



National Fenestration Rating Council Incorporated

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Procedure for
Determining Fenestration Product Air Leakage

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FOREWORD

The National Fenestration Rating Council, Incorporated ("NFRC") has developed and operates a uniform rating system for energy and energy-related performance of fenestration products. The Rating System determines the U-factor, Solar Heat Gain Coefficient (SHGC), and Visible Transmittance (VT) of a product, which are mandatory ratings for labeling NFRC certified products and are mandatory ratings for inclusion on label certificates, and are supplemented by procedures for voluntary ratings of products for Air Leakage (AL), and Condensation Resistance. Together, these rating procedures, as set forth in documents published by NFRC, are known as the NFRC Rating System.

The Rating System employs computer simulation and physical testing by NFRC-accredited laboratories to establish energy and related performance ratings for fenestration product types. The Rating System is reinforced by a certification program under which NFRC-licensed responsible parties claiming NFRC product certification shall label and certify fenestration products to indicate those energy and related performance ratings, provided the ratings are authorized for certification by an NFRC-licensed certification and Inspection Agency (IA).

The requirements of the rating, certification, and labeling program (the "Certification Program") are set forth in the most recent versions of the following as amended, updated or interpreted from time to time:

- NFRC 700 Product Certification Program (the "PCP")
- NFRC 705 Component Modeling Approach ("CMA") Product Certification Program (the "CMA-PCP").

Through the Certification Programs and the most recent versions of its companion programs as amended, updated or interpreted from time to time:

- The laboratory accreditation program (the "Accreditation Program"), set forth in the NFRC 701 Laboratory Accreditation Program (the "LAP")
- The IA licensing program (the "IA Program"), set forth in NFRC 702 Certification Agency Program (the "CAP")
- The CMA Approved Calculation Entity ("ACE") licensing program (the "ACE Program") as set forth in the NFRC 708 Calculation Entity Approval Program (the "CEAP"),

NFRC intends to ensure the integrity and uniformity of NFRC ratings, certification, and labeling by ensuring that responsible parties, testing and simulation laboratories, and IAs adhere to strict NFRC

requirements.

In order to participate in the Certification Programs, a manufacturer / responsible party shall rate a product whose energy and energy-related performance characteristics are to be certified in accordance with mandatory NFRC rating procedures. At present, a manufacturer/responsible party may elect to rate products for U-factor, SHGC, VT, Air Leakage, Condensation Resistance, or any other procedure adopted by NFRC, and to include those ratings on the NFRC temporary label affixed to its products, or on the NFRC Label Certificate. U-factor, SHGC and VT, AL, and Condensation Resistance rating reports shall be obtained from a laboratory, which has been accredited by NFRC in accordance with the requirements of the NFRC 701.

The rating shall then be reviewed by an IA which has been licensed by NFRC in accordance with the requirements of the NFRC 702. NFRC-licensed IAs also review label format and content, conduct in-plant inspections for quality assurance in accordance with the requirements of the NFRC 702, and issue a product Certification Authorization Report (CAR), or approve for issuance an NFRC Label Certificate for site-built or CMA products and attachment products. The IA is also responsible for the investigation of potential violations (prohibited activities) as set forth in the NFRC 707 Compliance and Monitoring Program.

Ratings for products that are labeled with the NFRC Temporary and Permanent Label, or products that are listed on an NFRC Label Certificate, in accordance with NFRC requirements, are considered to be NFRC-certified. NFRC maintains a Certified Products Directory (CPD), listing product lines and individual products selected by the manufacturer/responsible party for which certification authorization has been granted.

NFRC manages the Rating System and regulates the Product Certification Program (PCP), Laboratory Accreditation Program (LAP) and Certification Agency Program (CAP) in accordance with the NFRC 700 (PCP), the NFRC 701 (LAP), the NFRC 702 (CAP), the NFRC 705 (CMA-PCP), and the NFRC 708 (CEAP) procedures, and conducts compliance activities under all these programs as well as the NFRC 707 Compliance and Monitoring Program (CAMP). NFRC continues to develop the Rating System and each of the programs.

