hot Box Apparatus

E283/E283M Test Method for Determining Rate of Air Leakage Through Exterior Windows, Skylights, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen

E631 Terminology of Building Constructions

E783 Test Method for Field Measurement of Air Leakage Through Installed Exterior Windows and Doors

E1424 Test Method for Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure and Temperature Differences Across the Specimen

2.2 *Other Documents:*

ANSI/DASMA 105 Test Method for Thermal Transmittance and Air Infiltration of Garage Doors and Rolling Doors[3]

NFRC 102 Procedure for Measuring the Steady-State Thermal Transmittance of Fenestration Systems[4]

3. Terminology

3.1 *Definitions*—Definitions and terms are in accordance with Terminology E631 and C168, from which the following have been selected and modified to apply specifically to fenestration systems. See Fig. 1 and Fig. 2 for variable identification. (For further information on definitions and procedures, see Appendix X2 or Test Method C1199.)

[1] This practice is under the jurisdiction of ASTM Committee E06 on Performance of Buildings and is the direct responsibility of Subcommittee E06.51 on Performance of Windows, Doors, Skylights and Curtain Walls.

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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.

[3] Available from American National Standards Institute (ANSI), 25 W. 43rd St., 4th Floor, New York, NY 10036, http://www.ansi.org.

[4] Available from National Fenestration Rating Council (NFRC), 6305 Ivy Ln., Suite 140, Greenbelt, MD 20770, http://www.nfrc.org.

