AMERICAN ARCHITECTURAL

AAMA 1503-09

Voluntary Test Method for Thermal Transmittance and Condensation Resistance of Windows, Doors and Glazed Wall Sections

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AAMA 1503-09
ORIGINALLY PUBLISHED: 1998
PRECEDING DOCUMENT: 1503-98
REVISED: 1/09
PUBLISHED: 3/09

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FOREWORD

AAMA started work leading to the development of procedures and equipment suitable for the evaluation of thermal performance of fenestration products in 1972. The first AAMA voluntary standard for thermal performance, AAMA 1502.3, was published in 1972. It was developed specifically to measure the condensation resistance of aluminum residential insulating windows and sliding glass doors. Aluminum had long been the most popular framing material for these products. Architects, builders and users preferred aluminum for its excellent operating and performance characteristics, its low maintenance, color, style and design versatility. However, one characteristic of aluminum construction that was not desirable was its susceptibility to condensation under conditions of high inside relative humidity and low outside air temperature.

To provide greater resistance to condensation, many manufacturers had developed thermally improved or "thermalized" windows, doors and glazed wall products. Such products incorporated thermal barriers in the aluminum framing to prevent through metal conductance between the inside air and the outside air. In addition, such products were glazed with two or more panes of glass with an air space between the panes to increase the insulation in the vision areas. Thermal barriers in the framing members were generally designed to equal or exceed the condensation resistance of the insulating glass. Through this type of construction the condensation resistance of the entire assembly was uniformly improved.

Since manufacturers used several techniques to make thermalized products, it became important that architects, builders and users have a reliable method of evaluating thermal performance, in order to properly match products to the climates and conditions in which they would be used and in order to make valid comparisons of products. AAMA 1502 test methods made this possible as far as determining a product's condensation resistance was concerned.

The other major area of concern relative to thermal performance is a product's thermal transmittance. It is this property which determines the heat loss through the product. Lower thermal transmittance means higher energy efficiency since less heat is going to be lost through the product. Although there is not necessarily a direct correlation, a design which provides good condensation resistance may also provide good resistance to heat loss. With high fuel costs, reduction of heat loss is critically important in a building design.

To meet the need for a standard test, AAMA developed, and in 1980 published, AAMA 1503.1, a voluntary standard for the measurement of thermal transmittance of windows, doors and glazed wall sections. This standard was not limited to residential windows and sliding glass doors, but covered all categories and types of these products as well as glazed sections for wall systems. The advent of this standard made it possible to measure the heat flow resistance capabilities of a complete window, door or wall section assembly in a repeatable and reliable manner. In 1981, AAMA 1502.7, the voluntary standard for condensation resistance, was updated so that it too was applicable to all categories and types of windows, doors and glazed wall sections.

The 1988 revision of AAMA 1503.1 included many technical improvements and brought the condensation resistance evaluation and the U-Factor evaluation methods together in one comprehensive thermal performance standard.

AAMA 1503 has been investigated, researched, restructured and thoroughly evaluated by more scientists and interested parties than any other thermal performance test method. The revision in 1998 changed some of the test parameters (cold room temperature and warm room temperature) to be coincident with those used by the National Fenestration Rating Council (NFRC). This change was made without creating any technical inaccuracies or inconsistencies in the results and allows an NFRC 100 evaluation to be performed concurrently with the AAMA 1503 test.

Most important, this version of AAMA 1503 contains the latest improvements evolving from over 25 years of thermal testing by many AAMA accredited testing laboratories. Calibration techniques were changed to reflect the significant improvement in window thermal performance over the years and sealing against potential air infiltration has been improved. Other calibration and test techniques were also refined. In addition, a component was added to allow for testing of multiple glazing options via AAMA's 1505 glass library to provide simple, cost effective and fully tested U-Factor and CRF values for the industry.

There is every reason to believe that AAMA 1503 is, by far, the industry's most comprehensive and accurate method for directly testing for the *air-to-air thermal transmittance and condensation* characteristics of architectural products. It is equally applicable to products made from all materials and glazing combinations. It is likely to be the foremost method for testing air-to-air thermal transmittance for years to come; no other competing test method is currently under development.

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AAMA invites scientific input and comments from all interested parties for evaluation and potential use in future editions of this voluntary test method.

1.0 SCOPE

1.1 This test method measures the thermal characteristics of windows, doors and glazed exterior wall sections under steady-state conditions. Specifically, measurements and calculations made using this procedure can be used to determine the thermal transmittance (air-to-air) or U-Factor, the air infiltration rate and/or the condensation resistance factor, hereafter called "CRF" for these products.