NFRC owns all rights in and to each of the NFRC 700, NFRC 701, NFRC 702, NFRC 705, NFRC 707, NFRC 708 and each procedure, which is a component of the Rating System, as well as each of its registration marks, trade names, and other intellectual property.

The structure of the NFRC program and relationships among participants are shown in Figure 1, Figure 2, and Figure 3. For additional information on the roles of the IAs and laboratories and operation of the IA Program and Accreditation Program, see the NFRC 700 (PCP), NFRC 701 (LAP), and NFRC 702 (CAP) respectively.

Figure 1

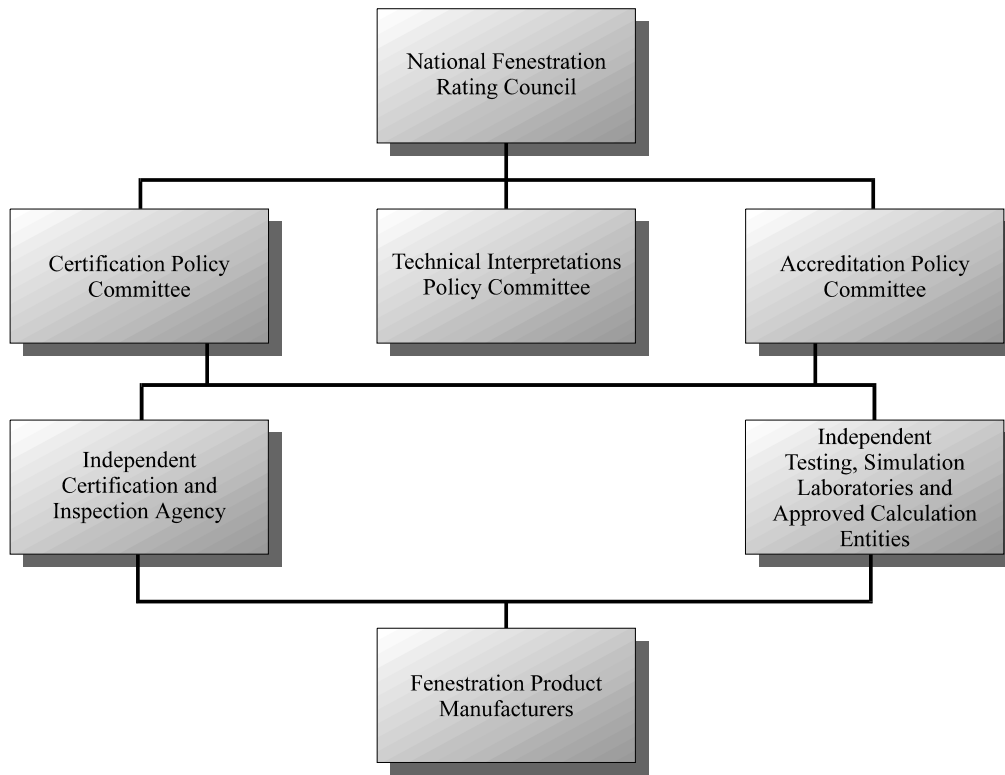


Figure 2

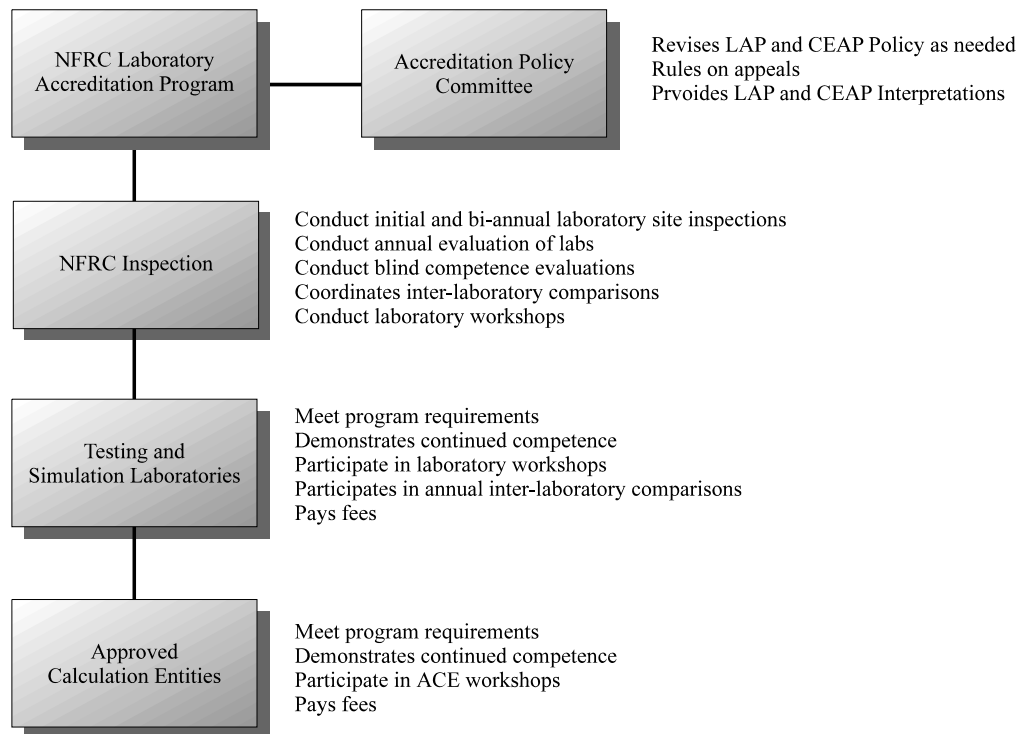
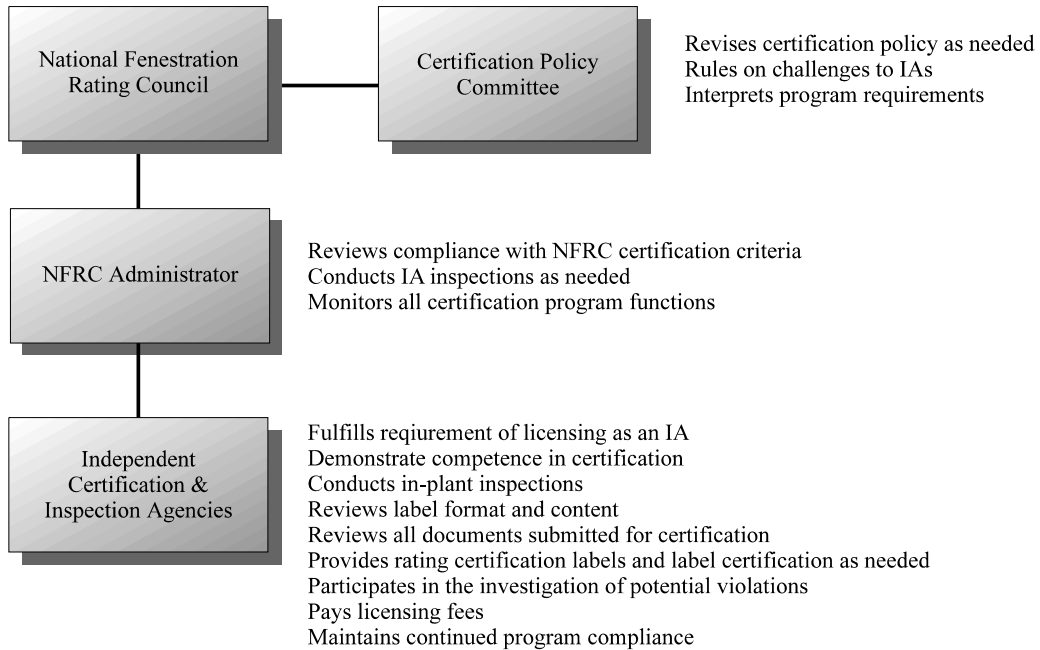


Figure 3



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

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DISCLAIMER

NFRC certification is the authorized act of a manufacturer/responsible party in: (a) labeling a fenestration or related attachment product with an NFRC Permanent Label and NFRC Temporary Label, or (b) generating a site built or CMA label certificate, either of which bears one or more energy performance ratings reported by NFRC-accredited simulation and testing laboratories and authorized for certification by an NFRC-licensed IA. Each of these participants acts independently to report, authorize certification, and certify the energy-related ratings of fenestration and related attachment products.

