National Fenestration Rating Council Incorporated

NFRC 102-2004

Procedure for
Measuring the Steady-State Thermal Transmittance
of Fenestration Systems

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FOREWORD

This National Fenestration Rating Council (NFRC) procedure is for use by the NFRC Accredited Testing Laboratories and laboratory inspector(s). It is intended to be a companion document to ASTM C 1199-00, specifying specific NFRC requirements and deviations. It is also intended to eliminate the necessity to interpret vague or general statements from all other referenced test documents.

This NFRC procedure is a compilation of information from ASTM C 1199, data from hundreds of thermal performance tests by technicians and engineers, NFRC round robin data, and technical interpretations by NFRC.

This procedure incorporates or references many aspects of ASTM C 1199 and ASTM C 1363, with modifications adopted by NFRC. NFRC is working cooperatively with ASTM and the ISO with the goal of having a single unified test procedure. It is the intention of NFRC to adopt a harmonized standard when established.

Questions on the use of this procedure should be addressed to:

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Table of Contents

1. SCOPE

The following parts of Section 1: Scope of ASTM C 1199-00 are valid for this procedure:

1.1	Note 1	Note 2	1.3
1.5	1.6	1.7	

The following parts of Section 1: Scope of ASTM C 1199-00 are amended for this procedure:

1.2 is replaced with the following:

1.2(A) This test method refers to the thermal transmittance, U, of a fenestration system installed vertically in the absence of solar and air leakage effects.

1.4(A) For rating purposes, this test method describes how to calculate a standardized thermal transmittance, U_{ST}. Two standardization methods are described, the Calibration Transfer Standard (CTS) method and the area-weighting (AW) method. The method used shall be in accordance with section 8.2(A).

2. REFERENCED DOCUMENTS

The following parts of Section 2: Referenced Documents of ASTM C 1199-00 are valid for this procedure:

2.2	2.3

The following parts of Section 2: Referenced Documents of ASTM C 1199-00 are amended for this procedure:

2.1 is amended as follows:

2.1(A) ASTM Standards: The references to C 236 and C 976 are invalid in the context of the NFRC Test Procedure. Any references to these documents should refer to the appropriate section of ASTM C 1363.

3. TERMINOLOGY

The following parts of Section 3: Terminology of ASTM C 1199-00 are valid for this procedure:

3.1	3.2.1	3.2.2	3.2.3.1
3.2.4	3.2.5	3.2.5.1	3.2.5.2
3.2.6	3.2.7	3.2.8	

The following parts of Section 3: Terminology of ASTM C 1199-00 are amended for this procedure:

3.2 is valid in its entirety with the following addition:

3.2(A) The following additional definitions are valid for this procedure:

Test specimen - effective thermal conductance, C - The time rate of heat flow through a unit area of a test specimen (fenestration system), induced by a unit temperature difference between the test specimen surfaces. It is calculated as follows:

$$C_s = \frac{1}{\left(1/U_s - 1/h_h - 1/h_c\right)} \qquad (1A)$$

View Factor - The portion of the metering box "viewed" by the test specimen that is exchanging radiation with the interior test specimen surface. This area of the metering box would be comprised of the baffle surface and any portion of any perimeter metering box wall that the test specimen is exchanging radiation with at a 90º incident angle. For most test specimens using this method, the metering box baffle would be the only surface exchanging radiation with the test specimen.

Projecting Products - A non-planar product where the glazing projects outward past the cold side surround panel surface plane (i.e. skylights, garden windows).

3.2.3 is valid in its entirety with the following addition:

3.2.3(A) The following equation may be used as an alternate.

$$U_{ST} = \frac{1}{\left[\left(\frac{1}{h_{STh}}\right) + \left(\frac{1}{C_s}\right) + \left(\frac{1}{h_{STc}}\right)\right]} \qquad (2A)$$

3.3 is valid in its entirety with the following addition:

3.3(A) The following definitions are valid for this procedure:

C_s = thermal conductance of test specimen (surface to surface), $W/m^{2o}C$ ($Btu \cdot in/hr \cdot ft^2 \cdot {}^oF$)

t_{sp1} = area-weighted room side surround panel surface temperature, ºC (ºF)
t_{sp2} = area-weighted weather side surround panel surface temperature, ºC (ºF)

4. SIGNIFICANCE AND USE

The following parts of Section 4: Significance and Use of ASTM C 1199-00 are valid for this procedure:

4.1	4.3	4.3.2
4.3.3	Note 3	

The following parts of Section 4: Significance and Use of ASTM C 1199-00 are amended for this procedure:

4.2 is replaced with the following:

4.2(A) Since both temperature and surface air film conditions affect results, use of recommended conditions will assist in reducing confusion caused by comparing results of tests performed under dissimilar conditions. Standardized test conditions for determining the thermal transmittance of fenestration systems are specified below.

NFRC Test Conditions:

1. Interior ambient temperature of 21.0ºC ± 0.3ºC (69.8°F ± 0.5ºF).
2. Exterior ambient temperature of -18.0°C ± 0.3ºC (-0.4ºF ± 0.5ºF).
3. The interior relative humidity shall be maintained at or below 15% with the following exception:

   An interior relative humidity greater than 15% but less than 25% is allowed if there is no condensation on the specimen at the conclusion of testing. If the interior relative humidity is greater than 15%, it is required that the laboratory record a minimum of three specimen interior surface temperatures throughout the test. These temperature locations shall be located at the expected coldest points on the specimen interior surface to demonstrate that the surface temperatures during the test remained above the dew point.
4. An interior measured film coefficient during CTS panel(s) calibration testing of 7.67 W/m^2ºC (1.35 Btu/h·ft^2·ºF) ± 5%.
5. An exterior measured film coefficient during CTS panel(s) calibration testing of 30.0 W/m^2ºC (5.28 Btu/h·ft^2·ºF) ± 10%.

6. A combined film coefficient during CTS panel(s) calibration testing of 6.108 $W/m^{2}{}^{o}C$ (1.076 $Btu/h{\cdot}ft^{2}{\cdot}{}^{o}F$) (± 5%).

4.3.1 is valid in its entirety except for a typographical error.

In the first sentence, a reference to "h_h and h_s" should be "h_h and h_c".

4.4 is replaced with the following:

4.4(A) The thermal transmittance of a test specimen is affected by its size and three-dimensional geometry. Therefore, it is mandatory that fenestration systems be tested at the sizes specified in Table 4-3 of the current version of NFRC 100.

5. CALIBRATION

The following parts of Section 5: Calibration, based on ASTM C1199-00 are valid for this procedure:

5.1	5.1.1	5.1.2	5.1.2.2
Note 4	Note 5	5.1.4	
Note 6	5.2	5.2.1	5.2.1.1
Note 7	5.2.1.2	5.2.2	5.2.2.1
5.2.3	5.2.3.1	5.2.4	5.2.4.1
5.2.4.3	Note 8	5.2.4.4	5.2.4.5
5.2.4.6	Note 9	5.2.4.7	Note 10
5.2.4.7(2)	Note 11	5.2.4.7(3)	Note 12
5.3	5.3.1	5.3.2	5.3.3
Note 13	5.3.4	Note 14	

The following parts of Section 5: Calibration, of ASTM C1199-00, are amended for this procedure:

5.1.2.1 is valid with the following change:

