

SECTION 01 83 16

EXTERIOR ENCLOSURE PERFORMANCE REQUIREMENTS
12/10

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM C 1060	(2003) Standard Practice for Thermographic Inspection of Insulation Installations in Envelope Cavities of Frame Buildings
ASTM C 1153	(2003e1) Standard Practice for Location of Web Insulation in Roofing Systems Using Infrared Imaging
ASTM E 1186	(2009) Standard Practices for Air Leakage Site Detection in Building Envelopes and Air Barrier Systems
ASTM E 779	(2003) Standard Test Method for Determining Air Leakage Rate by Fan Pressurization
ASTM E 1677	(2005) Standard Specification for an Air Retarder (AR) Material or System for Low-Rise Framed Building Walls
ASTM E 1827	(2007) Standard Test Methods for Determining Airtightness of Buildings Using an Orifice Blower Door

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION (ISO)

ISO 6781	(1983) Thermal Insulation - Qualitative Detection Of Thermal Irregularities In Building Envelopes - Infrared Method
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1.2 AIR BARRIER SYSTEM

The airtight components of the building envelope and the joints, junctures and transitions between materials, products, and assemblies forming the air-tightness of the building enclosure are called "the air barrier system." Services include coordination between the trades, the proper scheduling and sequencing of the work, preconstruction meetings, inspections, tests, and related actions, including reports performed by Contractor, by independent agencies, and by governing authorities.

1.3 CHARACTERISTICS

Ensure that the intent of constructing the building enclosure with a continuous air barrier system to control air leakage into, or out of the

conditioned space is achieved. The air barrier system shall have the following characteristics:

- a. It must be continuous, with all joints sealed.
- b. It must be structurally supported to withstand positive and negative air pressures applied to the building enclosure.
- c. Connection shall be made between:
 1. Foundation and walls, including penetrations, ties and anchors.
 2. Walls, windows, curtain walls, storefronts, louvers and doors.
 3. Different wall assemblies, and fixed openings with those assemblies.
 4. Wall and roof connections.
 5. Wall and roof over unconditioned space.
 6. Walls, floor and roof across construction, control and expansion joints.
 7. Walls, floor and roof to utility, pipe and duct penetrations.
 8. Floor over unconditioned space.
 9. Junctures, abutment, and connections or overlaying with air barrier materials by different manufacturers.
 10. Seismic and expansion joints.
 11. All other leakage pathways in the building envelope.
- d. All penetrations of the air barrier and pathways of air infiltration/exfiltration shall be made air-tight and shall have the following properties:

1. Air Penetrations: 0.004 cubic feet per minute per square foot under a pressure differential of 0.3 inch water gauge (1.57 pounds per square foot) (0.02 liters per second per square meter at 75 Pascals) when tested according to [ASTM E 2178](#). Type I per [ASTM E 1677](#).
2. Water Vapor Transmission: 13 perms or less when tested according to [ASTM E 96](#), Method B.
3. Surface Burning Characteristics: Class A when tested in accordance with [ASTM E 84](#). Flame Spread: 10, Smoke Developed: 10.
4. Air Infiltration Barrier system shall be wrapped/sealed tight to all items that penetrate the building exterior closure.
5. Air Infiltration Barrier shall be continuous, applied to the face of exterior gypsum board sheathing on exterior wall, onto exterior soffit and fascia, and onto roof insulation.

1.4 MATERIAL PERFORMANCE REQUIREMENTS

1.4.1 Materials

Provide materials which have an air permeance not to exceed 0.004 cubic feet per minute per square foot under a pressure differential of 0.3 inch water gauge (1.57 pounds per square foot) (0.02 liters per second per square meter at 75 Pascals) when tested according to [ASTM E 2178](#), and a vapor permeance of 0.1 perms or less when tested according to [ASTM E 96](#).