NFRC does not certify a product and certification does not constitute a warranty of NFRC regarding any characteristic of a fenestration or fenestration-related attachment product. Certification is not an endorsement of or recommendation for any product or product line or any attribute of a product or product line. NFRC is not a merchant in the business of selling fenestration products or fenestration-related products, and therefore cannot warrant products as to their merchantability or fitness for a particular use.

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1. PURPOSE

To specify a procedure for determining fenestration product air leakage.

2. SCOPE

This procedure defines the criteria for testing fenestration air leakage rates to the requirements and guidelines as established by the NFRC. Many of the criteria are referenced from other ASTM standards and NFRC 100. Issues of test pressures, leakage mode, test size, and test temperatures are based on currently acceptable and recognized industry practices for air leakage testing of fenestration.

This procedure is applicable to fixed and operable fenestration products.

Air leakage rates for a given fenestration product may vary depending on quality control, environmental factors (temperature, barometric, pressure, humidity, etc.), user-stresses, operating style differences, long term durability, variable installation methods, and material/design selection. This procedure does not address any of these issues. The air leakage rates obtained from this procedure are intended primarily for product comparison purposes.

3. DEFINITIONS

Product line: a series of fenestration products specific to operator type (see Table 4-3 of NFRC 100) and framing material.

Individual product: any one specific fenestration product, specific to weatherseals, glazing method, hardware, assembly/fabrication methods, opening/non-opening configurations, ventilators, weep systems, and sills.

Projected fenestration product area, (A_{pf}): the area of the rough opening in the wall, for the fenestration product, less installation clearance.

4. TEST CRITERIA

ASTM E 283 [1] shall be the only method used to measure product air leakage rates (see Note 1 below). The following conditions shall apply:

- A. The differential static test pressure shall be 75 pascals (1.57 psf), applied to the exterior of the test specimen, so as to cause the air leakage to occur at the specimen's interior side.

- B. The measured air leakage shall be corrected to standard atmospheric conditions of 101.3 kPa (760 Torr), 50 percent relative humidity, and 21.0°C (69.8°F).
- C. The rate of air leakage for all window fenestration products shall be reported as $l/s \cdot m^2$ (cfm/ft²).
- D. The specimen test sizes shall be as defined in NFRC 100 or larger production size.
- E. The leakage rate shall be measured to one decimal place in $l/s \cdot m^2$ (i.e., #.#).
- F. Operating force shall be measured and recorded per 101/I.S.2/NAFS-2 for all fenestration products. The specimen shall be operated per ASTM E 283 prior to an air leakage test being performed. No adjustments shall be made to the specimen between conducting the operating force and air leakage tests.
- G. Once the test specimen has been received by the laboratory, no material or component modifications to the product shall be performed by the laboratory without written instructions from the manufacturer. The laboratory shall report all adjustments and modifications that were made to the specimen to obtain the reported air leakage rates.

[Note 1: This procedure references the use of ASTM E 283 as the only method for measuring individual product air leakage rates. ASTM E 283 is a laboratory test method that has been used for many years to measure air leakage rates under controlled conditions. Because this procedure measures air leakage rates only one pressure differential, it is best used to compare the relative performance of fenestration products. It does not directly provide information on how a product will perform in a specific building application at field conditions.]