5.1.2.1(A) A surround panel, consisting of a stable homogeneous thermal insulation material with a thermal conductivity at 24ºC (75ºF) not in excess of 0.03 W/mK (0.02 $Btu/h{\cdot}ft^{2}{\cdot}{}^{o}F$) and having a very low gas permeance, shall be provided for mounting the test specimen (see Figure 11-1). For structural integrity, the homogeneous insulation core may be sandwiched between two sheets of a support material having a very low gas (air and water vapor) permeance and stable thermal and dimensional properties. The surface of the surround panel shall have an emissivity greater than 0.8. The opening in the central homogeneous insulation board core may be covered with a nonreflecting tape to minimize surface damage. The thickness of the homogeneous insulation core of the surround panel (see Figure 11-2) shall be at least the maximum thickness of the test specimen (usually one part of the test specimen frame) and shall be in no circumstances less than 100 mm (4 in.). The maximum thickness of the homogeneous insulation core of the surround panel shall be no more than 25 mm (1 in.) greater than the maximum thickness of the test specimen. That is, for test specimen maximum thicknesses less than or equal to 100 mm (4 in.), the surround panel core thickness shall be 100 mm (4 in.). For test specimen maximum thicknesses greater than 100 mm (4 in.) and up to 125 mm (5 in.), the surround panel core thickness shall be 125 mm (5 in.). For test specimen maximum thicknesses greater than 125 mm (5 in.) and up to 150 mm (6 in.), the surround panel core thickness shall be 150 mm (6 in.) and so on for larger test specimens. Unless specifically required for test specimen mounting purposes (very high mass test specimens like patio doors or large curtain walls), no thermal anomalies (that is, thermal bridges like wood or metal) shall exist in the surround panel. In those specific situations where the surround panel is not homogeneous, a detailed drawing describing the surround panel and the thermal anomaly materials and the modified surround panel construction, along with the measured thermal conductance (using Test Methods C 177 or C 518) of all materials used shall be included with the test report. It is required that the thermal conductance (*Csp*) of the facing and core materials of the surround panel be measured in a guarded hot plate (ASTM C177) or a heat flow meter (ASTM C518) at a 1.5°C (35°F) mean. If the surround panel assembly exceeds 175mm (7 in.), it is acceptable to calculate the thermal conductance of the assembled surround panel using test results from a guarded hot plate (ASTM C177) or a heat flow meter (ASTM C518) at a 1.5°C (35°F) mean. In this case, the measured thermal conductance (using ASTM C177 or ASTM C518) of representative samples of all materials used in the calculation must have documented test results from the same manufacturing lot as the materials used in construction. For core materials the minimum thickness of the representative sample shall be100mm (4 in.). It is also recommended that thermal conductance be measured at two additional temperatures that cover conditions experienced during testing.

5.1.3 is valid with the following change:

5.1.3(A) The projected area of the Calibration Transfer Standard shall cover the same range as the test specimen model size and tolerances as specified in the current version of NFRC 100. Two Calibration Transfer Standards shall be used; one approximately the largest model size to be tested and one approximately the smallest model size to be tested.

The CTS Panel values used shall be those closest to the representative size of the test specimen in relation to the appropriate CTS Panel size.

5.1.4.1 is replaced with the following:

5.1.4.1 (A) Radiating surface temperatures – The temperature of all baffle surfaces exchanging radiation heat transfer with the test specimen using the same area weighing criteria as specified in Test Method C1363. Although it is recommended, it is not required to instrument those surfaces which may exchange radiation if they are not parallel to the interior face of the surround panel (baffles, surround panel opening, box surfaces, shields, etc.).

5.1.4.2 is replaced with the following:

5.1.4.2(A) ***Air temperatures*** - The air temperature sensors shall be located 75 mm (3 in.) from the surface of the surround panel. The air temperature sensors shall be arranged in a vertical grid network, with a minimum density of two sensors per square meter of metering area, but not less than nine. The rows and columns closest to the metering box walls shall be located at a minimum distance of 150 mm (6 in.) from each meter box wall. Parallel averaging of air temperatures shall be allowed on vertical elevations (horizontal rows) only.

This equation shall also apply to the radiating surface temperatures, surround panel surfaces, and each meter box wall individual surface. Locations are to be evenly distributed to properly characterize each individual surface area.

5.1.5 is replaced with the following:

5.1.5(A) ***Air leakage*** - All fenestration product types shall be sealed at the warm side surface, A specimen with a primary/secondary (storm window) application shall be sealed at the warm side of each application. Weep holes/slots located on the cold side shall be sealed on the cold side. In addition, all requirements of Section 7.1.3 of ASTM E 1423 and Note 4, should be followed, except where in conflict with the above language.

5.2.3.2 is replaced with the following:

5.2.3.2(A) Criteria for NFRC Steady State

1. Determining steady-state involves two separate evaluations. First, a series of four hourly sets of data are compared to the group mean to determine if steady state has been achieved. Second, two additional consecutive two-hour test periods are individually compared to the average initial four-hour period and each other to verify steady-state conditions are maintained. The following tests are applied to both assessments.

2. The average room and weather side air temperatures and all other surface temperatures shall not vary by more than ± 0.3ºC (± 0.5ºF) over the entire eight (8) hour steady state period. (See ASTM C 1363 requirements.)

3. The total heat input into the metering box, Q (including Q_{mb}, Q_{fl}, and warm room heater and circulating fan power) shall be used to determine steady state. The mean of the four one-hour steady state periods shall agree within ± 1% of the mean of each of the two hour test periods and each of the two (2) two-hour test periods must be within ± 1% of one another.

4. As an alternative, steady-state conditions and time constant may be determined per ASTM C 1363.

5.2.4.2 is valid in its entirety with the following addition:

5.2.4.2(A) As a secondary check on Q_s, the following equation is required:

$$Q_S = Q - Q_{sp} - Q_{fl} \tag{4A}$$

This equation shall produce the same result as the primary equation within ± 10%

5.2.4.7(1) is valid in its entirety with the following addition:

5.2.4.7(1) (A) The baffle-to-surround panel interior surface spacing may be adjustable to serve as one means of adjusting the air flow velocity. For the purpose of maintaining a characterized air flow, a minimum spacing of 140 mm (5.5 in.) to a maximum of 200 mm (8 in.) is required. (Reference to Section 6.8.9.2 of ASTM C 1363.)

5.2.4.7(4), 5.2.4.7(5), and 5.2.4.7(6) are replaced with the following:

5.2.4.7(A) Weather side surface heat transfer coefficient, h_c

$$h_c = \frac{Q_s}{\left[A_s\left(t_2 - t_c\right)\right]} \tag{5A}$$

Where t_2 is calculated according to equation (17)

The following parts of Section 5: Calibration of ASTM C 1199-00 are invalid for this procedure:

5.1.4.2 5.2.3.2 5.2.4.7(4) 5.2.4.7(5) 5.2.4.7(6)

6. EXPERIMENTAL PROCEDURE

The following parts of Section 6: Experimental Procedure of ASTM C 1199-00 are valid for this procedure:

6.1	6.2	6.3	6.3.1
6.4	6.5	6.5.1	6.5.2
6.5.2.3	6.5.3	6.5.4.2	

The following parts of Section 6: Experimental Procedure of ASTM C 1199-00 are amended for this procedure:

6.2.1 is valid in its entirety with the following addition:

6.2.1(A) Skylights shall be tested in a configuration that is as close to the actual installation as possible (without flashing) with the following conditions:

1. Curb Mounted skylights that do not have an integral curb attached shall be simulated and tested installed on a nominal 40 mm by 90 mm (1 1/2 in by 3 1/2 in.) wood curb made from douglas fir with no knots.
2. Skylights shall be tested and reported in the vertical orientation.
3. Skylights installed inside the rafter opening that have the bottom of the curb touching the finish facing material may extend the surround panel material to the inside of the curb, or the inside of the finished opening material, whichever comes first. The surround panel material shall not extend beyond the inside of the skylight curb.
4. The skylight size listed in NFRC 100 is based on a center of the rafter to center of the rafter dimension. Thereby the standard size references a median size between a skylight mounted between the rafters and a skylight mounted on top of the rafters.
5. The U-factor for skylights is based on the projected fenestration product area. For skylights installed between the rafters, the outside dimension of the curb is considered to be the projected area. For skylights installed on top of the rafters, the inside dimension of the curb is considered to be the projected area.

6.4.1 is replaced with the following:

6.4.1(A) Establish, as per the procedure in section 5.2.3.2(A), steady-state temperature and power conditions for which the test specimen is to be tested and record measurements of power, temperatures, and velocity at no greater than five minute intervals throughout the steady-state test period.

