National Fenestration Rating Council Incorporated

NFRC 100:
Section B: Procedure for Determining Door Systems Product Thermal Properties (Currently Limited to U-Factors)

Foreword

Consumers today have many energy saving fenestration product options to choose from. Advances in fenestration product technologies include the use of low-emissivity coatings, low-conductivity gas-fills, insulating spacers, and new frame materials and designs. While the use of one or more of these components will improve fenestration product thermal performance, it will also increase the complexity of the selection process.

This procedure has been developed by the National Fenestration Rating Council (NFRC) to meet the need for a uniform and accurate means for evaluating the U-factors of fenestration systems using state-of-the-art simulation procedures validated with physical testing. The U-factors established by this procedure are determined at a fixed set of environmental conditions. Consequently, the U-factors determined using this procedure may not be appropriate for directly determining seasonal energy performance.

This document supercedes and replaces *NFRC 100-B (1995)*.

A procedure to evaluate total product solar heat gain coefficients and visible transmittances is addressed in *NFRC 200*; to determine glazing layer optical properties in *NFRC 300* and *NFRC 301*, and to determine air leakage rates in *NFRC 400*. A procedure to address condensation resistance factors is under development.

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

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B1.0 Purpose

To specify a method or the method for determining exterior door systems thermal transmittance (U-factor).

B2.0 Scope

B2.1 Exterior Door Systems And Effects Covered by *NFRC 100, Section B*

(a) Products of all frame and door materials including, but not limited to, aluminum, steel, thermally broken steel and aluminum, wood, vinyl, reinforced vinyl, fiberglass, and plastic, used singly or in combination;

(b) Exterior door products, both glazed and unglazed, including, but not limited to, swinging (hinged) doors, sidelites, and fixed doors used as sidelites or window walls. Note: Doors may be tested under Section A or Section B of *NFRC 100* at the discretion of the manufacturer;

(c) Single or multiple assemblies of exterior swinging doors, and sidelites;

(d) Products of any size;

(e) Products of all glazing materials, tints, and types such as, but not limited to, clear glass, tinted glass, thin plastic films (internally suspended, internally applied, or externally applied), rigid plastics, and translucent fiberglass with or without any solar control, low-E or any other partially transparent coating;

(f) Products with any or no gap width between glazing layers;

(g) Products with any gas-fill between glazing layers such as, but not limited to, air, argon, krypton, SF_6, CO_2, or mixes of these gases;

(h) Products with any spacer or spacer systems between glazings, such as, but not limited to, metallic, non-metallic, or composite spacers;

(i) Products utilizing any and all glazing dividers such as, but not limited to, interior, exterior, or between glazing grills, muntin bars, true divided lites, or simulated divided lites;

(j) Products utilizing shading systems between glazings limited to those that are an integral, i.e., non-removable, part of the product;

(k) Products designed for vertical installation only;

(l) Products utilizing foam as core material; and

(m) Garage doors with or without glazing areas. These procedures are under development.

B2.2 Door Products and Effects Not Covered by *NFRC 100, Section B*

(a) Horizontal sliding patio doors; these products are covered in Section A.

(b) Products with shading systems other than those listed in B2.1(j);

(c) Thermal performance changes of a door system over the course of time, *i.e.*, durability;

(d) Issues of water tightness, structure, and air infiltration;

(e) Any site-built products; and

(f) Transoms (see *NFRC 100*)

B3.0 Definitions

Door/slab/slab door/fixed panel: a side hinged attachment, nominal >610 mm (24 inches) in width, whose primary function is to allow human egress, or non-operable panels >610 mm (24 inches) in width. (Not intended for rating fixed windows).

Door system: the door, slab, or slab door together with the surrounding frame, weatherstrip, sill, and sweep.

Sidelite: a hinged or fixed slab construction nominals < 610 mm (24 inches) in width.

U-factor: the heat transmission in a unit time through a unit area of a test specimen and its boundary air films, induced by a unit temperature difference between the environments on each side.

(a) Frame U-factor (U_f): the heat transfer through all frame members divided by the induced temperature difference and the frame area (as defined in Section B3.22).

(b) Lite frame U-factor (U_{lf}): the heat transfer through all lite frame members divided by the induced temperature difference and the lite frame area (as defined in Section B3.21)

(c) Divider U-factor (U_d): the U-factor representative of the divider area (as defined in Section B3.17).

(d) Divider edge U-factor (U_{de}): the U-factor representative of the divider edge area (as defined in Section B3.18).

(e) Edge-of-lite U-factor (U_e): the U-factor representative of the edge-of-lite area (as defined in Section B3.19).

(f) Center-of-lite U-factor (U_c): the U-factor representative of the center-of-lite area (as defined in Section B3.20).

(g) Door core U-factor (U_{dc}): the U-factor representative of the door core area (as defined in Section B3.23).

(h) Panel U-factor (U_p): the U-factor representative of the panel area (as defined in Section B3.24).

(i) Edge-of-panel U-factor (U_{ep}): the U-factor representative of the edge-of-panel area (as defined in Section B3.25).

(j) Exterior door system U-factor (U_t): the U-factor representative of the total exterior door system (as defined in Section B3.26).

Product line: a given series of door systems defined by skin material, core material, and edge of door construction that differ only in:

--size
--panel and cut out configurations
--the replacement of core and/or panel area with glazing system

--center-of-lite characteristics and edge-of-lite characteristics such as glazing types, gap widths, glazing lite areas, use of dividers, use of spacers, glazing coatings, gas fills
--opening/non-opening configurations, e.g. X vs O, XX vs XO
--inswing or outswing operation
--door slab changes where one component of the same physical shape with a thermal conductivity that does not differ by more than a factor of 10
--frame components, e.g. headers, jambs, and threshold
--variations in frame and/or door interior/exterior finish, paint, varnish or stain do not constitute different product lines provided that each of these variations do not change the surface emittance by more than 0.10.

Individual product: any one specific exterior door product, of any size, within a product line specific to center-of-lite and edge-of-lite characteristics, panel characteristics, and opening/non-opening configurations. See Section 4.2 of *NFRC 100* for further details.