1.4.2 Assemblies

Assemblies of materials and components shall have an air permeance not to exceed 0.06 cubic feet per minute per square foot under a pressure differential of 0.3 inch water gauge (1.57 psf) (75 Pa) when tested

according to [ASTM E 1677](#). Air leakage of window, skylight and door assemblies that are part of the building envelope shall be determined in accordance with AAMA/WDMA/CSA 101/I.S.2/A440, or NFRC 400 by an accredited, independent laboratory, and labeled and certified by the manufacturer. Windows and skylight air leakage shall not exceed 0.02 cubic feet per minute per square foot under a pressure differential of 0.3 inch water gauge, or 0.3 cubic feet per minute per square foot under a pressure differential of 6.54 psf (300 Pa). Door assembly air leakage shall not exceed 0.3 cubic feet per minute per square foot at for all other products at 1.57 psf (75 Pa). Exception: Overhead doors shall be permitted to use air leakage as determined by test at standard test conditions in accordance with [ANSI/DASMA 105](#).

1.4.3 Outdoor Air Intakes and Exhaust Openings

Stair and elevator shaft vents and other outdoor air intakes and exhaust openings integral to the building envelope shall be equipped with not less than a Class I motorized, leakage-rated damper with a maximum leakage rate of 4 cubic feet per minute per square foot at 1.0 inch water gauge (26 psf) (1250 Pa) when tested in accordance with [AMCA 500D](#). These air tight, operable dampers shall be installed when the air barrier is penetrated by:

- a. Fixed open louvers such as in elevator shafts and machine rooms.
- b. Mechanical system components which allow infiltration or exfiltration of air when the systems are inactive, such as atrium smoke exhaust systems, elevator shaft smoke relief openings, and other similar elements.

Such dampers shall be set in the closed position and automatically open upon:

1. the activation of any fire alarm initiating device of the building's fire alarm system;
2. the interruption of power to the damper.

Exception: Gravity (non-motorized) dampers are permitted to be used in buildings less than three stories in height above grade.

1.4.4 Building

Air leakage of the entire building shall not exceed 0.25 cubic feet per minute per square foot under a pressure differential of 0.3 inch water gauge (1.57 psf) (75 Pa) when tested according to [ASTM E 779](#).

1.5 PROJECT CONDITIONS

1.5.1 Temperature

Install air and vapor barrier within range of ambient and substrate temperatures recommended by air and vapor barrier manufacturer. Do not apply air and vapor barrier to a damp or wet substrate.

1.5.2 Field Conditions

Do not install air and vapor barrier in snow, rain, fog, or mist. Do not install air and vapor barrier when the temperature of substrate surfaces and surrounding air temperatures are below those recommended by the manufacturer.

1.6 WARRANTY

1.6.1 Material Warranty

Provide manufacturer's standard product warranty for a minimum 3 years from date of Substantial Completion.

1.6.2 Installation Warranty

Provide installer's 2-year warranty from date of Substantial Completion, including all components of the air and vapor barrier assembly, against failures including loss of air tight seal, loss of watertight seal, loss of adhesion, loss of cohesion, failure to cure properly.

1.7 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES.

SD-01 Preconstruction Submittals

Testing and Inspection Plan; G, RO

Report of potential deficiencies; G, RO

SD-02 Shop Drawings

Air Barrier Assembly Details; G, RO

SD-03 Product Data

Proposed Materials; G, RO

SD-05 Design Data

Test Documentation; G, RO

Submit not later than 60 days after Notice to Proceed.

SD-06 Test Reports

Written reports of each test shall include, but are not limited to, the following:

- a. Date of Issue
- b. Project title and number
- c. Name, address, and telephone number of testing agency
- d. Dates and locations of samples and tests or inspections
- e. Names of individuals making the inspection or test
- f. Designation of the Work and test method
- g. Identification of product and Specification Section
- h. Complete inspection or test data
- i. Test results and an interpretation of test results
- j. Ambient conditions at the time of sample taking and testing
- k. Comments or professional opinion on whether inspected or tested Work complies with Contract Document requirements
- l. Name and signature of laboratory inspector

m. Recommendations on retesting

Building Airtightness Test; G, RO

Submit five copies of the certified written report from inspection and testing agency of each test not later than 10 days after each test.

Thermography Test; G, RO

Submit five copies of the certified written report from inspection and testing agency of each test not later than 10 days after each test.

SD-07 Certifications

Qualifications of Testing Entity; G, RO

1.8 QUALITY ASSURANCE

1.8.1 Building Air Tightness Test Firm Qualifications

The testing firm shall have minimum 2 years experience in air tightness testing and analysis, with a minimum of three successful projects of similar type and scope in the previous 3 years, using the specified testing standard, and employing qualified test technicians.