6.5.2.1 is replaced with the following:

6.5.2.1(A) Additional temperature measurements shall be made on the surround panel wall. There shall be a minimum of eight temperature sensors, with four at positions bisecting the four lines from the corners of the surround panel aperture to the corresponding corners of the metering area, and four at the positions bisecting the sides of the rectangle having the first four thermocouples at its corners.

6.5.2.2 is replaced with the following:

6.5.2.2(A) When using the CTS Method, the attachment of interior and exterior surface thermocouples to the test specimen shall be voluntary. For the area-weighted method, it is a requirement to make temperature measurements on the fenestration system frame, glazing (center and near edges) and on any other test specimen surfaces (sills, muntins, etc.), in order to provide a representative area weighted value of the fenestration system surface to surface temperature difference. It must be recognized that there is a wide range of fenestration system designs; therefore it is not possible to specify the locations of the test specimen temperature sensors to provide a correct area weighted determination of the various surface temperatures for all configurations. Area-weighting surface temperature measurements are obtained by placing each predetermined individual temperature sensor in the center of surface area that represents the average temperature of those areas. Consequently, thermocouples may be placed on both horizontal and vertical surfaces depending on the geometry of the test sample. The cross sections in Figure 11-1 to Figure 11-7 show typical interior and exterior specimen surface temperature locations. Additional thermocouples may be needed to adequately capture the average temperatures and areas of the test specimen. Each glazing corner edge thermocouple shall be placed at a point 13 mm (1/2 in.) from the adjacent framing. The temperature sensors used shall be at a minimum, special limit (premium) thermocouples 30 gage [0.25476 mm (0.01003 in.)], for surface temperature measurements. Placement shall be as such to minimize the disturbance of the air flows on the surfaces of the test specimen.

6.5.2.2(A).a The attachment of thermocouples shall be performed by using a nominal 25 mm by 100 mm (1 in. by 4 in.) 3M 425 aluminum tape with the 100 mm (4 in.) dimension parallel to the thermocouple wire. The surface emissivity of the tape shall be similar (± 0.1) to the surface emissivity of the sample. (Refer to NFRC 101 for guidance.)

6.5.4, 6.5.4.1, 6.5.4.3 are replaced with the following:

6.5.4(A) Wind Speed Measurements - The exterior applied dynamic wind (perpendicular or parallel) shall produce an exterior film coefficient of 30.0 $W/m^2 {}^oC$ (5.28 $Btu/h{\cdot}ft^2{\cdot}{}^oF$) ± 10% during calibration testing of a CTS Panel. The weather side wind speed shall be measured in the free stream condition. One such method for perpendicular weather side wind would be to have the exterior wind speed measured at the mid-point area of the exit aperture of the discharge plenum. The sensor shall be located a maximum distance of 150 mm (6 in.) toward the wind generator from the vertical plane of the exit aperture. Note that the center of the exit aperture and the center of the test specimen should be in the same plane as noted in Section 5.1.4.

For parallel flow patterns, this location shall be in the free air stream such that the wind speed sensor is not in the test specimen surface boundary layers or wakes. A distance of 75 mm (3 in.) out from the exterior surface of the surround panel, at the center point, is required.

6.5.4.1(A) Periodic traversing of the weather side air flow field, to determine the air velocity distribution, is required during annual CTS Panel calibration testing. For the exterior wind flow, 20 equidistant measurements shall be made, with a grid of 4 rows in height and 5 columns in width, to determine the uniformity of the exterior wind velocity.

6.5.5 is replaced with the following:

6.5.5(A) Variations in the pressure in the space between the panes of glass in sealed glazing units may cause deflections in the glass. In extreme cold weather cases, the glass surfaces may bow and come into contact with each other at their center points. This change in the enclosed space dimensions can significantly affect the thermal conductance, C_s, and the thermal transmittance, U_s, of the test specimen. Some of the factors which can cause a pressure unbalance between the glazing unit enclosed air space and the surrounding environment are:

(1) Differences in the barometric pressure due to a difference in the elevations of the fenestration manufacturing facility and the testing facility.

(2) Changes in barometric pressure at the testing facility due to local weather variations.

(3) Changes in the mean temperature of the glazing unit enclosed airspace during testing.

Recognizing that glass deflection can cause a change in the thermal conductance, C, and the thermal transmittance, U, an estimation of the gap spacing between the glass sheets is required immediately before and after the test. The initial gap thickness can be estimated by either measuring the overall glazing thickness at the center or measuring the deflection profile of each glass plate and then subtracting the thickness of the individual plates. Gap thickness during the test can be estimated from the initial thickness measurements minus the change in glass deflections, which occur during the test. The glazing deflection measurements shall be performed on both sides of the fenestration system and shall be included in the test report. The glazing deflection measurements shall be performed:

(1) Just before the test commences, and

(2) Immediately after the test is completed and while the test specimen enclosed air space mean temperature is close to that which existed during the test.

The following parts of Section 6: Experimental Procedure of ASTM C 1199-00 are invalid for this procedure:

6.4.1	6.5.2.1	6.5.2.2	6.5.4
6.5.4.1	6.5.4.2	6.5.4.3	6.5.5

7. CALCULATION OF THERMAL TRANSMITTANCE

The following parts of Section 7: Calculation of Thermal Transmittance of ASTM C 1199-00 are valid for this procedure:

7.1	7.1.1	7.1.2	7.1.3
7.1.4			

8. CALCULATION OF STANDARDIZED THERMAL TRANSMITTANCE

The following parts of Section 8: Calculation of Standardized Thermal Transmittance of ASTM C 1199-00 are valid for this procedure:

8.1	Note 15	Note 16	8.2.2
8.2.3	8.2.4	8.2.5	8.2.6
8.2.8	8.2.9		

The following parts of Section 8: Calculation of Standardized Thermal Transmittance of ASTM C 1199-00 are amended for this procedure:

8.2 is replaced with the following:

8.2(A) The following sections offer two methods of calculating the standardized thermal transmittance. The procedure that utilizes the calculation of the equivalent surface temperatures to compute the test specimen thermal conductance (CTS method) is described in 8.2.1-8.2.3, 8.2.5 and 8.2.7and the method that uses the area-weighted surface temperature measurements to compute the standardized thermal transmittance of the test specimen (area weighting method) is described in 8.2.4, 8.2.6, and 8.2.8. All products shall use the CTS method.

8.2.1 is valid in its entirety with the following typographical correction:

8.2.1(A) Equation (32) should read:

$$Q_S = Q_{r1} + Q_{cl} \tag{7A}$$

8.2.7 is valid in its entirety with the following addition:

8.2.7(A) The following equation may be used as an alternate:

$$U_{ST-CTS} = \frac{1}{\left[\left(\frac{1}{h_{STh}}\right)+\left(\frac{1}{C_s}\right)+\left(\frac{1}{h_{STc}}\right)\right]} \tag{8A}$$

8.2.8 is valid in its entirety with the following typographical correction:

8.2.8(A) Equation (41) should read:

$$U_{st[aw]} = \frac{1.0}{\left[\left(\frac{1}{U_s}\right)+\left(\frac{A_s}{A_h}\right)\left(\frac{1}{h_{STh}}-\frac{1}{h_h}\right)+\left(\frac{A_s}{A_c}\right)\left(\frac{1}{h_{STh}}-\frac{1}{h_c}\right)\right]} \tag{9A}$$

A_h and A_c shall be determined in accordance with

Figure 11-8.