Table 4-1 101/I.S.2/NAFS-02 Operating Force Table

Product Type	Performance Class	Point of Force Application	Direction of Force	Maximum Force to Initiate Motion		Maximum Force to Maintain Motion	
				N	(lbs)	N	(lbs)
Vertically sliding hung windows	R	Midpoint of operating handle(s) or of meeting rails	Vertical, parallel to plane of glazing	200	(45)	135	(30)
Vertically sliding hung windows	LC	Midpoint of operating handle(s) or of meeting rails	Vertical, parallel to plane of glazing	230	(50)	155	(35)
Vertically sliding hung windows	C, HC, & AW	Midpoint of operating handle(s) or of meeting rails	Vertical, parallel to plane of glazing	230	(50)	200	(45)
Vertically sliding non-hung windows	R	Midpoint of operating handle(s) or of meeting rails	Vertical, upward parallel to plane of glazing	110	(25)	90	(20)
Vertically sliding non-hung windows	LC	Midpoint of operating handle(s) or of meeting rails	Vertical, Upward parallel to plane of glazing	230	(50)	155	(35)
Horizontally sliding windows	R	Midpoint of operating handle(s) or of meeting stiles	Horizontal, parallel to plane of glazing	135	(30)	90	(20)
Horizontally sliding windows	LC, C, HC & AW	Midpoint of operating handle(s) or of meeting stiles	Horizontal, parallel to plane of glazing	180	(40)	115	(25)
Horizontally sliding windows	R, LC & C	Midpoint of operating handle(s) or of meeting stiles	Horizontal, parallel to plane of glazing	135	(30)	90	(20)

Product Type	Performance Class	Point of Force Application	Direction of Force	Maximum Force to Initiate Motion		Maximum Force to Maintain Motion	
				N	(lbs)	N	(lbs)
Horizontally sliding windows	HC & AW	Midpoint of operating handle(s) or of meeting stiles	Horizontal, parallel to plane of glazing	180	(40)	115	(25)
Casement and projecting windows with rotary operators	R, LC & C	End of crank handle	Perpendicular to crank handle and screw	70	(15)	30	(7)
Casement and projecting windows with rotary operators	HC & AW	End of crank handle	Perpendicular to crank handle and screw	90	(20)	45	(10)
Casement and projecting windows with lever type operators	R, LC & C	End of crank lever	Perpendicular to lever in the plane of its motion	155	(35)	100	(22)
Casement and projecting windows with lever type operators	HC & AW	End of crank lever	Perpendicular to lever in the plane of its motion	230	(50)	135	(30)
Other casement and projecting windows	R, LC & C	Midpoint of sash opposite hinges or operating handles	Perpendicular to the plane of glazing	155	(35)	100	(22)
Other casement and projecting windows	HC & AW	Midpoint of sash opposite hinges or operating handles	Perpendicular to the plane of glazing	230	(50)	135	(30)
Roof windows with rotary operators	R, C, LC, HC & AW	End of crank handle	Perpendicular to crank handle and screw	90	(20)	45	(10)
Other roof windows	R, C, LC, HC & AW	Midpoint of sash opposite hinges or operating handles	Perpendicular to the plane of glazing	230	(50)	135	(30)

5. REPORT

An NFRC 400 test report shall contain the following:

- A. Information specified in ASTM E 283 in addition to that which is noted below.
- B. All measured operating forces.
- C. All air temperatures, atmospheric pressures, and humidities measured during the test.
- D. All test differential pressures. All total air leakages, extraneous air leakages, and net specimen leakages measured in l/s (cfm) and corrected to standard atmospheric temperature and pressure conditions.
- E. Total specimen air leakage rates measured in l/s·m² (cfm/ft²).
- F. A description of the means of calibration of the airflow test apparatus and date of last calibration.
- G. A description of any and all changes to the specimen, which were required in order to achieve the final air leakage rates. The laboratory shall provide the manufacturer's approval letter in this report; and
- H. Report all specimen air leakage rates to one decimal place in accordance with NFRC units conversion policy, with a minimum reported rate of 0.1.

6. REFERENCES

- [1] ASTM E 283, American Society for Testing and Materials, "Standard Test Method For Determining The Rate Of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across The Specimen."
- [2] AAMA/WDMA 101/I.S.2/NAFS-02 Voluntary Performance Specification for Windows, Skylights and Glass Doors.
- [3] NFRC 100-2010: Procedure for Determining Fenestration Product U-factors, National Fenestration Rating Council.

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