1.2 This method is specifically intended for measurements on heterogeneous constructions with variations in thickness, conductivity and surface profile, which are common to windows, doors and glazed wall sections.

1.3 In this test method, a forced convection generated by a perpendicular air flow is established on the exterior (cold room side) of the test specimen. Cold side surface coefficients are controlled by adjusting the test apparatus to specific performance conditions using a Calibration Transfer Standard (CTS) panel.

1.4 On the interior (warm room side), a natural convection is established by the combined effects of the downward flow of cooler air over the face of the specimen due to natural convective currents, and by optional (if necessary for calibration) forced convective currents downward and parallel to the specimen. The warm room heaters, fans and blowers are adjusted so that the resulting warm side surface coefficients are within the calibration specifications.

1.4.1 This test method does not include the effects of air infiltration because operable test specimens will be thoroughly sealed, and the dynamic wind pressure at the exterior will be balanced to a zero differential pressure with a static air pressure on the interior side or by insuring there is no air infiltration before and after the test.

1.4.2 While not an absolute value, the CRF is a rating number obtained under specified test conditions to allow a relative comparison of the condensation performance of the product. It will provide a comparative rating and permit the determination of the conditions beyond which an objectionable amount of condensation may occur.

1.5 The test facilities must conform to the calibration requirements specified in this test method. However, the details of the test apparatus necessary to achieve these conditions may vary. The equipment, calibrated within the tolerance outlined in this test method, will produce results that can be used for comparison purpose under the same test conditions.

1.6 Those applying this test method shall be trained in techniques of temperature measurement, shall understand the theory of heat flow, and shall have experience in thermal testing. Since it is undesirable to specify the construction of the test facility in such detail that it would unnecessarily restrict the method to a single arrangement, those applying the method shall have the technical competency to determine the accuracy and operating variables of their respective test facilities.

1.7 The primary units of measure in this document are metric. The values stated in SI units are to be regarded as the standard. The values given in parentheses are for reference only.

2.0 REFERENCE DOCUMENTS

2.1 References to the standards listed below shall be to the edition indicated. Any undated reference to a code or standard appearing in the requirements of this standard shall be interpreted as to referring to the latest edition of that code or standard.

2.2 American Architectural Manufacturers Association (AAMA)

AAMA 1502.3-72, Standards and Tests for Thermally-Improved Aluminum Prime Windows and Sliding Glass Doors

AAMA 1502.7-81, Voluntary Test Method for Condensation Resistance of Windows, Doors and Glazed Wall Sections

AAMA 1503.1-80, Voluntary Test Method for Thermal Transmittance of Windows, Doors and Glazed Wall Sections

AAMA 1505-03, Voluntary Test Methods for Thermal Performance of Fenestration Products with Multiple Glazing Options

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2.3 ASTM International (ASTM)

ASTM C 168-08a, Standard Terminology Relating to Thermal Insulation

ASTM C 177-04, Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot Plate Apparatus

ASTM C 518-04, Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus

ASTM C 1045-07, Standard Practice for the Calculating Thermal Transmission Properties under Steady-State Conditions

ASTM C 1199-00, Standard Test Method for Measuring the Steady-State Thermal Transmittance of Fenestration Systems Using Hot Box Methods

ASTM C 1363-05, Standard Test Method for the Thermal Performance of Building Materials and Envelope Assemblies by Means of A Hot Box Apparatus

ASTM E 283-04, Standard Test Method for Determining Rate of Air Leakage Through Exterior Windows, Curtain Walls and Doors Under Specified Pressure Differences Across the Specimen

2.4 National Fenestration Rating Council (NFRC)

NFRC 100, Procedure for Determining Fenestration Product U-factors

3.0 SUMMARY OF METHOD

3.1 To determine the thermal transmittance (U), of a specimen, it is necessary to know its projected area (A), the heat flow rate (Q), and the temperature difference (ΔT). The heat flux and the temperature difference shall be determined under conditions of steady-state heat transfer. The apparatus shall establish and maintain the desired steady-state temperature difference across the test specimen for the period of time necessary to ensure constant heat flux and to accurately measure the desired quantities.

3.2 To determine the heat flow rate (Q), a five-sided metering box is placed with its open side against the warm face of the surround panel. If the average temperature differential across the walls of the metering box is maintained at a constant zero magnitude, the net transfer of heat between the metering space and the surrounding guard space will be zero in magnitude. The energy input to the metering space will be a measure of the heat flux through the known area of the panel.