8.2.9.1 is replaced with the following:

8.2.9.1(A) The standardized surface heat transfer coefficients are as specified below:

$$h_{STh}\left(W/m^2\,K\right) = 1.46\left[\frac{(t_h - t_1)}{H}\right]^{0.25} + \sigma e1\left[\frac{(t_h + 273.16)^4 - (t_1 + 273.16)^4}{(t_h - t_1)}\right]$$

or

$$h_{STh}\left(Btu/h\cdot ft^2\cdot{}^\circ F\right) = 0.30\left[\frac{(t_h - t_1)}{H}\right]^{0.25} + \sigma e1\left[\frac{(t_h + 459.67)^4 - (t_1 + 459.67)^4}{(t_h - t_1)}\right]$$

Where

H = total height of production m (ft)
h_{STc} = 30.0 W/m^2K (5.28 $Btu\cdot in/hr\cdot ft^2\cdot{}^oF$)

The following parts of Section 8: Calculation of Standardized Thermal Transmittance of ASTM C 1199-00 are invalid for this procedure:

8.2	8.2.9.1

9. REPORT

The following parts of Section 9: Report are valid for this procedure:

9.1.1	9.1.2	9.1.3	9.1.4
9.1.5	9.1.6	9.1.7	9.1.8
9.1.9	9.1.10	9.1.11	9.1.11.1
9.1.11.2	9.1.11.3	9.1.12	9.1.12.1
9.1.12.2	9.1.13	9.1.14	9.1.15
9.2	9.2.1	Note 17	

The following parts of Section 9: Report of ASTM C 1199-00 are amended for this procedure:

9.1 is valid in its entirety with the following addition:

9.1(A) The report shall include all of the information required by the NFRC LAP and subsequent NFRC LAP Bulletins. If the test specimen size is non-standard (more than ± 13 mm (± 1/2 in.) in width and/or height different than the model size referenced in Table 4-3 of NFRC 100), then the text "non-standard size" shall be inserted immediately following the size everywhere the size is listed both in the full report and in any summary (example: "1150 mm by 1700 mm – non-standard size"). If the test conditions are non-standard then the text "non-standard test conditions" shall be inserted immediately following the name of the procedure everywhere the test procedure is listed both in the full report and in any summary (example “NFRC Test Procedure – non-standard test conditions”).

The following parts of Section 9: Report of ASTM C 1199-00 are invalid for this procedure:

None

10. PRECISION AND BIAS

The following parts of Section 10: Precision and Bias are valid for this procedure:

10.1	10.1.1	10.1.1.1	10.1.1.2
10.1.1.3	10.1.1.4	10.1.2	10.1.2.1
10.1.2.2	10.1.2.3	10.1.2.4	10.1.2.5
10.1.2.6	10.1.2.7	10.1.3	10.1.4

The following parts of Section 10: Precision and Bias of ASTM C 1199-00 are amended for this procedure:

None

The following parts of Section 10: Precision and Bias of ASTM C 1199-00 are invalid for this procedure:

None

11. APPENDICES (MANDATORY INFORMATION)

The following parts of Section 11 Appendices (Mandatory Information) of ASTM C 1199-00 are valid for this procedure:

A1.1	A1.2	A1.2.1	A2.1
A2.2	A2.2.1	A2.2.2	A2.2.3
A2.2.4	A2.2.5	A2.3	A2.3.1

The following parts of Appendices (Mandatory Information) of ASTM C 1199-00 are amended for this procedure:

None

The following parts of Section 11: Appendices (Mandatory Information) of ASTM C 1199-00 are invalid for this procedure:

None

BIBLIOGRAPHY

All Bibliography references of ASTM C 1199-00 are valid for this procedure. The following references are in addition to those listed in ASTM C 1199-00.

ASHRAE Handbook, Fundamentals Volume, American Society of Heating, Refrigerating, and Air Conditioning Engineers, Inc.

Bowen, R.P. and K.R. Solvason, "A Calorimeter for Determining Heat Transmission Characteristics of Windows", Submitted to ASTM for publication, 1985.

BS874: Part 3: Section 3.1: 1987, British Standard Methods for Determining thermal insulation properties, Part 3. Tests for thermal transmittance and conductance, Section 3.1 Guarded hot box method, British Standards Institution, British Standards House, 2 Park Street, London W1A 2BS, England.

ISO 8990, Thermal Insulation - Determination of Steady-State Thermal Transmission Properties - Calibrated and Guarded Hot Box, International Standards Organization.

Figure 11-1 Thermocouple Location Two-Lite Curtain Wall, Patio Door

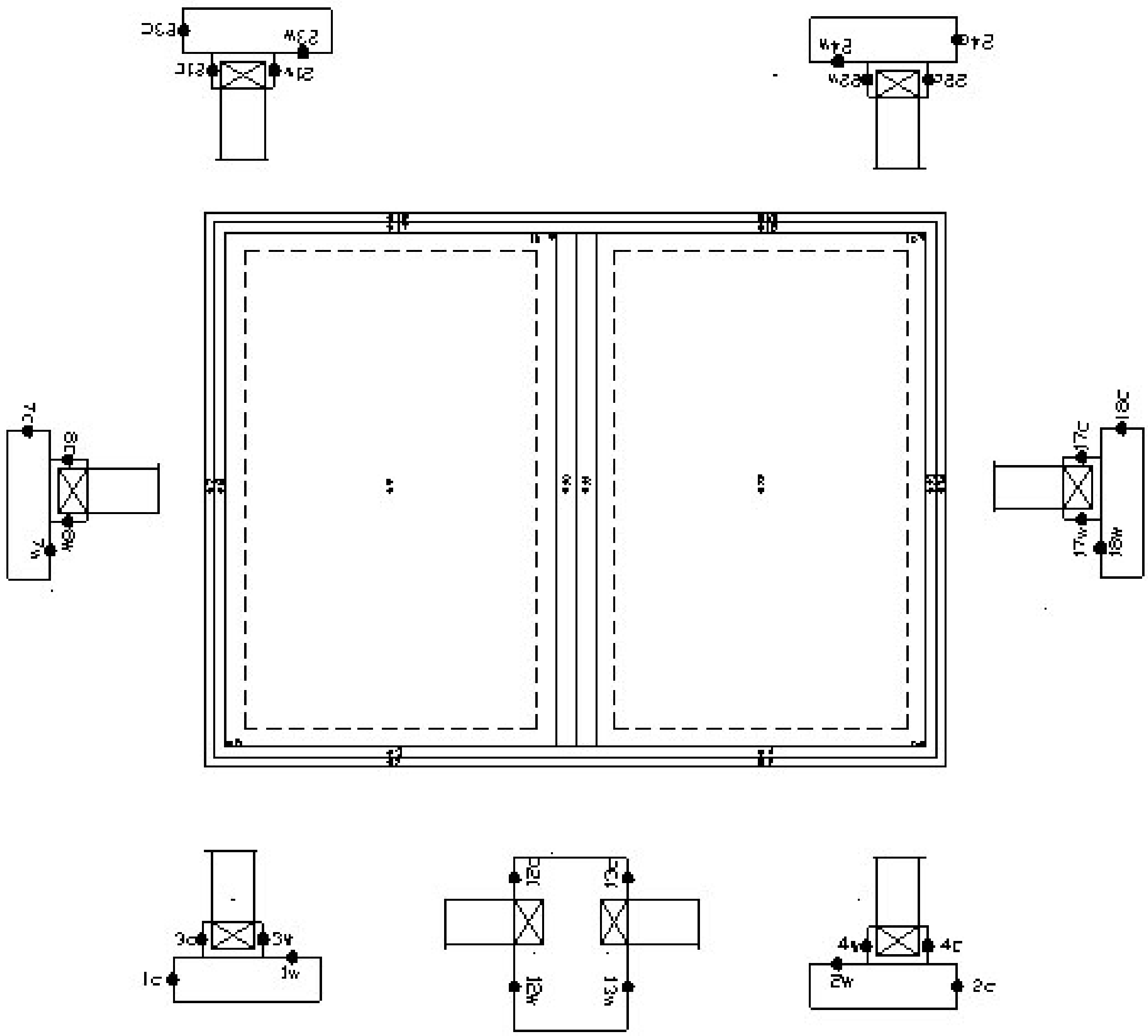


Figure 11-2 Thermocouple Location Casement, Projected (Awning)

