UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated January 2021
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08/19, CHG 1: 02/20

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SECTION 07 27 10.00 10

BUILDING AIR BARRIER SYSTEM
08/19, CHG 1: 02/20

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NOTE: This guide specification covers contractor responsibilities, quality control, and maximum leakage requirements of the constructed air barrier system. This specification must be accompanied by plans showing and detailing the air barrier; it is not intended to stand alone in any set of construction documents. This specification is intended for use on new construction and additions, and on renovations involving major upgrade to the building envelope.

Adhere to UFC 1-300-02 Unified Facilities Guide Specifications (UFGS) Format Standard when editing this guide specification or preparing new project specification sections. Edit this guide specification for project specific requirements by adding, deleting, or revising text. For bracketed items, choose applicable item(s) or insert appropriate information.

Remove information and requirements not required in respective project, whether or not brackets are present.

Comments, suggestions and recommended changes for this guide specification are welcome and should be submitted as a Criteria Change Request (CCR).
****

PART 1 GENERAL

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NOTE: UFC 3-101-01 Architecture gives air barrier system requirements for new construction and renovations.

Testing of the air barrier system is covered in the companion UFGS 07 05 23 PRESSURE TESTING AN AIR BARRIER SYSTEM FOR AIR TIGHTNESS. If air barrier

system testing is required by the UFC, the testing specification must accompany this specification in the construction documents.

This specification is applicable to air barrier systems installed in new building construction and in major renovations involving upgrade to the building envelope; it is not applicable to unconditioned buildings. This specification is intended to define Contractor responsibilities for the construction of the air barrier system across the six sides of a building that when installed properly will control the infiltration or exfiltration of air through the air barrier system. A tight building is essential to a properly functioning HVAC system, to reduce energy consumption, and to prevent problems arising from excessive infiltration or exfiltration into or out of the environmentally conditioned spaces.

UFC 3-101-01 Architecture is recommended reading for the designer. Also recommended is "Air Barrier Systems in Buildings" by Wagdy Anis, FAIA; available at http://www.wbdg.org/resources/airbarriers.php**.**

Additional resources include:

EP 415-1-261 Vol 6 BUILDING ENVELOPES for construction related aspects of the air barrier system and other building envelope components.

Annex 61 Deep Energy Retrofit Guide Chapter 10 and Appendix G Air Tightness for Guidance on Renovation and Retrofit Applications and Strategies.

AIR BARRIER SYSTEM CONCEPTS AND DESIGNER NOTES:

1. Design a continuous air barrier system to control air leakage into, or out of, the conditioned space.

2. On drawings dedicated to the air barrier system, identify the surface boundary of the building air barrier system in plan and in building section views. Think of the air barrier system as a sealed balloon.

3. Keep in mind that window and door components are part of the building air barrier system. One must be able to trace a continuous plane of air-tightness throughout each air barrier system envelope.

4. Of course, intake, exhaust, and relief dampers are part of the air barrier system. If these dampers are not located at or near the building wall, then the duct between the air barrier in the exterior wall and the damper is also part of the air barrier system and must be well sealed.

5. Walls of ventilated crawl spaces logically cannot

be the boundary of the air barrier system. Nor can the roof above a ventilated attic be part of an air barrier system.

6. Defining the air barrier system boundary is the responsibility of the building designer. Plan views should show the horizontal outline (by dashed lines) of the air barrier system and any individual air barrier zones. Rooms with permanent fixed openings to the outdoor environment cannot be included in the air barrier envelope because such openings would represent a hole in the air barrier envelope (the balloon).

7. Building and/or wall sections should show the vertical outline (by dashed lines) of the air barrier system from floor to roof or ceiling.

8. Wall and roof sections and details should show the location of the air barrier membrane within the exterior building envelope.

9. Air barrier materials located on the outboard side of the wall system and the interior side of the insulation attached to a durable substrate is subject to less expansion and contraction than if located on the outer side. Additionally this location is the proper hygrothermal location for the vapor plane of the wall assembly for stud cavity or masonry block walls. The concrete material can act as the air/water/vapor barrier on pre-cast, cast-in-place concrete, and Insulated Concrete Form (ICF) walls.

10. Air barrier materials that also serve as interior finishes are discouraged because such materials are subject to damage, difficult to seal, and often compromised by occupant penetrations.