Baseline product: For baseline product definition refer to the guidelines prescribed in *NFRC 100*, Section 4.3. The baseline product is the individual product selected for validation testing. To validate lites and lite frame simulations, the baseline product for product lines which include glazing options must include a lite.

Frame: the structural members into which the door leaf is installed, including the hinge jamb, latch jamb, header, sill (threshold), door bottom sweep, and perimeter weatherstrip.

Door leaf: the pivoted or swinging portion of a door system, sometimes referred to as a door slab.

Steel door: a door manufactured from steel skins which may be coated with paint, plastic, wood veneers or other finishes. The door leaf may or may not incorporate a structural perimeter, including but not limited to, materials of wood, wood products, composites, or other reinforcing materials. The core of the door leaf may be hollow or filled with material, including but not limited to, insulating polyurethanes, styrenes or honeycombs.

Composite door: a door manufactured from skins molded from plastics, fiberglass compounds, compressed composites or other non-metallic materials. The door leaf may or may not incorporate a structural perimeter constructed from materials, including but not limited to, wood, wood products, composites, or other

reinforcing materials. The core of the door leaf may be filled with materials including but not limited to insulating polyurethanes, styrenes, or honeycombs.

Wood door: a door manufactured from solid wood, wood veneers, wood laminates or wood composites or a combination thereof. Such doors are generally assembled from stiles, rails and panels, but may also be wood flush doors of solid or hollow core construction.

Embossed/Raised Panel: decorative areas on a door leaf. On a steel door these may be pressed into the steel skin or achieved by the application of plastic or other material plant-ons. On composite doors, these are usually molded into the door skin or may also be achieved by the use of plant-ons. Wood doors usually incorporate thinner wood sections assembled into the stiles and rails. Note: See Figure B6 for a typical 6-panel layout.

Decorative Panel/Panel Insert: a decorative raised molding which is inserted into a cut-out in an insulated door slab. Decorative panels are typically molded from a composite material. The gap between the two halves of the panel may be filled with an insulating material.

Sight line: the line formed by the inner edge of the lite frame and the glazing material in a plane perpendicular to the door core surface.

B3.16 Projected door system area (A_{ds}): the area of the rough opening in the wall, for the door system, less installation clearance. See Figures B1, B2, B3, and B4.

Divider area (A_d): the projected area in the plane parallel to the door system glazing of all true dividers. Excluded are all dividers for simulated divided lites, either internal or external, and interior or exterior decorator grills. See Figures B1, B2, B3, B4, and B5.

Divider edge area (A_{de}): all glazed vision areas within 64mm (2.5 in.) of any part of a divider area. The divider edge area shall exclude any edge-of-glass area contained within the following defined area. See Figures B1, B2, B3, B4, and B5.

Edge-of-lite area (A_e): all glazed vision areas within 64 mm (2.5 in.) of the door lite frame sightline, excluding any area contained in the above defined divider area. See Figures B1, B2, B3, B4, and B5.

Center-of-lite area (A_c): all glazed areas except those within 64 mm (2.5 in.) of the lite frame sight line, or within 64 mm (2.5 in.) of any part of a primary door and/or frame and/or divider. See Figures B1, B2, B3, B4, and B5.

Lite frame area(A_{lf}): the projected area extending from the sightline of the lite frame into the surrounding homogeneous door core surface for a distance of 25 mm (1.0 in.) beyond the outer edge of the lite frame, and parallel to the door core surface. See Figures B1, B2, B3, B4, and B5.

Frame area (A_f): the projected areas of the door jambs, header, threshold, door bottom sweep and the peripheral structural elements of the door leaf, in a plane parallel to the door core surface. See Figures B1 and B2

(a) Wood Doors: the projected areas of the door jambs, header, and threshold and door bottom sweep in a plane parallel to the door core surface. See Figures B3 and B4.

Door core area (A_{dc}): the projected area of the door less the frame, frame edge, lite frame, edge-of-lite, center-of-lite, divider edge, divider, edge-of- panel, and panel areas. See Figures B1, B2, B3, and B4.

Panel area (A_p): the sum of the projected areas of all decorative panels of uniform thickness, in a plane parallel to the door core surface. See Figures B1,B2, B3, and B4.

Edge-of-panel area (A_{ep}): the projected area extending from the point of uniform thickness to the point which includes 25 mm (1.0 in.) of door core material from the interface of any decorative bead or from the interface of the panel cutout and the door core. See Figures B1, B2, B3, and B4.

Exterior door system: the total door system which includes all frame, frame edge, lite frame, divider, divider edge, edge-of-lite, center-of-lite, door core, edge-of-panel, and panel areas.

Default frame for slab testing:

(a) 116 mm (4-9/16 in.) softwood single rabbetted frame of 8 to 12% moisture content, with a specific gravity of 0.35 to 0.45, and with a dual durometer plastic compression weatherstrip and flexible sweep. The door sill shall be a standard 116 mm (4-9/16 in.) extruded aluminum sill with a wall thickness of 1.4 mm (0.055 in.)

to 1.6 mm (0.065 in.) with a poured in place polyurethane filled and debridged thermal break without a wood substrate.

(b) Steel default frame shall consist of a 146 mm (5-3/4 in.) - 16 Ga. pressed steel frame with a minimum 121 mm (4-3/4 in.) throat depth, applied weather-strip, and an aluminum non-thermally broken sill with a sill wall thickness of 1.4 mm (0.055 in.) to 1.6 mm (0.065 in) and no substrate. Frame shall consist of a head jamb, hinge jamb, lock jamb, and necessary anchors and reinforcings for hinges and locks. See Figures B7 and B8-2.

Thermally broken sill: the minimum design characteristics to qualify as thermal-break product are:

(a) the material used as the thermal-break must have a thermal conductivity of not more than 35.4 W/m^{2}K (3.6 Btu-in/hr-ft'^{2}-F), and;

(b) the thermal-break must produce a gap of not less than 5.3 mm (0.21 in.), and;

(c) all metal members of the product exposed to interior and exterior air must incorporate a thermal-break meeting the criteria in (a) and (b) above.

In addition, the product must be clearly labeled by the manufacturer that it qualifies as a thermally broken product as defined above.