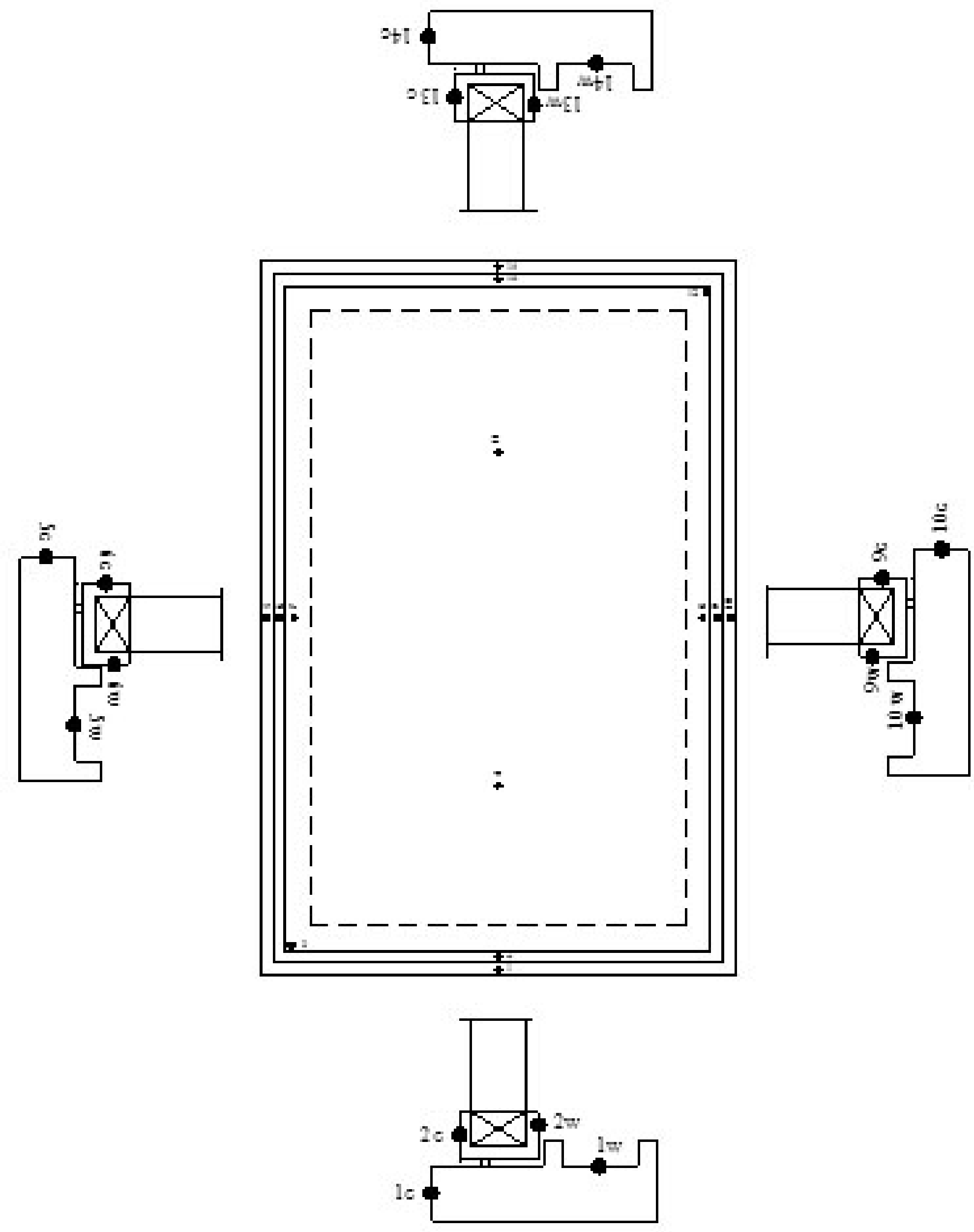


Figure 11-3 Thermocouple Location Fixed

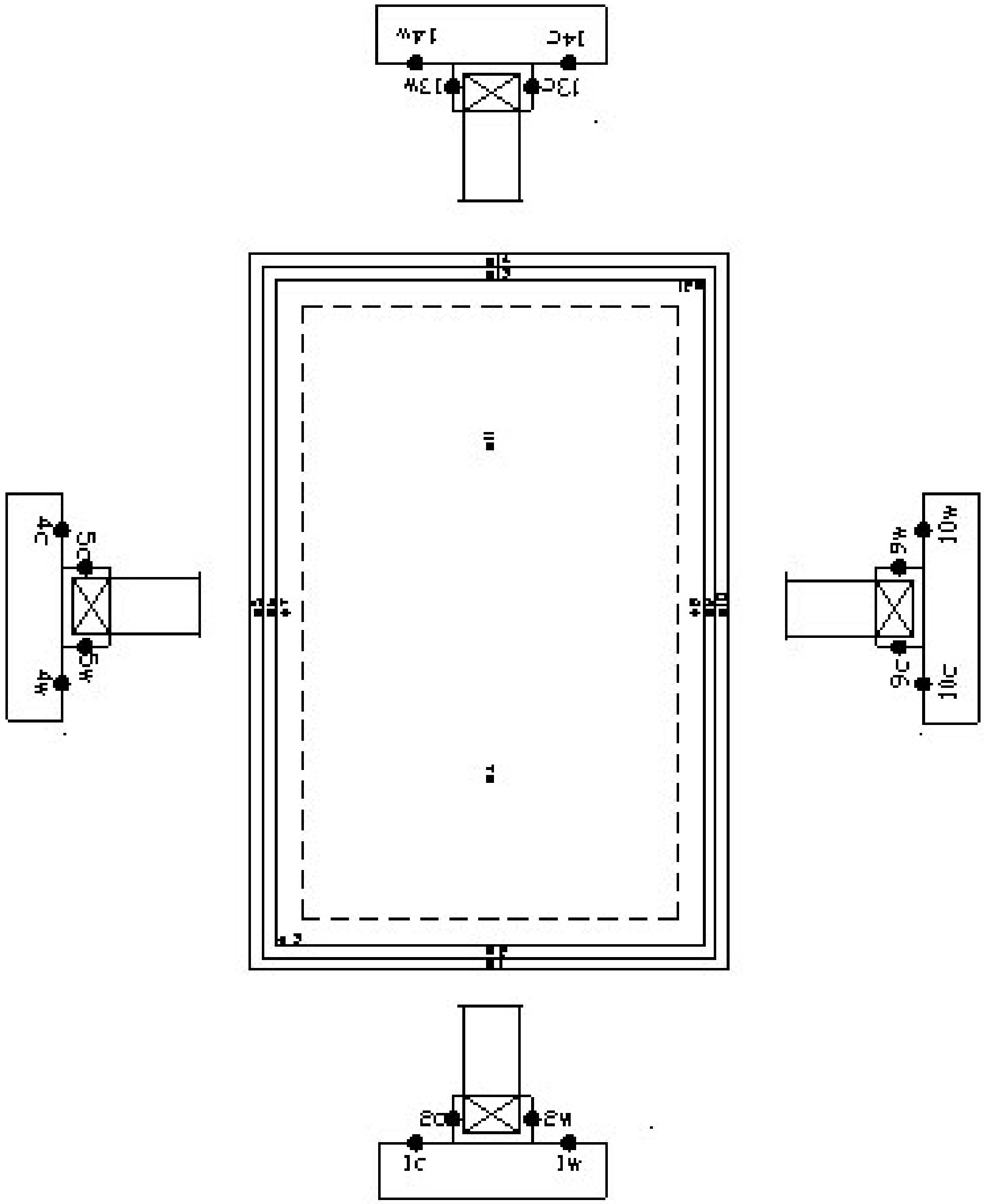


Figure 11-4 Thermocouple Location Horizontal Slider

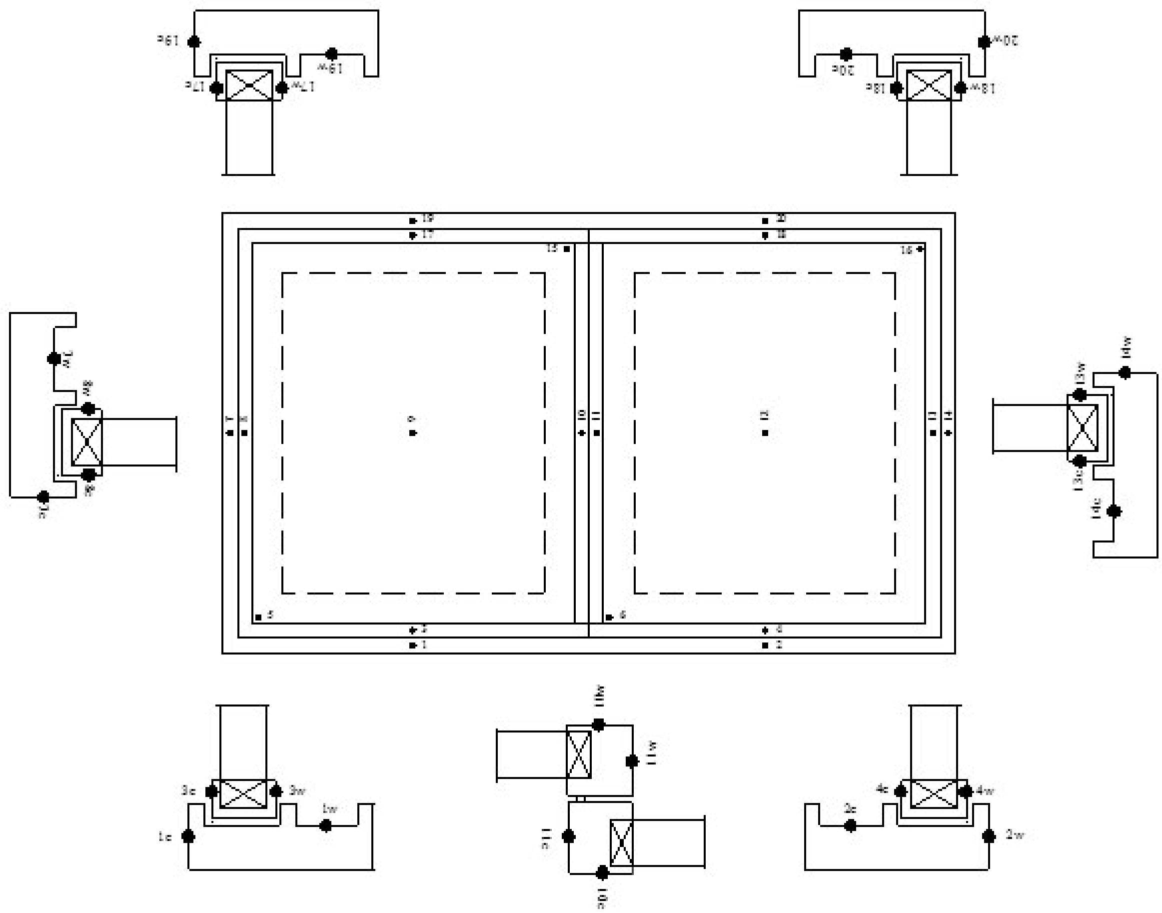


Figure 11-5 Thermocouple Location Vertical Slider