11. An air barrier material located on the outboard side of the exterior wall assembly can often serve as the air, vapor and water resistive layer of the wall system. Common stud cavity or masonry wall types must incorporate an air/water/vapor control layer on the outboard side of the wall assembly and when doing so, this should be a Class 1 vapor barrier/retarder by material permeance. Applying an air barrier will establish the vapor plane of the wall system in the correct location and allow inward and outward drying potential for the assembly from this plane. Consider the vapor permeance of all materials and their relative position within the exterior envelope to assure the increasing permeance of the materials from the vapor plane to the inner, conditioned space surface of the wall system. Particular attention should be paid to the climatic conditions the wall system will be situated in and experience over the lifetime of the assembly. Air barrier materials may have low water vapor permeance

and act as intended, or if located incorrectly, unintended vapor retarders or barriers. Other materials used with the envelope may also have low water vapor permeance. Careful consideration regarding the location of such materials is crucial to avoid vapor barrier temperature below the dew point temperature of the air on either side, and to avoid double vapor barriers that prevent inward drying to the conditioned space and can trap condensation within the thermal envelope. Such conditions can contribute to mold problems and material failure problems. The thermal resistance, vapor permeance, and relative thermal position of the component materials must be selected such that at all locations within the envelope, the dew point temperature is less than the local surface temperature.

If software such as WUFI hygrothermal modeling is available use it to verify wall system performance or to model unique conditions or building applications that are atypical for a given condition or climate.

12. Keep in mind that air barrier membranes must withstand forces due to positive and negative pressures caused by wind and Stack Effect. As a point of reference, many roofs are designed for a wind uplift pressure of 4.3 kPa 90 lb/sq.ft. Building wraps are particularly susceptible to wind forces unless sandwiched between rigid wall components (example: sheathing and board insulation). Otherwise, wraps may experience excessive flexing and stressing and point loading of the securing fasteners.

13. On the drawings, identify each air barrier material, membrane, coating, window component, door component, dampers, and other components that compose the continuous air barrier envelope. Materials that are part of the designated continuous air barrier system must be identified as such. Although many materials used in exterior assemblies are air tight, they may or may not serve as part of the designated continuous air barrier system.

14. In a roof assembly, locate the air barrier material on the inside of the insulation and attached to a durable substrate. Roof assemblies shall be designed in accordance with UFC 3-110-03 Roofing, updated Jan 2017.

15. Detail the connection of roof and wall air barrier materials. The roof-wall interface has been the source of major air infiltration and exfiltration in the past due to the many irregularly shaped decking and structural support members intersecting at this point, and insufficient attention to detail to the air barrier system at

this location. Although sequencing the connection of the roof-wall air barriers is the Contractor's responsibility, drawing notes suggesting a sequence of the trades may serve as helpful reminders to the installer.

16. Detail the connection of wall and floor air barrier materials.

17. Detail the connection of the wall air barrier materials to window and door components.

18. Detail the penetrations of the air barrier envelope by pipe, ducts, and conduit showing the method of sealing the penetration.

19. Detail the air barrier material to be continuous under or around all electrical boxes and panels, plumbing fixture boxes, and other items affecting air barrier system continuity. Do not penetrate the air barrier envelope with lighting fixtures. Continuity and air tightness is easier to achieve when air barriers materials are located outboard of the cavities that contain wiring, conduit, and plumbing.

20. In other specification sections, specify the air barrier materials used in the system. As defined by The Air Barrier Association of America (ABAA) all air barrier materials must have an air permeance less than 0.02 L/s-m^2 0.004 CFM/sq-ft at 75 Pa when tested in accordance with ASTM E2178.

21. Identify the allowable leakage rates of windows, exterior doors, curtain wall assemblies, skylights, dampers, and all other such air barrier components in the specification sections covering these components.

22. Note that the Energy Star program has no air leakage requirement for windows and doors. However, ASHRAE 90.1 contains maximum leakage values for fenestration and doors determined in accordance with NFRC 400. These are minimal requirements and do not represent state of the art. The IECC standard contains leakage limits for doors and windows that may be useful as a guideline. Be sure the specifications for fenestration and doors include maximum air leakage values.

23. Leakage rates for sectional type overhead doors are published by manufacturers, however, there is no known manufacturer who publishes tested leakage performance for roll-up type overhead door assemblies. For roll-up type doors, specify the best weatherstripping available in the specification section covering overhead doors and specify a maximum leakage when such ratings are available.