Outdoor air ventilator assembly: a device, other than a sash unit, for the purpose of controlling the passage of air though a fenestration product.

B4.0 Standard Conditions & Requirements

This section presents standard tests and calculations Standard for determining total or component door system U-factors. Read and follow Section B5.0, Door System and Thermal Properties, before performing any of the Requirements tests or calculations identified in this section.

B4.1 Test Procedures: There are two different test procedures approved for use in this procedure. Section B4.2 defines the Total Door System Test Procedure, its standard conditions, and requirements. Section B4.3 defines a Component Test Procedure, which may only be utilized with written approval by NFRC.

B4.2 Total Door System Test Procedure
See Section 5 of *NFRC 100*

B4.3 Component Test Procedure
See Section 5.1.2 of *NFRC 100*

B4.4 Model Product Line Sizes and Configurations for Reporting U-factors - For Model Product Line Sizes and Configurations for Reporting U-factors see *NFRC 100*, Section 5.2.

Each door of a double door or swinging patio unit will be rated as the single door of the same style or model. For opaque doors with flat raised or embossed panels, a 6-panel layout shall be representative of all panel doors within a product line of the same panel thickness. For non-wood doors only, this layout may also be considered representative of flush doors. See Figure B6 for typical 6-panel layout.

B4.5 Representative Product Line Sizes for Testing of Production Line Door System Products
For representative product line sizes refer to *NFRC 100*, Section 5.3. For representative product line system model size for doors and sidelites of the complete system (slab, frame, and sill) must be within ± 25 mm (1.00 in.) of the model sized listed in Table 1 of the *NFRC 100* document.

B4.6 Simulation Procedures
All computational procedures shall comply with the conditions of *NFRC 100*, Section 5.4.

B4.7 Approved Center-of-Lite Computational Programs
WINDOW 4.1 or more recent NFRC-approved version Reference |7,8|

B4.8 Approved 2-D Heat Transfer Computational Program
FRAME 4.0 and THERM 2.0 or more recent NFRC-approved version Reference |9|.

The conductance and emittance of many materials not contained in Frame *3.1* may be listed in the 1993 ASHRAE Handbook of Fundamentals, and in the CRC Handbook of Physics and Chemistry. Thermal conductance can also be measured by a reputable laboratory using ASTM C 177 of ASTM C 518. To measure glass emittance, use *NFRC 301-93*: standard test method for emittance of specular surfaces using spectrometric measurements.

B4.9 Approved Total Exterior Door System U-factor Calculational Procedure

The total door system U-factor shall be calculated as outlined below:

(a) Determine all of the following, as applicable:

(1) Panel(s) U-factor using the approved 2-D heat transfer computational program;

(2) Door core U-factor using the approved 2-D heat transfer computational program;

(3) Center-of-lite U-factor using the approved center-of-lite computational program, with input as needed from the approved center-of-lite conductance test procedure given in Section B4.1.2.(a);

(4) Edge-of-lite U-factor using the approved 2-D heat transfer computational program;

(5) Divider U-factor using the approved 2-D heat transfer computational program;

(6) Divider edge U-factor using the approved 2-D heat transfer computational program;

(7) Lite frame U-factor using the approved 2-D heat transfer computational program;

(8) Frame U-factor using the approved 2-D computational program;

(9) Edge-of-panel U-factor using the approved 2-D computational program; and

(10) The component areas in square feet, to the nearest .001 m^2 (0.01 ft^2) of:

* Frame area
* Lite frame area
* Divider area
* Divider edge area
* Edge-of-lite area
* Center-of-lite area
* Door core area
* Panel area
* Edge-of-panel area
* Projected total exterior door system area

(b) Perform the following calculations as shown in Equation B1:

(1) Multiply the center-of-lite, divider, edge-of-lite, divider edge, panel, door core, lite frame, edge-of-panel, and frame U-factors by their corresponding areas;

(2) Total these nine quantities; and

(3) Divide this total by the projected total exterior door system area to produce computed total door system product U-factors for all the door systems in the matrix of required U-factors.

$$U_t = [(U_f*A_f)+(U_{lf}*A_{lf})+(U_d*A_d)+(U_{de}*A_{de})+(U_e*A_e)+(U_c*A_c)+(U_{dc}*A_{dc})+(U_p*A_p)+(U_{ep}*A_{ep})]/A_{ds}$$

[Equation B1]

Where: U_t = Total Door System U-factor
U_f = Frame U-factor
A_f = Frame Area
U_{lf}= Lite Frame U-factor
A_{lf}= Lite Frame Area
U_d= Divider U-factor
A_d= Divider Area
U_{de}= Divider Edge U-factor
A_{de}= Divider Area

U_e= Edge-of-Glass U-factor
A_e= Edge-of-Glass Area
U_c= Center-of-Lite U-factor
A_c= Center-of-Lite Area
U_{dc}= Door Core U-factor
A_{dc}= Door Core Area
U_p= Panel U-factor
A_p= Panel Area
U_{ep}= Edge-of-panel U-factor
A_{ep}= Edge-of-panel Area
A_{ds}= Projected Total Exterior Door System Area

B4.10 Equivalent

Simulated and tested U-factors for given total fenestration product shall be considered equivalent if they comply with *NFRC 100*, Section 5.5.

B5.0 Door System Thermal Properties

This section presents and references methods for determining specific door system heat transfer properties or quantities used in the determination of these properties. At this time, the scope of these properties is limited to total door system U-factor.

B5.1 If a manufacturer wishes to simulate their door slab in both the wood and steel default frames (or proprietary wood and steel frames), the manufacturer may either simulate all individual products in the matrix, or develop an add-on for the steel frame. To develop the steel frame add-on, all the individual products in the matrix are simulated in the wood default frame. The best performing product in the wood frame is then simulated in the steel frame. The difference between these two U-factors is the steel frame add-on. The U-factor for the remaining products in the steel frame is the U-factor for that product in the wood frame plus the steel frame add-on.

For sill options with a higher U-factor than the default sill, an add-on for the sill can be determined by simulating the best performing system with both sills and using the difference as a sill add-on.