3.3 Moisture migration, condensation and freezing within the specimen can cause variations in heat flow. To avoid this, it has been determined that the relative humidity in the warm room must be maintained at, or below, the dew point of the test specimen. This can typically be achieved by maintaining a humidity of 25% or less. Tests in this apparatus, referred to as a guarded hot box, shall be conducted on substantially dry test panels with no effort made to impose or account for the effect of water vapor flow through, or into, the panel during the test.

3.4 A basic principle of the test method is to maintain a zero temperature difference across the metering box wall. Adequate temperature controls and monitoring capabilities are essential. It is recognized that small temperature gradients could occur across the metering box walls due to the limitations of controllers and the effect of the convection currents within the metering box. Since the total wall area of the metering box is often more than twice the metering area of the panel, small temperature gradients through the walls may cause heat flows totaling a significant fraction of the heat input to the metering box if the walls are not well-insulated. For this reason, the metering box walls shall be insulated using materials of high thermal resistance, low heat capacity and high air flow resistance. They shall be instrumented so that the heat flow through them can be calculated and this extraneous heat flow (hot box heat loss or gain) can be included in the specimen heat flow calculation.

3.5 As a primary system control, this test method utilizes surface heat transfer coefficients calculated for a CTS from calibration test results. The test conditions shall be adjusted during CTS calibration tests to obtain surface coefficients with the tolerance of the standard values specified in this method.

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3.6 Test samples of windows, doors and wall sections having irregular surfaces do not have uniform inside and outside surface coefficients. The utilization of a CTS and the selection of and adjustment to standard surface coefficients provides the means by which different constructions of the same general product type can be compared under the same test conditions, wherein the rate of heat flow (Q) through the same area (A) is the only unknown.

3.7 The first intent of this procedure is to measure the thermal transmittance of test samples exposed to the same conditions; it is not intended to create uniform surface coefficients on the test specimens.

The second intent of this procedure is to determine a rating factor to predict the condensation forming characteristics of the product under test. This CRF is calculated from temperature data taken by prescribed location and roving location thermocouples under stabilized test conditions. Locations of the thermocouples are important factors as their placement is intended to provide representative temperature readings. Four thermocouples are used to monitor the coldest sash or frame surfaces. Incorporation of these data points provides a penalizing weighting factor in the calculations.

3.7.1 A primary concern in the thermal evaluation of these products is their air infiltration characteristics under pre-specified (wind) pressure loading conditions. This procedure negates the effect of air infiltration by sealing operable panel perimeters and by either balancing the dynamic wind loading on the cold side with a static air pressure on the warm side or testing both pre-test and post-test air infiltration to ensure it remained at zero. This test method does not include heat loss due to air infiltration. The performance of a given window, door or wall section will vary in regard to air infiltration. Consequently, heat loss due to air infiltration is a separate determination based on infiltration characteristics of the construction and environmental conditions.

3.8 It is important to achieve precise calibration of cold side and warm side surface coefficients to ensure consistent and reproducible test results. A pressure difference across the test specimen and variations in the water vapor content of the warm side air can cause errors in measuring heat flow. These variables must be reduced or eliminated to ensure reproducible test results. Pressure differences across the test specimen must be kept to the absolute practical minimum, or the air infiltration from the cold side to the warm side must be kept to zero to ensure valid test conditions and results.

3.9 Facilities which incorporate a metering box must be capable of maintaining warm side and cold side surface coefficients with the metering box in place. Facilities which utilize a temperature controlled room enclosure as a guard box shall be constructed and instrumented to control and measure heat flow with the same stability and accuracy as those facilities which use a metering box. Calibrated Hot Boxes and other types of hot boxes can be used as long as required conditions are obtained during calibrations and tests.

4.0 SIGNIFICANCE AND USE

4.1 This test method applies only to vertically oriented construction and is intended specifically for representative sized windows, doors and representative glazed wall sections.

4.2 Due to changes in the ratio of materials for different size specimens having the same construction, the thermal transmittance and/or CRF could vary with test specimen size. For these reasons, this test method sets forth specific sizes for product test specimens and their installations.