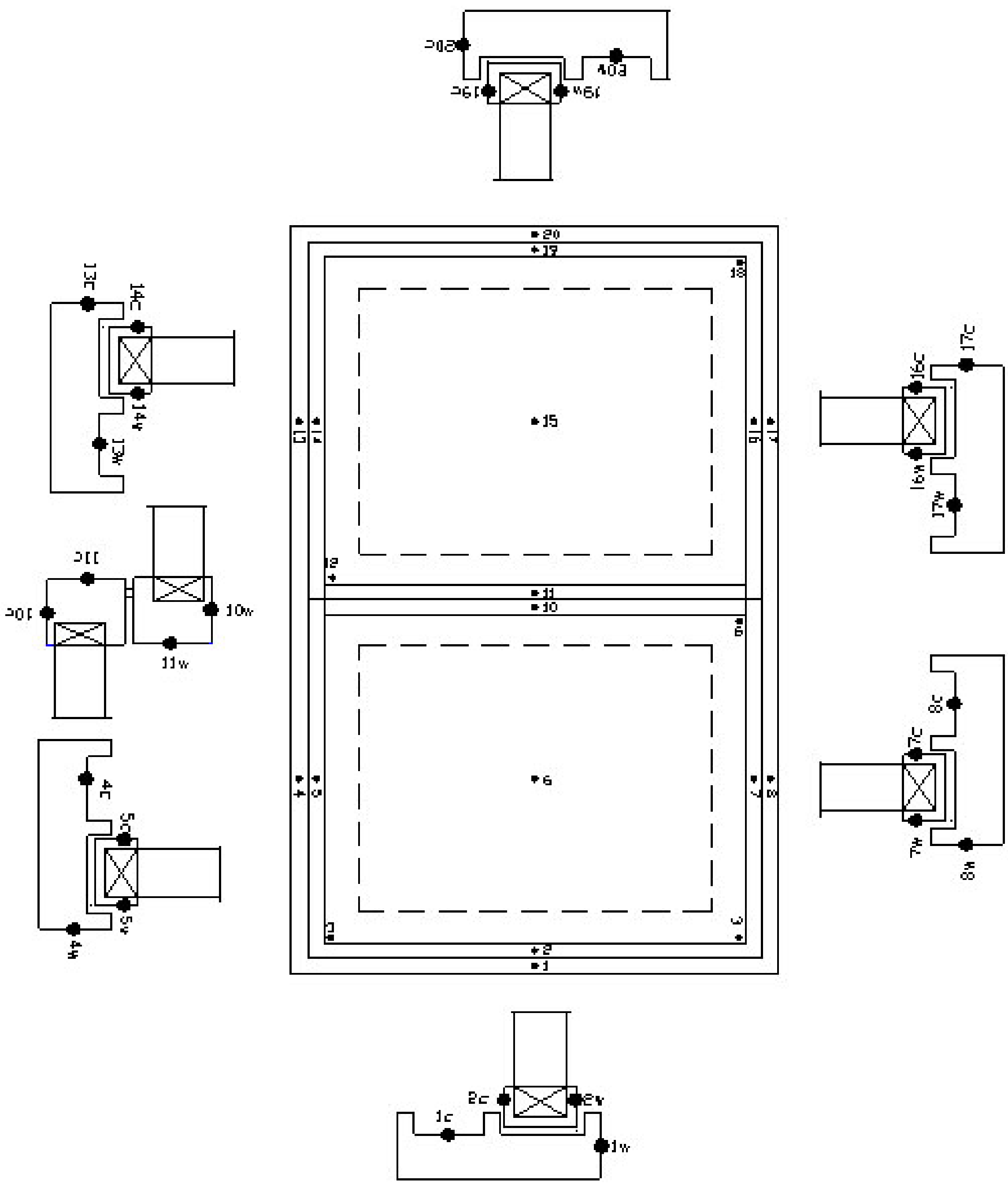


Figure 11-6 Thermocouple Location Entrance Door

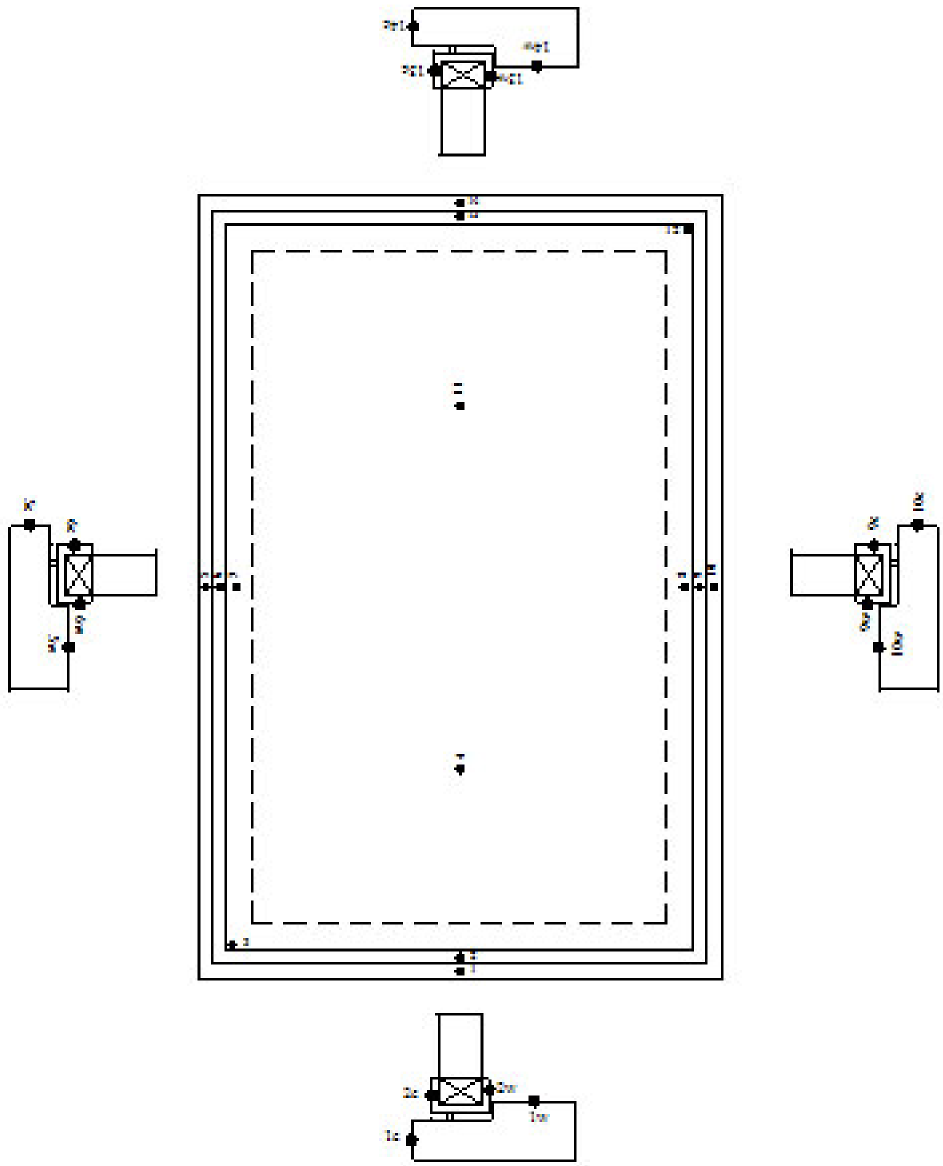


Figure 11-7 Thermocouple Location Divider

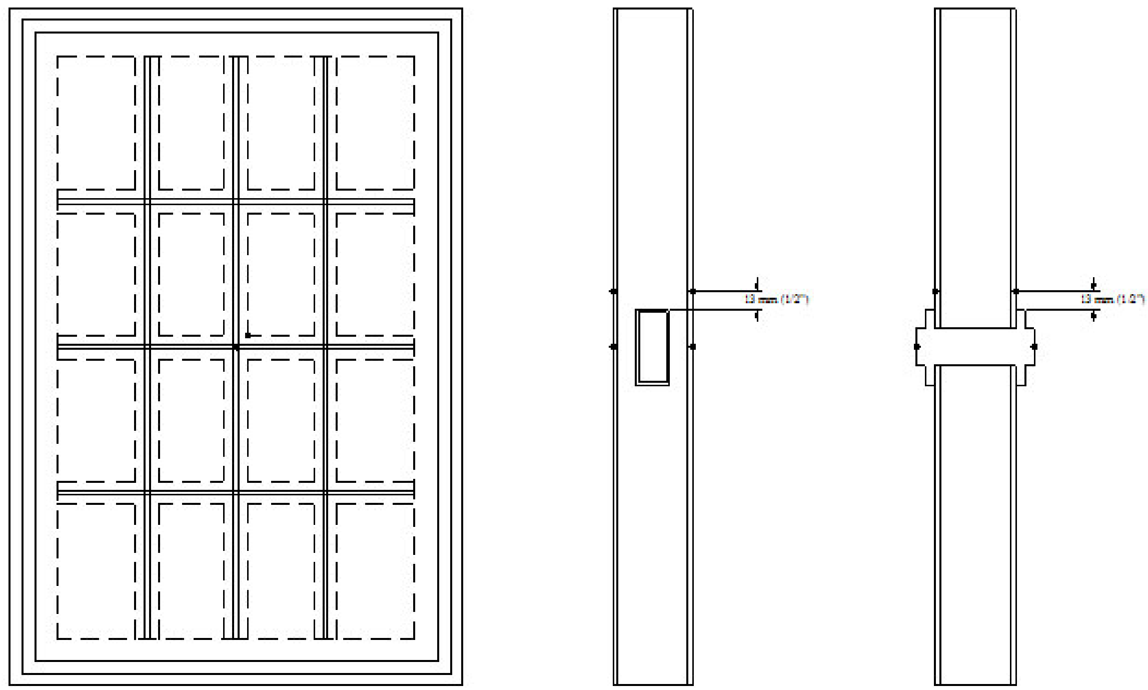
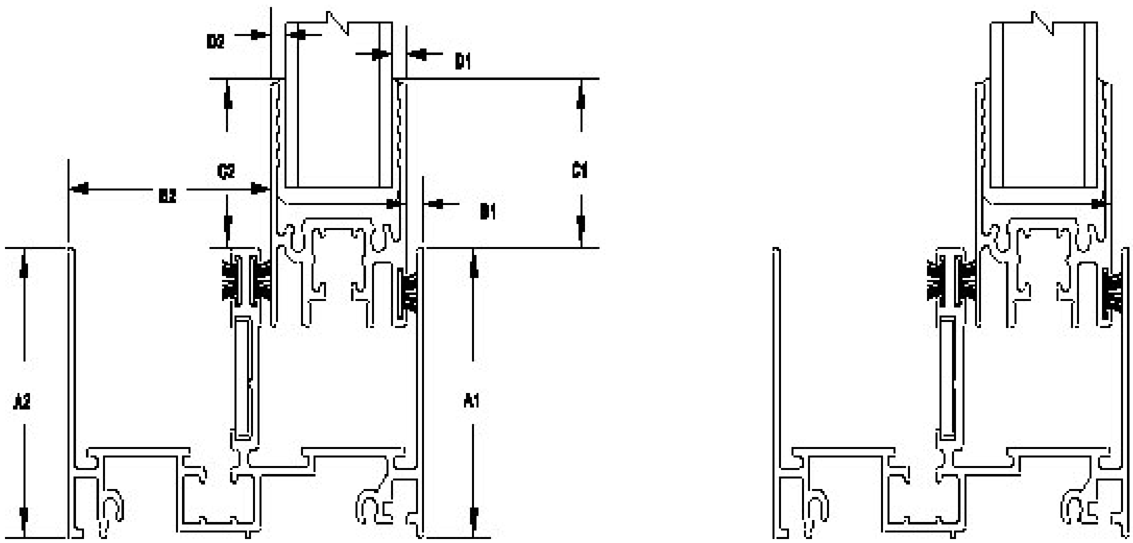


Figure 11-8 Example of Method to Determine Interior and Exterior Wetted 2-D Surface Areas



Area for the frame shall be calculated as
[projected height (A*) + projected depth (B*)] × assigned length of the section

Area for the sash shall be calculated as
[projected height (C*) + projected depth (D*)] × assigned length of the section