B5.2 Total Door System U-factors for Model Sizes

Total Fenestration Product U-factors for model sizes shall be calculated in accordance with *NFRC 100*, Section 6.1.

To reduce the number of individual products necessary to represent a product line refer to the guidelines prescribe in *NFRC 100*, Section 6.2.

Products of the same style or model number within the same product line which differ from one another in size only, shall be assumed to have the same U-factor as the 914 mm x 2032 mm (36 in. x 80 in.) nominal test size in the case of door systems, or the 356 mm x 2032 mm (14 in. x 80 in.) nominal test size in the case of sidelites. Separate calculations or testing on these products is not required.

In simulating U-factors, continuous single pane stained glass can be assumed to have the same properties as clear glass of the same glass thickness. This is also true for continuous single pane stained glass which is the middle layer of a triple glazed window, provided that the cavity between the stained glass and the surrounding glass is greater than 3 mm (1/8 in). If the cavity between the stained glass and the surrounding glass is less than 3 mm (1/8 in), either each stained glass pattern shall be considered to be a different individual product or the optional caming pattern as shown in the tables below can be used to represent all stained glass caming patterns. If the stained glass is not continuous it should not be considered in the U-factor analysis of the window. A triple glazed window with non-continuous stained glass as the middle layer shall be simulated as though it was a double glazed window, regardless of the cavity thickness between the stained glass and the surrounding glass. Products may be grouped based on glazing size. These groups are unglazed, 1/4, 1/2, 3/4, and full lite. Unglazed are solid doors, either flush or panel doors. The glazing designations are defined as follows:

	Flush Doors			Embossed, Stile and Rail Panel Doors	
Individual Product	**For Doors with**	**Simulated or Test as**	**Optional Caming Pattern(1)**	**Glass inserts for a 6-panel door**	**Optional Caming Pattern(1)**
1/4 glass	0.265 m^2 (410 sq. in.) or less	559mm x 483mm (22" x 19")	5 Vert 3 Hor	replace upper two panels and intermediate stiles and rails	< 24" use 5 Vert
1/2 glass	0.265 m^2 - 0.581 m^2 (410-900 sq. in.)	559mm x 1041mm (22" x 41")	5 Vert 8 Hor	replace upper four panels and intermediate stiles and rails	24" use 6 Vert
3/4 glass	0.581 m^2 - 0.710 m^2 (900-1100 sq. in.)	559mm x 1270mm (22" x 50")	5 Vert 10 Hor	replace lower four panels and intermediate stiles and rails	For horiz. use the formula: (H/4.5) - 1
full glass	0.710 m^2 (1100 sq. in.) or more	559mm x 1626mm (22" x 64")	5 Vert 13 Hor	replace all panels and intermediate stiles and rails	

	Flush Sidelites			Embossed, Stile and Rail Panel Sidelites	
Individual Product	**For Sidelites with**	**Simulated or Test as**	**Optional Caming Pattern(1)**	**Glass inserts for a 6-panel door**	**Optional Caming Pattern(1)**
1/4 glass	0.042 m^2 (65 sq. in. or less)	203mm x 203mm (8" x 8")	1 Vert 1 Hor	replace upper panel and intermediate stiles and rails	Vert 1
1/2 glass	0.042 m^2 - 0.226 m^2 (65 to 350 sq. in.)	203mm x 914mm (8" x 36")	1 Vert 8 Hor	replace upper two panels and intermediate stiles and rails	For horiz. use the formula: (H/4.5) - 1
3/4 glass	0.226 m^2 - 0.297 m^2 (350 to 460 sq. in.)	203mm x 1270mm (8" x 50")	1 Vert 10 Hor	replace lower two panels and intermediate stiles and rails	
full glass	more than 0.297 m^2 (460 sq. in.)	203mm x 1626mm (8" x 64")	1 Vert 13 Hor	replace all panels and intermediate stiles and rails	

(1) Note: When adding caming to the glazing option in the patterns as designated, the center-of-glass becomes non-existent and the entire glazing becomes edge-of-lite.

Sidelites with lites shall be grouped as separate Individual Products at the lite sizes indicated in the Table below.

Simulation shall be performed on a single rectangular shaped lite at the sizes of the Table below. The Baseline Product must have a lite size that is closest to the size indicated in the Table below and be within the area range specified. Different glazing options are still considered to be separate Individual Products.

Individual Product	for sidelites with	Simulate or Test Glazing Sizes
1/4 glass	41925 mm^2 (65 in^2) or less	200 mm x 200 mm (8 in x 8 in)
1/2 glass	> 41925 mm^2 to 225750 mm^2 (65 in^2 to 350 in^2)	200 mm x 910 mm (8 in x 36 in)
3/4 glass	> 225750 mm^2 to 296700 mm^2 (350 in^2 to 460 in^2)	200 mm x 1270 mm (8 in x 50 in)
Full glass	more than 296700 mm^2 (460 in^2)	200 mm x 1630 mm (8 in x 64 in)

B5.3 Product Line Validated Computational Procedure

To determine the Product Line Validated Computational Procedure refer to the guidelines prescribed in *NFRC 100*, Section 6.1.1.

B5.4 Total Door System Product U-factors for Non-Model Sizes

Total Fenestration Product U-factors for Non-Model Sizes shall be calculated in accordance with *NFRC 100*, Section 6.4.

B5.5 Custom Product Testing

A custom product is an NFRC individual product which must meet all of the following criteria:

a) A custom product must be composed of unique frame/sash components not covered within an existing standard product line's U-factor matrix.

b) The specific configuration of a specialty product must not be offered publicly in a manufacturer's catalog or similar literature.

c) Less than 500 units must be produced annually or if more than 500 units are produced annually, they must be produced as part of one

purchase order. U-factors for specialty products which meet all three criteria above may be represented by U-factors generated for a similar stock individual product made of the same operator type and materials. A simulation analysis from an accredited simulator confirming that the specialty product's U-factor is equal to or lower than the stock product's must be provided to the NFRC or their designated representative.

B5.6 New Products Within a Product Line

Additions to a Product Line shall follow the guidelines prescribe under *NFRC 100*, Section 6.3.