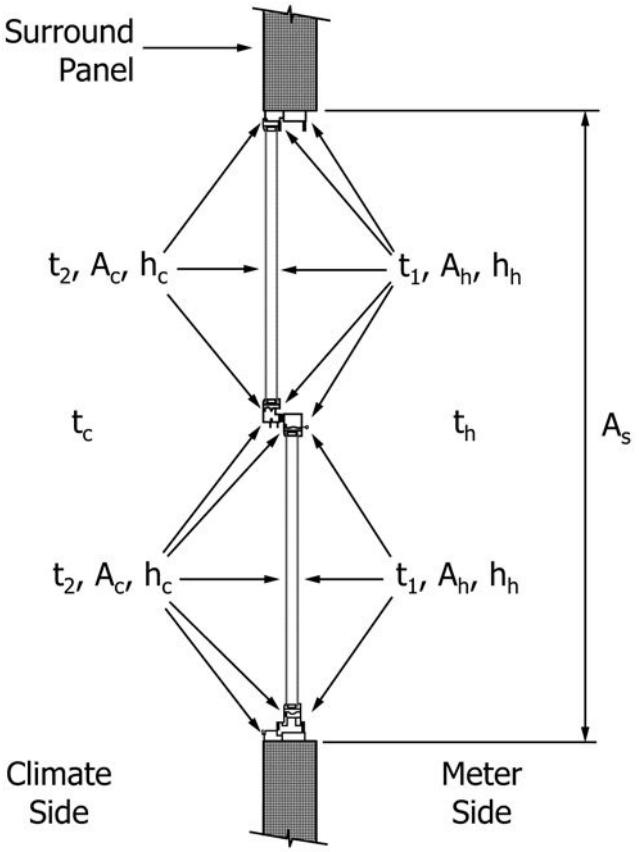

FIG. 1 Window Mounted Flush with Climate Side of Surround Panel

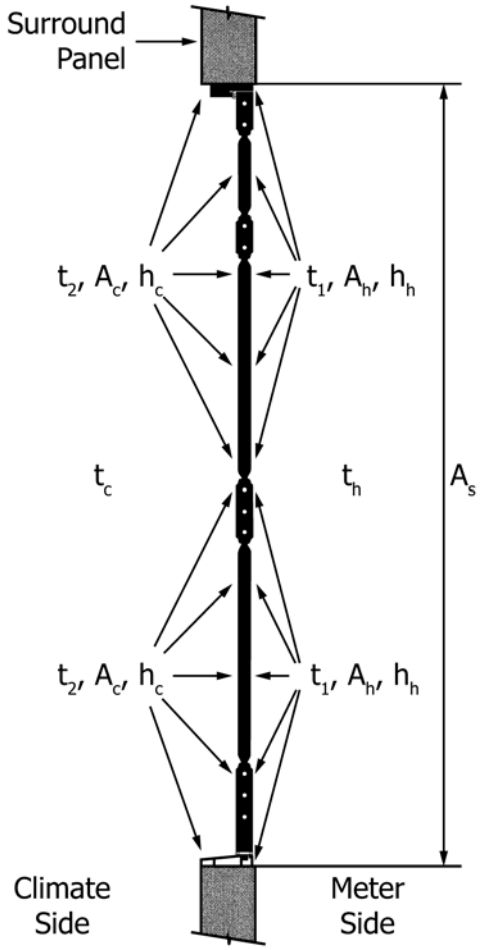

FIG. 2 Door Mounted Flush with Climate Side of Surround Panel

3.1.1 *surface heat transfer coefficient, h* (sometimes called *surface conductance* or *film coefficient)*—the time rate of heat flow from a unit area of a surface to its surroundings, induced by a unit temperature difference between the surface and the environment. Subscripts are used to differentiate between room-side ($_1$ or $_h$) and weather-side ($_2$ or $_c$) surface heat transfer coefficients (see Figs. 1 and 2).

3.1.2 *thermal transmittance* U_s (sometimes called *overall coefficient of heat transfer)*—the heat transfer in unit time through unit area of a test specimen and its boundary air films, induced by unit temperature difference between the environments on each side.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *standardized thermal transmittance,* U_{ST}—the heat transfer in unit time through unit area of a specimen (using standardized surface heat transfer coefficients) induced by unit temperature difference between the environments on each side. **C1199**

3.2.2 *surround panel* (sometimes called the *mask, mask wall,* or *homogeneous wall)*—a panel with a homogeneous core that may be faced with paint, plywood, or plastic in which the test specimen is mounted.

3.2.3 *test specimen*—the fenestration system or product being tested.

3.2.4 *thermal resistance,* R_S—the temperature difference between the environments on the two sides of a body or assembly when a unit heat flow per unit time per unit area is established through the body or assembly under steady-state conditions. It is defined as follows:

$$R_S = \frac{1}{U_S} \quad (1)$$

where:

R_S = overall thermal resistance of specimen (air to air under test conditions), $(m^2 \cdot K)/W$ $((ft^2 \cdot hr \cdot °F)/Btu)$.

3.3 *Symbols*—The symbols, terms, and units used in this test method are as follows:

A_c total heat transfer surface area of test specimen on weather side, m^2

A_h total heat transfer surface area of test specimen on room side, m^2

A_s projected area of test specimen, (same as open area in surround panel), m^2

h_c surface heat transfer coefficient, weather side, $W/(m^2 \cdot K)$

$h_h$surface heat transfer coefficient, room side, $W/(m^2 \cdot K)$

h_{h+c} surface heat transfer coefficient, combined room and weather side, $W/(m^2 \cdot K)$

h_{STc} standardized surface heat transfer coefficient, weather side, $W/(m^2 \cdot K)$

h_{STh} standardized surface heat transfer coefficient, room side, $W/(m^2 \cdot K)$

R_S overall thermal resistance of test specimen (air to air under test conditions), $(m^2 \cdot K)/W$

t_c average temperature of weather side air, °C

t_h average temperature of room side air, °C

t_1 average temperature of test specimen, room side surface, K or $°C$

t_2 average temperature of test specimen, weather side surface, K or $°C$

U_S thermal transmittance of test specimen (air to air under test conditions), $W/(m^2 \cdot K)$

U_{ST} standardized thermal transmittance of test specimen, $W/(m^2 \cdot K)$

4. Significance and Use

4.1 This practice details the test specimen sizes and test conditions, namely, the room-side and weather-side air temperatures, and the surface heat transfer coefficients for both sides of the test specimen, when testing fenestration products in accordance with Test Method C1199.