1.8.2 Building Air Tightness Test Technician Qualifications

The testing technician shall have 2 years experience in air tightness testing using the specified testing standard and equipment.

1.8.3 Thermography Test Firm Qualifications

The testing firm shall have minimum 2 years experience in thermographic testing and analysis, with a minimum of three successful projects of similar type and scope in the previous 3 years, using the specified testing standard, and employing qualified test technicians under the supervision of a Level III Certified Infrared Thermographer.

The testing firm shall be the same firm that provides building airtightness testing for the project. The testing firm shall be capable of coordinating testing procedures, analysis, recommendations, and reporting.

1.8.4 Thermography Test Technician Qualifications

The testing technician shall be a Level II Certified Infrared Thermographer and shall have 2 years experience in thermographic testing using the specified testing standard and equipment.

1.8.5 Certifications

Infrared Thermography Certifications shall be by the Infrared Training Center, N. Billerica, MA, or a comparable training organization acceptable to the Contracting Officer.

1.8.6 Subcontractor Coordination

Requirements of this section apply to the coordination between

subcontractors required to provide an airtight building enclosure, customized fabrication and installation procedures, not production of standard products including but not limited to:

- a. Continuity of the air barrier materials and products with joints to provide assemblies. Continuity of all the enclosure assemblies with joints and transition materials to provide a whole building air barrier system.
- b. Specific quality-control requirements for individual construction activities are specified in the sections of the specifications. Requirements in those sections may also cover production of standard products. Each subcontractor shall adequately and satisfactorily perform the quality assurance documentation, tests and procedures required by each section.

1.9 FIELD CONDITIONS

Perform testing under conditions stipulated in test standards, instrument manufacturer's instructions, and this Section.

1.9.1 Building Airtightness Test

Perform testing under the following ambient environmental conditions:

- a. Windspeed: Not greater than 4 mph
- b. Outside Air Temperature: Between 41 and 95 deg. F

1.9.2 Thermography Test

Perform testing on dry building surfaces after sunset and prior to sunrise under the following environmental conditions:

- a. Windspeed: Not greater than 15 mph
- b. Outside Air Temperature: At level to present differential with building interior temperature of 18 deg F minimum, for minimum of 4 hours prior to test, and not varying more than 30 percent during duration of testing.
- c. Indoor Air Temperature: At constant temperature varying not more than 4 deg. F
- d. Direct Solar Exposure of Surfaces: No direct solar radiation on inspected surfaces during and for minimum 4 hours prior to inspection for frame construction, 8 hours for masonry veneer construction, at acceptable outside air temperature.

PART 2 PRODUCTS

2.1 PRODUCTS

2.1.1 Product Data

Submit manufacturer's product data, manufacturer's printed instructions for evaluating, preparing, and treating substrate, temperature and other limitations of installation conditions, technical data, and tested physical and performance properties.

- a. Submit letter from primary materials manufacturer indicating approval of products not manufactured by primary manufacturer.
- b. Include statement that materials are compatible with adjacent materials proposed for use.
- c. Submit reports indicating that field peel-adhesion test on all materials to which sealants are adhered have been performed and the changes made, if required, to other approved materials, in order to achieve successful adhesion.

2.1.2 Samples

Submit clearly labeled samples, 3- by 4-inch (75 mm by 100 mm) minimum size of each material proposed.

2.1.3 Shop Drawings of Test Chamber

Submit shop drawings of proposed test chamber showing plans, elevations, large-scale details, and connections to the test apparatus.

2.1.4 Field Test Results of Test Chamber

Submit test results of air leakage test (and water leakage test) of test chamber in accordance with specified standards, including retesting if initial results are not satisfactory.

2.1.5 Shop Drawings

Submit shop drawings showing locations and extent of air and vapor barrier assemblies and details of all typical conditions, intersections with other envelope assemblies and materials, membrane counter-flashings, and details showing how gaps in the construction will be bridged, how inside and outside corners are negotiated, how materials that cover the air and vapor barrier are secured with air-tight condition maintained, and how miscellaneous penetrations such as conduits, pipes, electric boxes and similar items are sealed.