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B6.0 References

[1] ASTM C-177: Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus. Annual Book of Standards. Philadelphia, PA.

[2] ASTM C-518: Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Heat Flow Apparatus. Annual Book of Standards. Philadelphia, PA.

[3] ASTM C-1045: Practice for Calculating Thermal Transmission Properties from Steady-State Heat Flux Measurements. Annual Book of Standards. Philadelphia, PA.

[4] ASTM C-1199: Method for Measuring Steady-State Thermal Transmittance of Fenestration Systems Using Hot-Box Methods. Annual Book of Standards. Philadelphia, PA

[5] ASTM E-1423: Practice for Determining the Steady-State Thermal Transmittance of Fenestration Systems. Annual Book of Standards. Philadelphia, PA.

[6] ASTM C-1363: Standard Test Method for the Thermal Performance of Building Assemblies by Means of a Hot Box Apparatus

[7] ANSI/ISDI-107: Thermal Performance Standard for Insulated Steel Door Systems. American National Standards Institute, Inc. New York, N.Y.

[8] Wright, J.L. and Sullivan, H.F., Glazing System U-factor Measurement Using A Guarded Heater Plate Apparatus. ASHRAE Transactions, 1988. OT-88-07-3.

[9] D.K. Arasteh, E.U. Finlasson, C. Huizenga, Lawrence Berkeley Laboratory, Windows and Daylighting Group. WINDOW 4.1: A PC Program for Analyzing Window Thermal Performance in Accordance with Standard NFRC Procedures, LBL Report 35298. Berkeley, CA.

[10] E.U. Finlasson, D.K. Arasteh, C. Huizenga, M.D. Rubin, M.S. Reilly/ WINDOW 4.1: Documentation of Calculation Procedures, LBL Report 33943, July, 1993.

[11] Carpenter, Steve and McGowan, A.G.
FRAME 3.1. Enermodal Engineering, Waterloo, Ont.

[12] ANSI A250.1: Thermal Performance for Insulated Steel Door System.
American National Standards Institute Inc., New York, New York.

FIGURE B1: EXTERIOR STEEL/COMPOSITE DOOR SYSTEM AREA SCHEMATIC: VERTICAL ELEVATION.

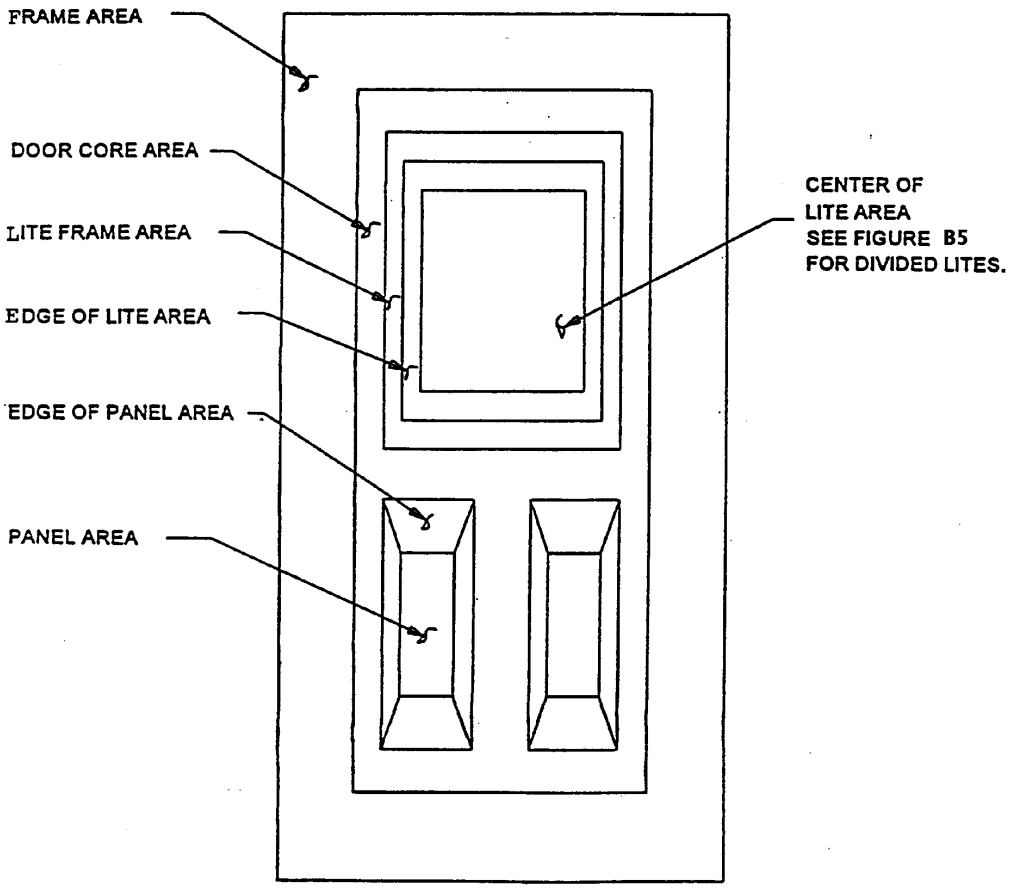
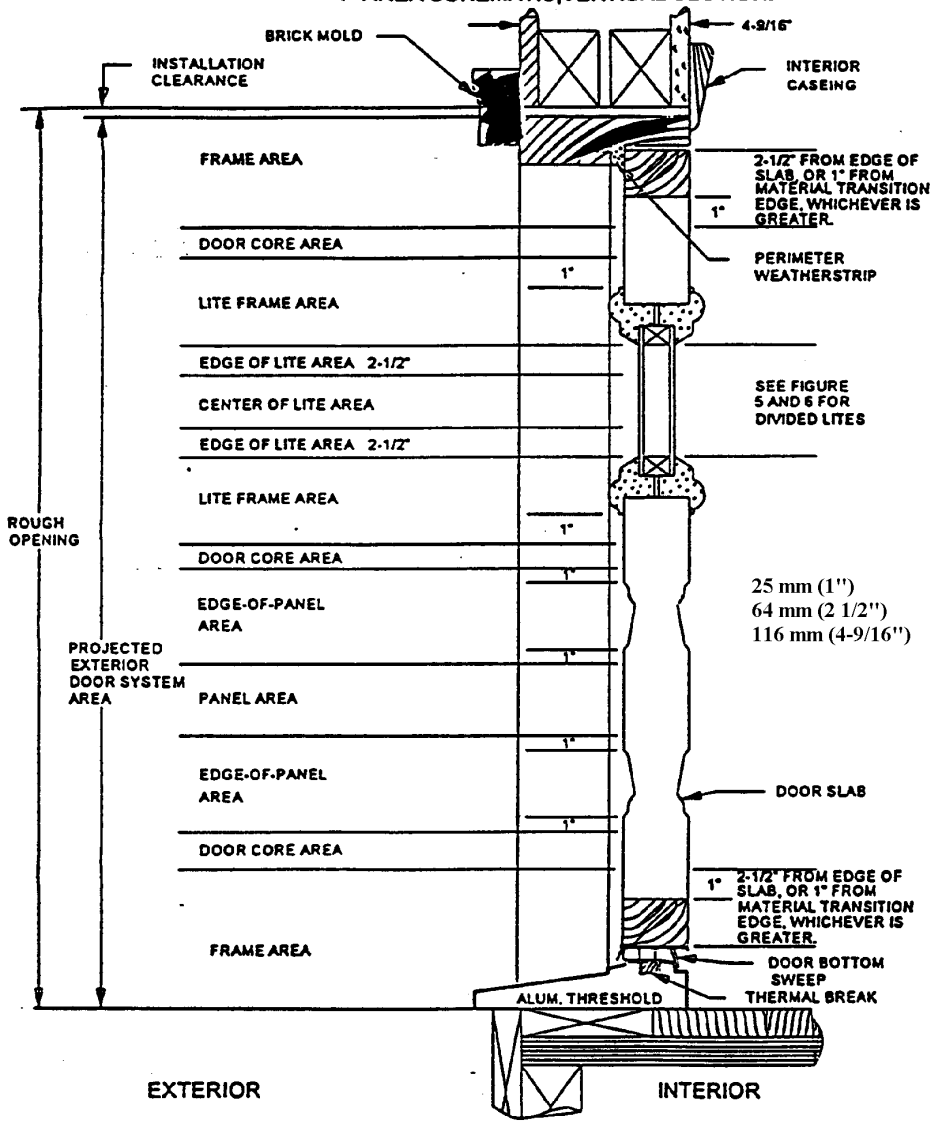