A1" designates as interior projected profile

A2" designates as exterior projected profile

Figure 11-9 Garage Door Installation

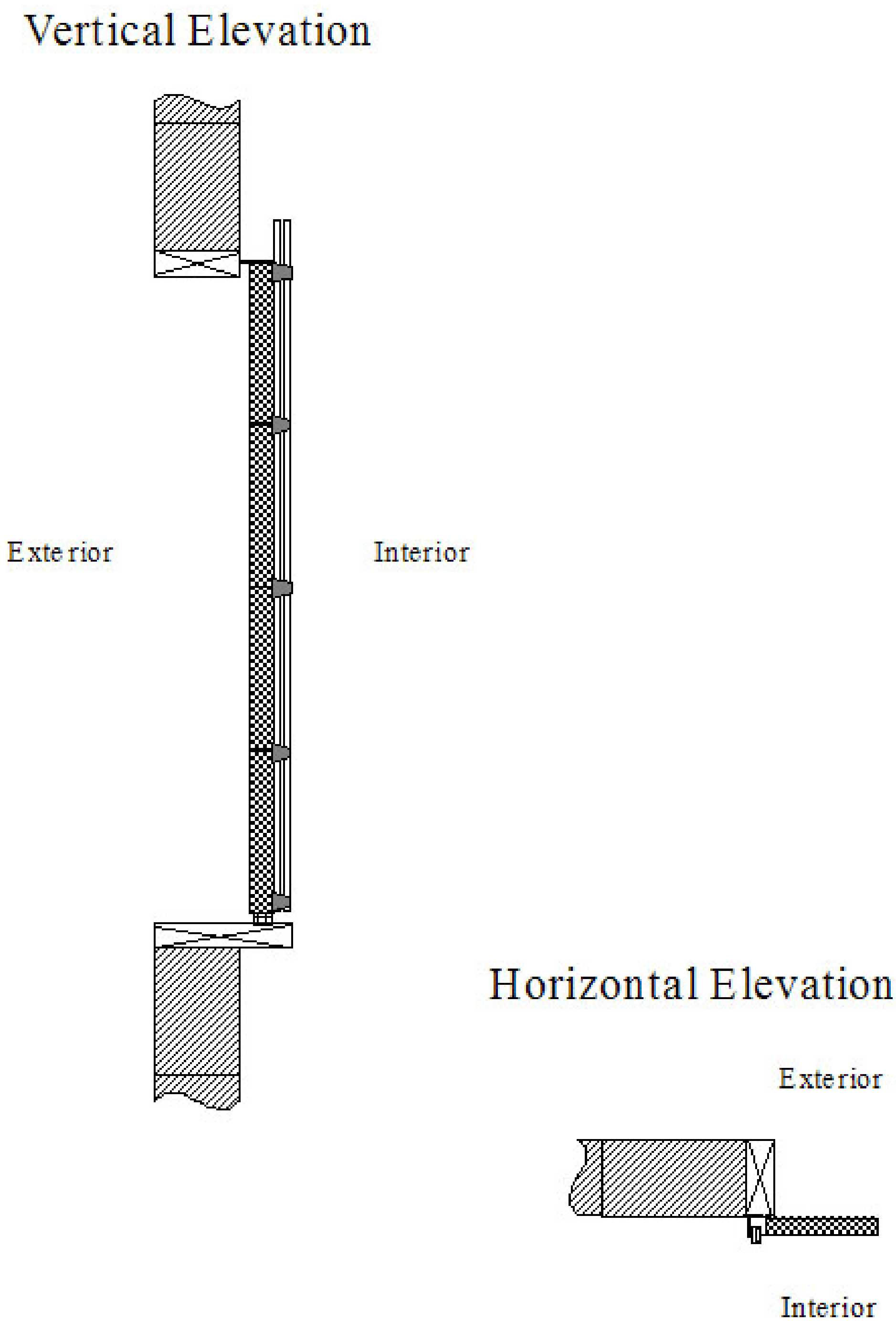
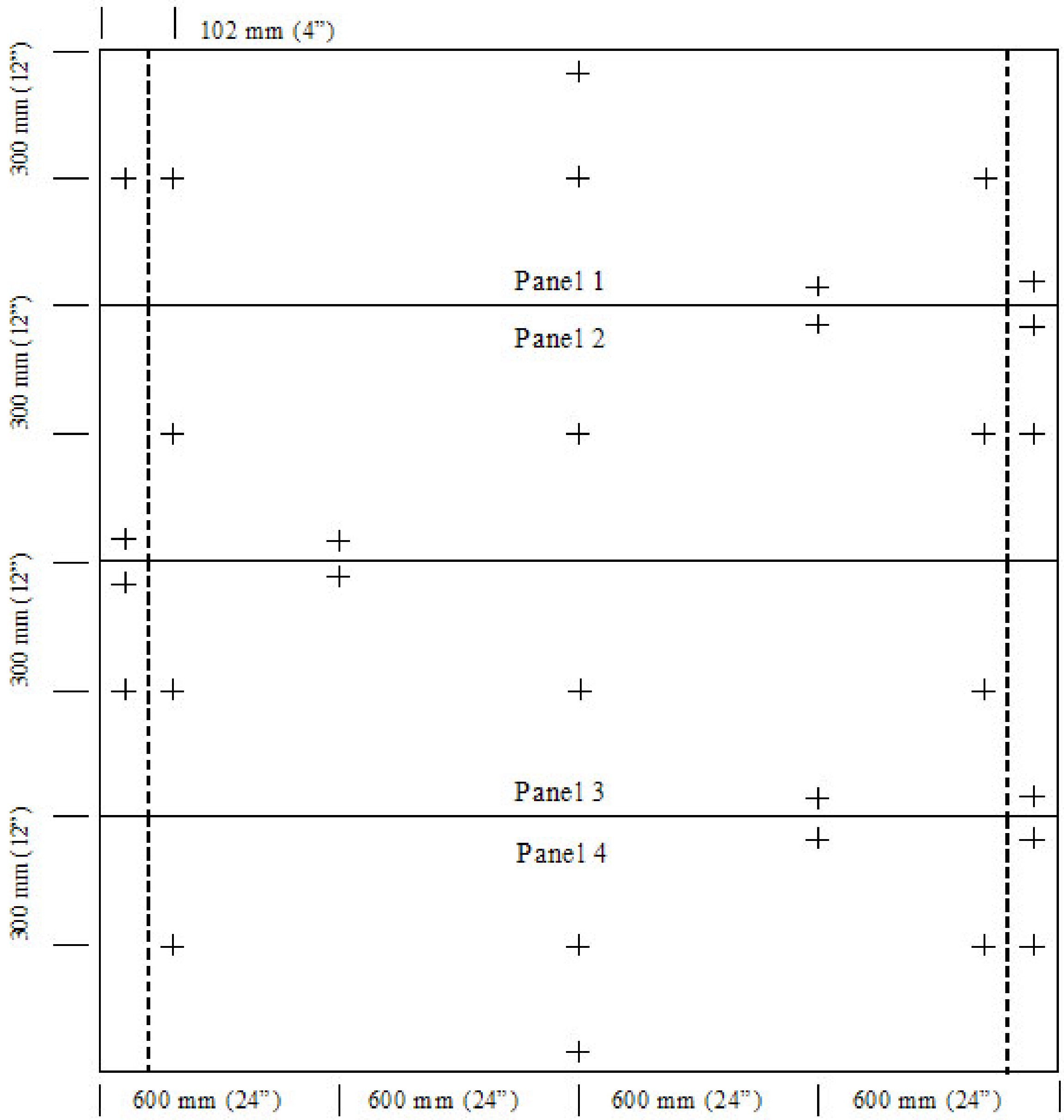


Figure 11-10 Thermocouple Location Four Panel Garage Door



Perimeter edge TC locations are 32 mm (1 1/4 in.)

Not all thermocouple locations may be necessary dependent upon the design of the garage door. Glazing TCs shall have 2 edge and 1 center.

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