24. Where louvered smoke ventilation openings are used at the top of elevator shafts, provide a motorized damper which is sprung normally open and held closed by the damper actuator. Connect the actuator to the fire alarm system to open the damper upon a building alarm. Refer to IBC Section 3004 Hoistway Venting.

25. Provide tight sealing dampers and controls to close all ventilation or make-up air intakes and exhausts during inactive or unoccupied periods. In the HVAC and building controls specification sections, specify all intake, relief, and exhaust dampers to be AMCA 511 leakage Class 1A (15.2 L/s/square meter@250 Pa(3 CFM/sq.ft. @ 1 in.w.c).

26. Often, there is but one air barrier envelope in a building and this single envelope may enclose the entire volume of the building or a portion of the building.

27. However, some buildings call for multiple air barrier envelopes. An example is in a vehicle maintenance facility; the air conditioned administrative office area must have an air barrier envelope system complete and separate from the air barrier envelope serving the maintenance area so that the admin area air barrier system is not nullified during warm weather when the vehicle maintenance bay doors are open. The common wall between the two areas is a part of the air barrier envelope for both areas. Therefore, the common wall must be tightly constructed and must include an air barrier material. Note that, in this case, the common wall is included in the calculation of the air barrier surface area.

28. Sometimes the entire air barrier envelope cannot be tested at once. An example is a building with multiple living quarters separated by full height partitions and without an interior corridor. If there is no discernable air path connecting the rooms (such as interior doorways or common ceiling plenums), testing the entire building air barrier envelope is precluded.

29. In this case, portions of the air barrier envelope should be tested. Selected rooms must be air pressure tested to determine the leakage through the portion of the air barrier envelope shared by the selected rooms. On the drawings, identify representative rooms at the exterior corners and rooms not at building corners to be tested, and in this specification, give the room number air barrier envelope area and leakage requirements for each room to be tested. Note the air barrier envelope surface area is only that portion of air barrier perimeter envelope shared by the room, it is not the entire room surface area. Testing in this situation

requires pressurizing adjacent rooms so that there is no room-to-room air leakage. For a description of the test process, Refer to UFGS 07 05 23 PRESSURE TESTING AN AIR BARRIER SYSTEM FOR AIR TIGHTNESS paragraph Pressure Testing a Multiple Isolated Zoned Building. Where a number of rooms have the same dimensions, the drawings should indicate that the test room will either be the room indicated or a room of the same size selected by the Contracting Officer.

30. On the drawings, the designer must identify the envelopes to be tested, usually by number. Refer to paragraph AIR BARRIER ENVELOPE SURFACE AREA AND LEAKAGE REQUIREMENTS.

31. Calculate the air barrier envelope surface area (sq. m(sq.ft.) for each envelope to be tested. This is the surface area of the volume enclosed by each air barrier envelope to be tested (includes floors, walls, fenestration, doors, and roof). On the drawings or in this specification, indicated the surface area for each air barrier envelope to be tested.

32. Two tests can be performed for the building envelope; an "Architectural Only Test", and an "Architectural Plus HVAC System Test". The Architectural Only Test calculates the leaking through the architectural portions of the envelope and allows some expedient sealing of many HVAC components to exclude any leakage through these items from test results.

The Architectural Plus HVAC System calculates the leakage from the entire building in a condition in which the HVAC system is off and allows no temporary masking or sealing of mechanical or HVAC components such as dampers, flues and vents. The Architectural plus HVAC System test should be included in the specifications of a contract when the building is designed such that the HVAC system may operate intermittently and when dampers will be used to prevent air leakage out of the conditioned space through the HVAC system. The Architectural Plus HVAC System test may be applied to residential project with intermittent HVAC system operation or a project in which there is a need to verify mechanical dampers in the HVAC system for leakage performance.

33. Indicate the allowable leakage rate of each air barrier envelope (___ L/s-m^2(___CFM/sq.ft. @ 75 Pa). Refer to UFC 3-101-01. Use the UFC maximum allowed values or less for the Architectural Only Test.

