



National Fenestration Rating Council Incorporated

NFRC 400-2004_[E1A0]

Procedure for
Determining Fenestration Product Air Leakage

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FOREWORD

Consumers today have a variety of energy-efficient fenestration products to choose from. One property, which may contribute to the energy impact of a fenestration product, is its air leakage rate. The energy impacts of a given fenestration product from infiltrating air can be determined based on the air leakage rate, the differential air temperature and the differential humidity ratio.

This procedure has been developed by the National Fenestration Rating Council, Incorporated (NFRC) to meet the need for a uniform and accurate means for evaluating the air leakage rates of fenestration products. Air infiltration rates determined under this procedure are best used to assess the comparative performance of products. The air infiltration rates determined by this procedure are determined at a fixed set of environmental conditions and will need to be adjusted to directly determine seasonal energy performance.

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

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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.
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- 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 283-91 (1999), American Society for Testing and Materials Volume 4. 1999, "Standard Test Method For Determining The Rate Of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across The Specimen," ASTM, 1916 Race St., Philadelphia, PA. 19103. USA.
- [2] AAMA/WDMA 101/I.S.2/NAFS-02 Voluntary Performance Specification for Windows, Skylights and Glass Doors.
- [3] NFRC 100-2004: Procedure for Determining Fenestration Product U-factors, National Fenestration Rating Council.

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