FIGURE B2: EXTERIOR STEEL/COMPOSITE DOOR SYSTEM AREA SCHEMATIC,VERTICAL SECTION.



THE PROJECTED DOOR PRODUCT AREA IS THE ROUGH OPENING AREA LESS INSTALLATION CLEARANCES. SIDE-LITE AREA SCHEMATIC MAY BE IDENTICAL OR SIMILAR WITHOUT PERIMETER WEATHERSTRIP & BOTTOM SWEEP

FIGURE B3: EXTERIOR WOOD DOOR SYSTEM AREA SCHEMATIC: VERTICAL ELEVATION.

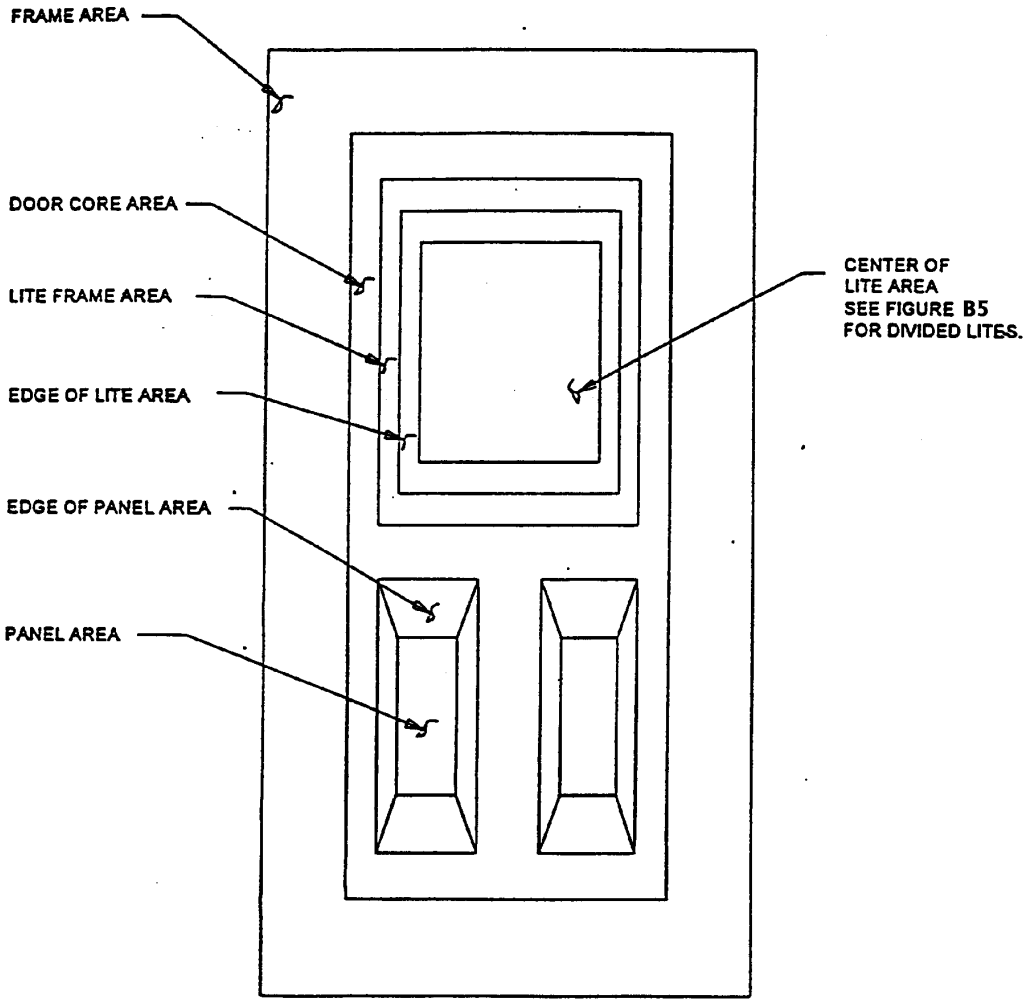
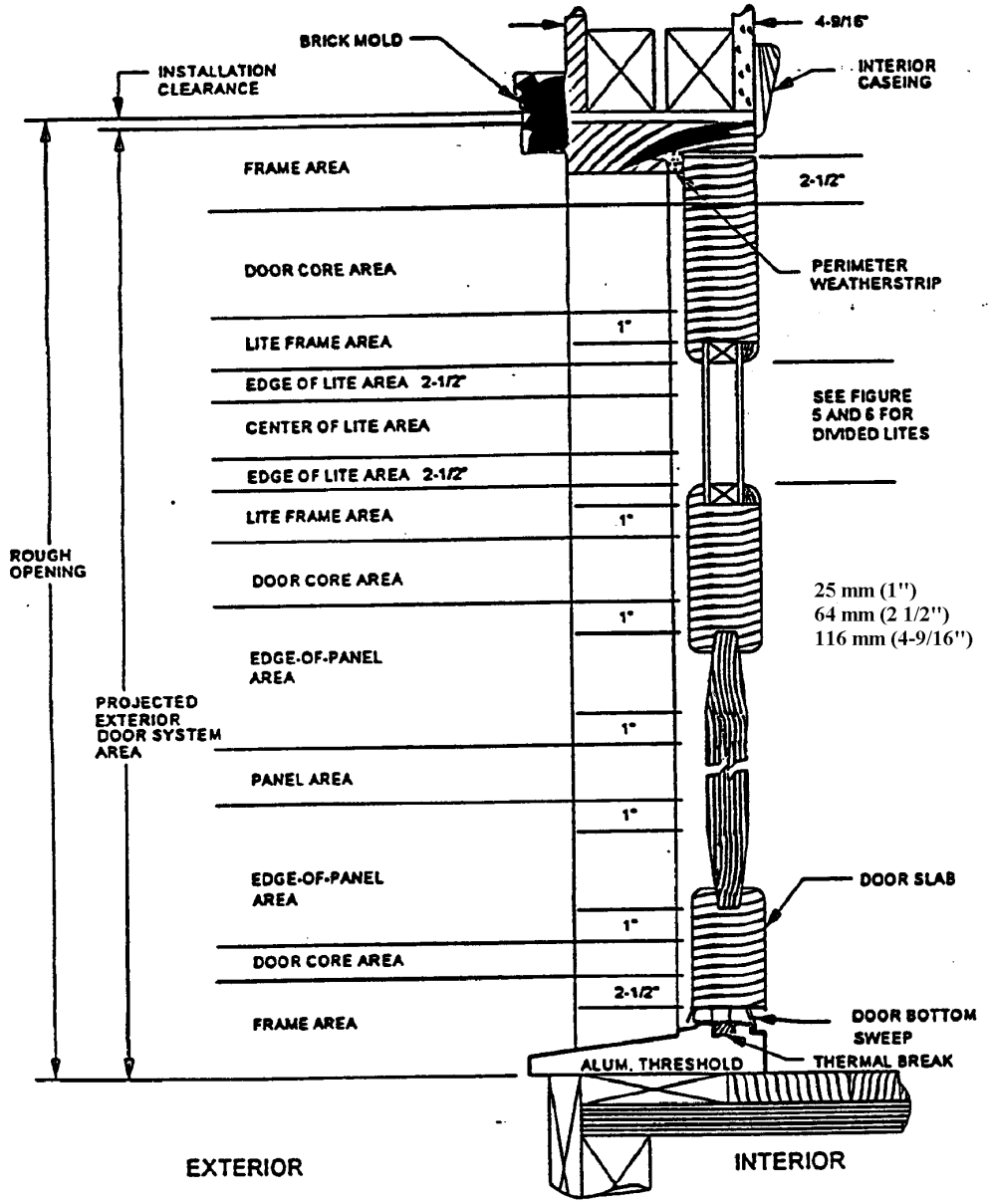
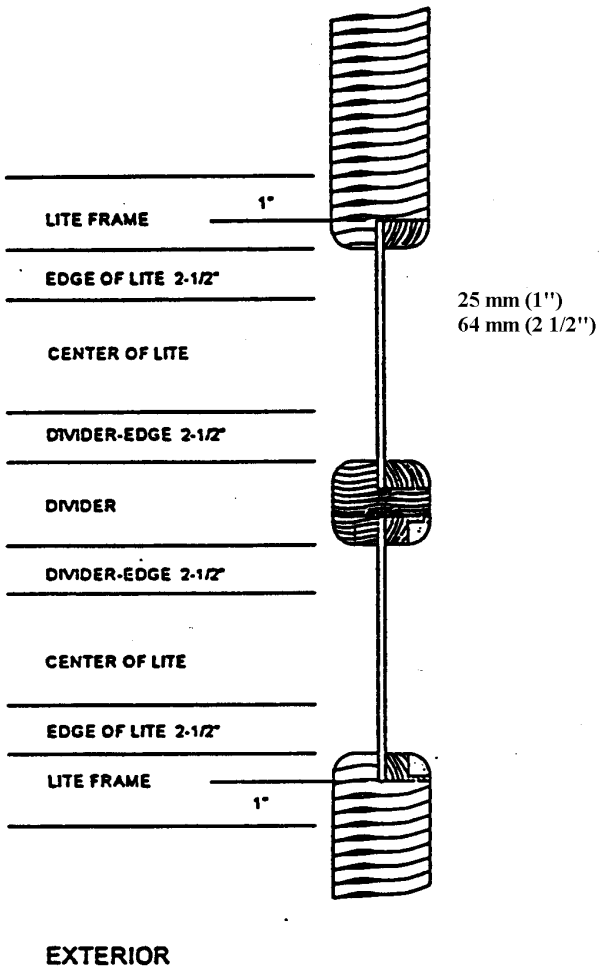


FIGURE B4: EXTERIOR WOOD DOOR SYSTEM AREA SCHEMATIC,VERTICAL SECTION.