4.3 The test procedures and equipment may not accurately compare glazed exterior wall sections which have deep exterior projections in relation to test samples with smaller or no exterior projections. The exterior incident air pattern on a small test sample may be seriously disrupted by projections which deflect the air movement. Interior convection also may be affected by large interior projections. These conditions may change the heat flow and thus, the outside and inside surface temperatures. Consequently, the size of the test specimen of this type must be sufficient to minimize these conditions. The areas of glass and/or panels, as well as the size and placement of mullions, must be representative of the full size wall.

4.4 This test method provides for repeatability of results within a given facility for a given test specimen. The method of calibration of test facilities also ensures that test results for a given test specimen are repeatable in different facilities when these facilities meet the calibration requirements.

4.5 The outside surface coefficient is based on the ASHRAE winter conditions of air with 6.7 m/s (15 mph) velocity and of -17.8°C (0.0°F). The inside surface coefficient is based on natural convection on the vertical plane.

4.6 Many conditions can influence thermal transmittance and the formation of condensation; they include the following:

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4.6.1 Type of wall construction and materials used.

4.6.2 For cavity walls, location of thermal barrier in framing members with respect to the cavity.

4.6.3 Absence or presence of drapes and/or shades.

4.6.4 Depth of reveal (recess at sill, jambs and head).

4.6.5 Location of heat sources and air flow rate.

4.6.6 Positive or negative pressure within the building which may cause an increase in air infiltration or exfiltration.

4.6.7 Outdoor wind velocity.

4.6.8 Location of surrounding buildings and type of surrounding terrain.

4.6.9 Variations in window conditions due to installation height on building elevation and direction of elevation.

4.7 The thermal transmittance value (U) can be used to compare similar products of the same test size. Comparison of test results of different size products, for example 915 mm x 1220 mm (36 in x 48 in) with 1220 mm x 1830 mm (48 in x 72 in) windows, may not be appropriate due to the differences in the ratio of sample area to glass edge between the two test samples.

4.8 The CRF may be used for comparative analysis of similar products of the same general configuration.

4.8.1 Refer to Figures 13 and 14 for determination of winter design temperatures, recommended maximum inside humidity levels, and minimum recommended CRF's for these conditions.

4.9 The U-Factor determined by tests at the standard test conditions can be used in estimating design loads for heating and cooling equipment of buildings since the surface coefficients are intended to be the same as those recommended in the ASHRAE method of calculating residential loads. Any use of test U-Factors should be determined by a competent engineer.

4.10 The test U-Factor determined by this method does not include the effects of lower or higher average wind speeds, and does not account for solar heat gain. Consequently, the test value should be appropriately evaluated when used in estimating seasonal product performance.

4.11 The most direct application of the CRF value is its use in the prediction of what set of exterior temperatures, interior temperatures, and interior humidity conditions will initiate condensation. Note that the test method and rating system are based on the assumption that a relatively small amount of condensation in comparison to the overall area is tolerable and will not result in a less accurate prediction of the overall thermal performance of the product.

4.12 This test method does not include heat loss due to air infiltration. The performance of a given window, door or glazed wall section will vary in regard to air infiltration as indicated in Section 3.7.1. Consequently, heat loss due to air infiltration is a separate determination based on infiltration characteristics of the construction and environmental conditions.

5.0 TERMINOLOGY

5.1 Thermal conductivity (λ): The time rate of heat flow through unit area and unit thickness of a homogeneous material under steady-state conditions when a unit surface temperature gradient is maintained in the direction perpendicular to the area. Materials are considered homogeneous when the value of the thermal conductivity is not affected by variation in the thickness or the size of the sample within the range normally used in construction. It is calculated as follows:

$$\lambda = \frac{Q}{A\,(t_1 - t_2)\,(L)} \qquad (1)$$

5.2 Thermal Conductance (C): The time rate of heat flow through a body per unit area from one of its bounding surfaces to the other for a unit temperature difference between the two surfaces, under steady-state conditions. It is calculated as follows:

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$$C = \frac{Q}{A\,(t_1 - t_2)} \qquad (2)$$