- a. Include VOC content of each material.
- b. Include statement that materials are compatible with adjacent materials proposed for use.
- c. Include recommended values for field adhesion test on each substrate.

2.1.6 Compatibility

Submit letter from manufacturer stating that materials proposed for use are permanently chemically compatible and adhesively compatible with adjacent materials proposed for use. Submit letter from manufacturer stating that cleaning materials used during installation are chemically compatible with adjacent materials proposed for use.

PART 3 EXECUTION

3.1 EXAMINATION

Certify that building exterior enclosure systems, subsystems, and construction have been completed in accordance with the contract.

Examine building interior and exterior for compliance with the cited test standards and this Section. Report non-complying conditions in writing. Do not proceed with testing until noncomplying conditions have been corrected.

3.2 PREPARATION

Prepare building envelope in accordance with test standards, instrument manufacturer's instructions, and this section.

3.2.1 Test Documentation

Submit for approval detailed test procedures description indicating the test apparatus, the test methods and procedures, and the analysis methods to be employed for the Building Air Tightness Test and the Thermography Test.

3.2.2 Building Airtightness Test

Prepare whole building as a single test zone, under closed test envelope conditions.

3.2.3 Thermography Test

Pressurize building interior; open interior doors. Remove items from walls and turn off equipment that would interfere with accurate infrared imaging of exterior enclosure performance.

3.3 FIELD QUALITY CONTROL

3.3.1 Building Airtightness Test

Perform building airtightness test in accordance with [ASTM E 1827](#), Single Point Method, instrument manufacturer's instructions, and as follows:

- a. Supplement building airtightness test with requirements of [ASTM E 779](#) as applicable.
- b. Perform positive pressure test relative to outdoors at multiple pressures up to minimum [0.30 inch w.g.](#) (inches water gauge). Measure building leakage rate.
- c. Perform negative pressure test at multiple pressures up to minimum [0.30 inch w.g.](#) and compare results to positive test. Where difference of 10 percent or more exists between tests, investigate causes and resolve reasons for differences. Retest building.
- d. For each test, take a minimum of five readings at various pressures and air flows within the range of the calibrated equipment. In the test report, show test points in graphical form on a log-log scale with pressure in inches water column displayed on the horizontal axis and flow in cfm displayed on the vertical axis. Submit written report for each complying and non-complying test.

Report results of testing in accordance with cited test standards.

3.3.2 Thermography Test

Perform thermography testing in accordance with [ASTM C 1060](#), instrument manufacturer's instructions, and the following:

- a. Supplement thermography testing of wall conditions with requirements of [ISO 6781](#), as applicable.
- b. Supplement thermography test of roof conditions with requirements of [ASTM C 1153](#), as applicable.
- c. Perform thermographic testing in coordination with building airtightness testing.
- d. Report results of testing in accordance with cited test standards. Present thermograms (images) and key drawings of building surfaces. Indicate missing insulation, defective insulation, and other anomalies. Provide written interpretation of thermal images. Include estimate of total area of each construction type and of total area with missing insulation and with defective insulation.

3.3.3 Coordinated Analysis and Reporting

Using building airtightness testing in coordination with thermographic testing, identify thermal envelope and air barrier deficiencies and correct construction to bring the work into compliance with this contract.

3.4 ADJUSTING

If building fails to meet airtightness performance requirement stipulated in this section, use techniques described in [ASTM E 1186](#) to locate air leak sources. Utilize non-toxic fog agents to identify leaks.

Perform remedial thermal insulation and air barrier work to correct deficiencies in building construction and to bring the work into compliance with this contract.

Perform re-testing to verify building meets this contract.

3.5 DELIVERY, STORAGE, AND HANDLING

3.5.1 Delivery

Deliver materials to project site in original packages with seals unbroken, labeled with manufacturer's name, product, date of manufacture, and directions for storage.

3.5.2 Storage

Store materials in their original undamaged packages in a clean, dry, protected location and within temperature range required by air and vapor barrier membrane manufacturer. Protect stored materials from direct sunlight.

3.5.3 Handling

Handle materials in accordance with manufacturer's recommendations.

-- End of Section --