THE PROJECTED DOOR PRODUCT AREA IS THE ROUGH OPENING AREA LESS INSTALLATION CLEARANCES. SIDE-LITE AREA SCHEMATIC MAY BE

FIGURE B5: DOOR LITE WITH DIVIDER AREA SCHEMATIC: VERTICAL SECTION.



CENTER-OF-LITE, EDGE-OF-LITE, DIVIDER, DIVIDER-EDGE, AND FRAME AREAS FOR A TYPICAL DOOR LITE PRODUCT. EDGE-OF-LITE AND DIVIDER-EDGE AREAS ARE 2-1/2" WIDE.

Figure B6
Typical 6-Panel Layout

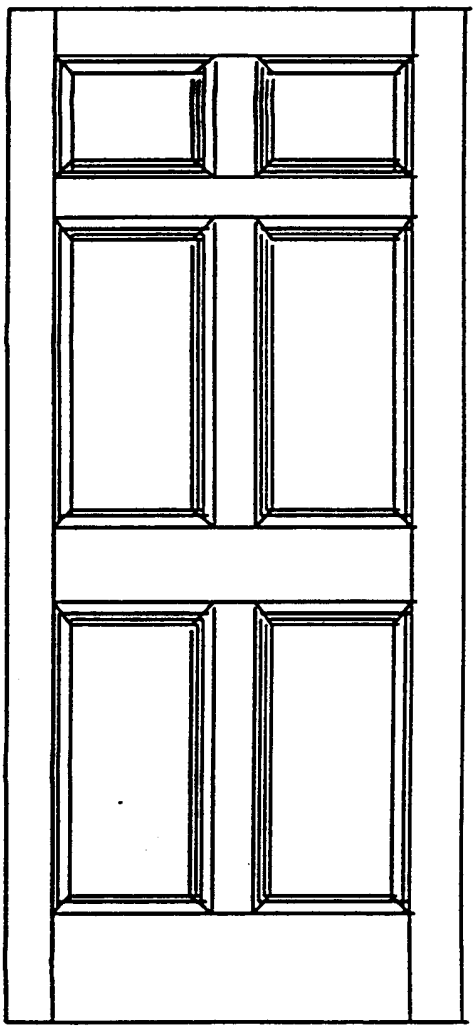


Figure B7 Common Pressed-Steel Frame

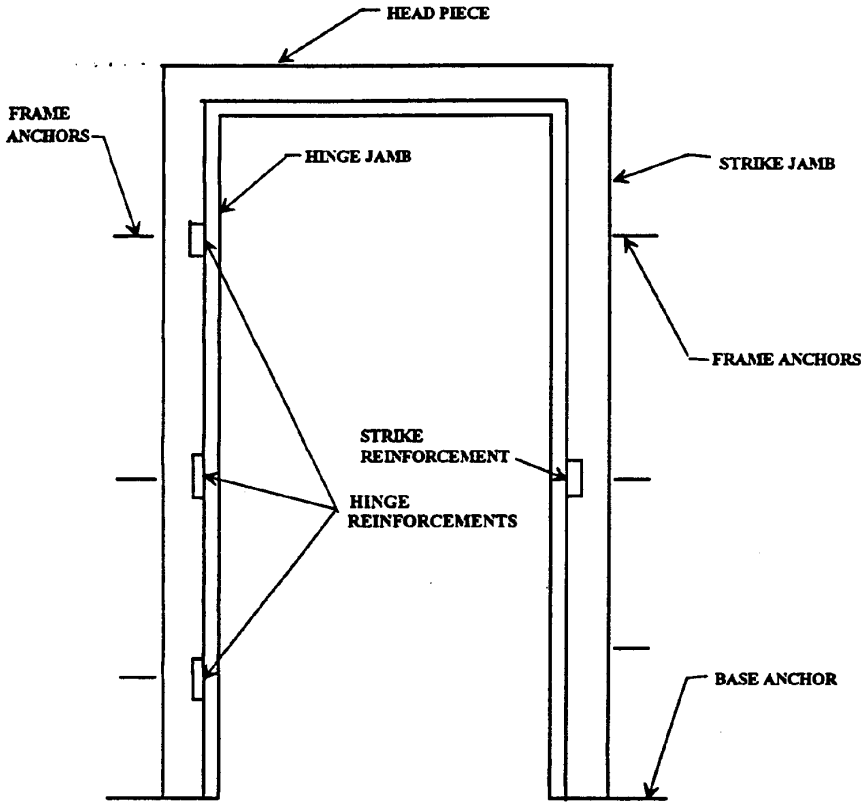


Figure B7-1 Single - Unit Type Pressed-Steel Frame

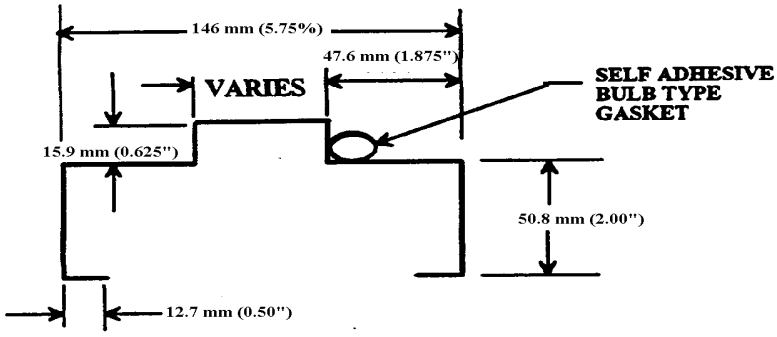


FIGURE B8-2 FRAME CROSS SECTION

PRESSED STEEL FRAME SPECIFICATIONS

I. Single-unit type pressed steel frames shall consist of a head, a sill and two jamb pieces, hinge reinforcements, a strike plate reinforcement, and base and wall anchors.

II. The wall anchors provided shall be adjustable or fixed masonry anchors, bolts with expansion shells, channel clips, "Z" clips, wood stud anchors or steel stud anchors.

III. The head and jamb pieces shall be constructed, as shown in Figures 1 and 2 of No. 16 Ga. steel.