5.3 Surface Coefficient (h): The ratio of steady-state heat exchange between the surface and its external surroundings to the temperature difference between the surface and its surroundings. It is expressed in terms of time rate of heat flow per unit area of a particular surface by the combined effects of radiation, conduction and convection for a unit temperature difference between the surface and the air. Subscripts I and II are used to denote indoor and outdoor air spaces, respectively. Surface coefficients are calculated as follows:

$$h_I = \frac{Q}{A\,(t_I - t_1)} \qquad (3)$$

$$h_{II} = \frac{Q}{A\,(t_2 - t_{II})} \qquad (4)$$

5.4 Thermal Transmittance (U): The time rate of heat flow per unit area under steady-state conditions from the air on the warm side of a body to the air on the cold side, per unit temperature difference between the warm and cold air. It is calculated as follows:

$$U = \frac{Q}{A\,(t_I - t_{II})} \qquad (5)$$

(U) is referred to as the overall coefficient of heat transfer. It can be calculated from the thermal conductance and surface coefficients as follows:

$$1/U = 1/h_I + 1/C + 1/h_{II} \qquad (6)$$

5.5 Condensation Resistance Factor (CRF): The numerical value determined by the lower of either the weighted frame temperature (FT) or average glazing temperature (GT) in relation to cold side air temperature t_{II} and warm side air temperature t_I. The weighted frame temperature (FT) is determined from the relationship of the average of 14 predetermined thermocouple temperatures (FT_p) and the average of the coldest sash or frame temperatures determined by four roving thermocouples (FT_r). A weighting factor, W, ratios the average predetermined thermocouple temperatures with the average of the coldest sash or frame temperatures determined by four roving thermocouples. The weighting factor is calculated as follows:

$$W = \frac{FT_p - FT_r}{FT_p - (t_{II} + 10)} \times 0.40 \qquad (7)$$

Where:
t_{II} = temperature of cold side air
10 = arbitrary temperature adjustment
0.40 = arbitrary weighting factor

The weighted frame temperature, FT, is calculated as follows:

$$FT = FT_p\,(1 - W) + W\,FT_r \qquad (8)$$

The average of six pre-determined thermocouple glazing temperatures (GT) and the weighted frame temperature (FT) are used in calculating the CRF for the glass and frame as follows:

$$CRF_G = \frac{GT - t_{II}}{t_I - t_{II}} \times 100 \qquad (9)$$

$$CRF_F = \frac{FT - t_{II}}{t_I - t_{II}} \times 100 \qquad (10)$$

Where: 100 = A multiplier to make CRF a whole number

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CRF numbers shall be whole numbers only. Any number 0.5 and greater shall be rounded to the next whole number. One number, the lower of the CRF_G or CRF_F, shall be reported as the product CRF. At the manufacturer's option the second number, CRF_G or CRF_F, may be reported with its proper subscript and clearly indicating its alternate significance.

5.6 For other definitions relating to thermal insulating materials, refer to ASTM C 168.

5.7 Symbols: The symbols used in the foregoing and subsequent paragraphs have the following significance:

A	=	Area normal to heat flow, m² (ft^2)
A_{CTS}	=	Area of the Calibration Transfer Standard in m² (ft²)
C	=	Thermal Conductance, W/(m² • k) [Btu/(hr • ft^2 • °F)]
Cg	=	Conductance of glass
CRF_F	=	Condensation Resistance Factor for the frame
CRF_G	=	Condensation Resistance Factor for the glass
FT	=	Weighted frame temperature
FT_p	=	Average temperature of 14 predetermined thermocouple locations on frame and sash members
FT_r	=	Average temperature of 4 roving thermocouple locations on the 4 coldest locations of frame and sash members
GT	=	Average temperature of 6 predetermined thermocouple locations on the glazing
h_I	=	Inside surface coefficient, W/(m² • k) [Btu/(hr • ft^2 • °F)]
h_{II}	=	Outside surface coefficient, W/(m² • k) [Btu/(hr • ft^2 • °F)]
L	=	Length of path of heat flow, mm (in).
Q	=	Time rate of heat flow through area A, W (Btu/hr)
Q_{CTS}	=	Measured Calibration Transfer Standard heat flow in W (Btu/hr)
Q_S	=	Net specimen heat flow in W (Btu/hr)
Q_T	=	Total measured heat input into metering room W (Btu/hr)
t_1	=	Average temperature of warm side surface, °C (°F)
t_2	=	Average temperature of cold side surface, °C (°F)
t_I	=	Average temperature of warm side air, °C (°F)
t_{II}	=	Average temperature of cold side air, °C (°F)
T	=	Lower of FT or GT
U	=	Thermal Transmittance, W/(m² • k) [Btu/(hr • ft^2 • °F)]
W	=	A weighting factor for calculation of FT
λ	=	Thermal Conductivity, W • mm/(m² • k) [Btu • in/(hr • ft^2 • °F)]

6.0 APPARATUS

6.1 The thermal test facility is intended to subject a test specimen to differential interior and exterior temperatures and a standard wind loading condition, and to accurately measure the thermal transmittance, air infiltration rate and surface temperatures of that specimen.