4.2 The thermal transmittance and conductance of a specimen are affected by its size and three-dimensional geometry. Tests should therefore be conducted using the specimen sizes recommended in 5.1. Should the specimen size differ from those given in 5.1, the actual size shall be reported in the test report.

4.3 Many factors can affect the thermal performance of a fenestration system, including deflections of sealed glazing units. Care should be exercised to maintain the original physical condition of the fenestration system and while installing it in the surround panel.

4.4 The thermal transmittance and conductance results obtained do not, and are not intended, to reflect performances expected from field installations since they do not account for solar radiation and air leakage effects. The thermal transmittance and conductance results are taken from specified laboratory conditions and are to be used only for fenestration product comparisons and as input to thermal performance analyses that also include solar and air leakage effects.

5. Test Specimen

5.1 *Specimen Sizes*—The specimen sizes given in Table 1 for different types of fenestration systems shall be used when testing fenestration products. For test specimens not manufactured at the exact sizes given in Table 1, choose the product with dimensions that produces the smallest value of deviation, D, calculated by Eq 2. For non-rectangular products, choose the product with an area closest to the area of the product in Table 1.

$$D = \sqrt{[(W_p - W_m)^2 + (H_p - H_m)^2]} \quad (2)$$

where:

D = deviation, mm (in.)
W_p, H_p = width and height of production size, mm (in.)
W_m, H_m = width and height of model size, mm (in.)

6. Test Conditions

6.1 *General*—A single set of test conditions does not necessarily define the thermal characteristics of a fenestration system. However, a single set of test conditions is specified to permit comparison of the thermal transmittance of different fenestration products. Thermal transmittance values obtained under this set of test conditions have been shown to be valid for the range of weather conditions typical of the North American climate [weather-side temperatures between 43 °C and −30 °C (110 °F and −22 °F) and wind speeds up to 6.7 m/s (15 mph)].

TABLE 1 Specimen Size Dimensions[A]

Window Type	Configuration	Test Specimen Model Size, mm. (in.)[B]
	I - Window Assemblies	
Vertical slider	XO or XX	1200 × 1500 (47 × 59)
Horizontal slider	XO or XX	1500 × 1200 (59 × 47)
Casement - Double	XX	1200 × 1550 (47 × 59)
Casement - Single	X	1200 × 1500 (47 × 59)
Projecting (Awning - Double)	XX	1500 × 1200 (59 × 47)
Projected (Awning - Single)	X	1500 × 600 (59 × 24)
Fixed (includes non-standard shapes)	O	1200 × 1500 (47 × 59)
Sloped Glazing	OO	2000 × 2000 (79 × 79)
Skylights/roof window	X	1200 × 1200 (47 × 47)
Greenhouse/Garden	X	1500 × 1200 (59 × 47)
Dual Action	X	1200 × 1500 (47 × 59)
Pivoted	X	1200 × 1500 (47 × 59)
Sidelites	X	600 × 1200 (24 × 79)
Transoms	X	1200 × 600 (79 × 24)
Basement	O	Rated at the appropriate product type
Bay or Bow		Rated at the appropriate product type
Composite - Fixed beside operable		1200 × 1500 (47 × 59)
Composite - Fixed over operable		1200 × 1500 (47 × 59)
Hinged Escape	X	1500 × 1200 (59 × 47)
Jal/Jal Awning	X	1200 × 1500 (47 × 59)
Tropical Awning	X	1500 × 1200 (59 × 47)
	II - Door Assemblies	
Swinging door(s) with frame	X, OX or XX	1000 × 2000 (39 × 82)[B] or 2000 × 2000 (79 × 79)[C]
Sliding Patio doors with frame	XO or XX	2000 × 2000 (79 × 79)

[A] Select size type based on the manufacturer's average standard size and intended use of the product.
[B] Typical of a single door.
[C] Typical of a double door.