6.2 Construction details, energy metering apparatus, and controls are the responsibility of the test laboratory. Details of chamber design and construction, instrumentation and operation manuals shall be documented. Refer to ASTM C 1363 for more details. See Figure 1 for reference use.

6.2.1 When the thermal test facility is used to conduct air infiltration tests in accordance with ASTM E 283, the cold and warm chambers shall be capable of withstanding internal and external pressures required by the test. All joints, corners and other openings of the test chamber shall be carefully and completely sealed.

6.3 COLD CHAMBER

6.3.1 The cold chamber shall include a means of generating a uniform perpendicular air flow sufficient to provide the required exterior surface coefficients prescribed in Section 7.4. The plenum discharge shall be positioned and the air baffles adjusted such that the cold side h_{II} coefficient is within the tolerance specified in Section 7.4.4.

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6.3.2 A refrigeration unit and controls are required to automatically maintain a temperature of -18.0°C (-0.4°F) within ± 0.3°C (± 0.5°F).

6.4 WARM CHAMBER

6.4.1 A metering box or room with heating devices and controls are required to automatically maintain a temperature of 21.1°C (70.0°F) within ± 0.3°C (± 0.5°F).

6.4.2 A system for controlling the humidity of the warm room air shall be provided. Relative humidity of the warm room shall not exceed 25% at any time during the test. A measurement instrument for measuring and recording the relative humidity is required. The instrument shall be accurate to within ± 5%. At no time shall condensation be allowed to form on the test specimen. This may require lowering the humidity levels below the allowed range for high U-Value test specimens.

6.5 A fixed wall or removable surround panel of very low thermal transmittance shall separate the cold chamber from the warm chamber. All joints shall be sealed. This wall or panel shall have a nominal opening designed to receive a calibration transfer standard panel as described in Section 7.1. The surround panel material shall be characterized by using ASTM C 177 or ASTM C 518 apparatus at three different mean temperatures. The correlation between material conductivity and mean temperature shall be obtained from the test results and used for all hot box tests including CTS calibrations to obtain net heat flow of the specimen or CTS.

6.6 TEMPERATURE MEASURING EQUIPMENT

6.6.1 All thermocouples shall be fabricated from the same lot of premium grade 24 gauge or lighter copper constantan type T thermocouple wire.

6.6.2 The cold room air temperature shall be determined by a vertical grid network located 75 mm (3 in) from the surface of the surround panel. The minimum thermocouple density, for the grid, shall be defined in ASTM C 1363-05.

6.6.3 The warm room air temperature shall be determined by a vertical grid network located 75 mm (3 in) from the surface of the surround panel. The minimum thermocouple density, for the grid, shall be as defined in ASTM C 1363-05.

6.6.4 The instrumentation shall indicate temperature readings of the thermocouples within 0.06°C (0.1°F).

6.7 PRESSURE MEASURING EQUIPMENT (FOR PRESSURE BALANCE APPARATUS ONLY)

6.7.1 If required, cold room air pressure detection shall be accomplished by measuring the total pressure 150 mm (6 in) inside the plenum as shown in Figure 1.

6.7.2 If required, the warm room pressure detection point shall be representative of overall room conditions and not located near known sources of air movement.

6.8 DATA ACQUISITION/CONTROL SYSTEM

6.8.1 The thermal test chamber shall be equipped with an automatic data acquisition system capable of reading and recording all temperature and heat flow data every five minutes (maximum). All five-minute data shall be recorded and later processed and averaged based on these data points. The system must also be capable of measuring and recording humidity and pressure differential at five-minute intervals (maximum). This information is necessary in order to determine the stabilization and evaluation periods as defined in Sections 7.3 and 9.3.9.

7.0 METERING CHAMBER EXTRANEOUS HEAT LOSS CALIBRATION

7.1 The metering chamber extraneous heat loss includes heat losses through chamber walls, wall edges, interface between metering chamber wall perimeter and the surround panel surface. This heat loss shall be subtracted from the total heat input to the warm side to obtain net heat flow through the test specimen. Follow the detailed procedure and conditions as specified in ASTM C 1363-05.

7.2 The thermal test facility shall be calibrated with at least two CTS panels, constructed as shown in Figure 3 to establish cold and warm side surface coefficients. These two CTS panels shall cover approximately the smallest and largest sizes of

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