34. To the Architectural Only Test maximum leakage rate, add an allowance for the HVAC system leakage

rate. An arbitrary allowance of 0.25 L/s-m^2 0.05 CFM/sq.ft. is suggested. This higher leakage rate is the Architectural Plus HVAC System Test maximum leakage rate. In other words, if the Architectural Only Test allowable leakage rate is X, the Architectural Plus HVAC System Test allowable leakage rate is X + 0.25 L/s-m^2 0.05 CFM/sq.ft.
Example:
- Architectural Only Test: 1.27 L/s-sq m 0.25 CFM/sq.ft. @ 75 Pa.
- Architectural Plus HVAC System Test: 1.5 L/s-m^2 0.30 CFM/sq.ft. @ 75 Pa.

35. Next, calculate and indicate the maximum test leakage in L/s (CFM) for each air barrier envelope and for each type test.

36. Renovations: Refer to UFC 3-101-01 for requirements. This specification is used on renovations if a major upgrade to the building envelope is involved. However, the UFC offers guidance on prioritizing the sealing of existing building envelopes based on funding.

37. Additions: Where a new addition shares a wall with and existing building, the designer has two options:
a) put an air barrier assembly in the common wall and treat the new addition as a separate test zone, or
b) indicate that doors and other openings in the common wall will be temporarily sealed during the test, and identify a portion of the existing building that can be closed and pressurized with separate pressurization equipment so that there is no differential pressure across the common wall during the test.

38. Special Design Conditions:

Humidified Rooms: A humidified space within an unhumidified building (example: computer equipment room) should be located as an interior room and not located on the building perimeter envelope. Otherwise pay close attention to the potential for condensation within the perimeter envelope during times of cold weather.

Removable Wall or Roof Panels for Equipment Installation: Removable wall and roof panels must maintain the same weather and air barrier qualities as the surrounding building materials. Removable sections must be detailed in a manner to be able to be resealed to the same level as originally installed.

Secure Compartmented Information Facilities (SCIFs) and Shielded Facilities: Coordinate compatibility

of SCIF and/or Shielding details with the air barrier details. It is recommended to locate such facilities at interior building locations away from exterior walls or provide a separation space between the protected facility and the exterior wall. When using the SCIF or shielded wall at exterior locations, care must be taken to maintain consistent wall/ceiling temperature and proper ventilation to avoid condensation and mold problems. Shielding materials must avoid use of organic adhesives, sealants, or other materials which promote mold growth. When using shielded assemblies as part of the exterior building shell assembly, it is recommended to use WUFI analysis to determine proper assembly of materials.

39. Copy and complete the checklist below and include it in the Architectural Design Analysis.

AIR BARRIER SYSTEM DESIGNER CHECKLIST

Drawings:

___ 1. Air barrier system drawings are included in the plans. (More than one drawing may be required. It may be necessary to provide a plan for each floor.)

___ 2. A reduced size plan and elevation views of the building indicating the desired perimeter boundary of each air barrier envelope is included.

___ 3. The air barrier envelopes to be tested are shown and given a unique number for reference as applicable.

___ 4. Details showing how the wall air barrier assembly is joined to the roof air barrier assembly are provided.

___ 5. Details showing how the wall air barrier material is joined to the floor / foundation are provided.

___ 6. Details showing how the wall air barrier material is joined to the window components are provided.

___ 7. Details showing how the wall air barrier material is joined to the door components are provided.

___ 8. Details are provided showing the air barrier system at expansion and isolation joints as applicable.

___ 9. Details are provided showing the method of sealing penetrations of the air barrier envelope at the wall, roof, or floor by conduit, piping,

cables, etc.

___ 10. Details showing how the air barrier materials are routed around wall and roof discontinuities are provided (soffits, overhangs, offsets, vestibules, gables, ridges, eaves, etc).

___ 11. In the wall and roof sections, materials and accessories that constitute the air barrier system are clearly identified. Examples: board materials, liquid applied coatings, spray applied foams, tape, calks, sealants.

___ 12. In the wall and roof sections, components and assemblies that constitute the air barrier system are clearly identified. Examples: windows, doors, skylights.

Note: The following are examples for air barrier materials:

- **Cast-in-place concrete**
- **Glass**
- **Metal**
- **Spray polyurethane foam**
- **Spray polyethylene foam**
- **Extruded polystyrene**
- **Low permeance building wrap products.**
- **Liquid applied one and two component materials**

Note: The following cannot serve as air barrier materials:

- **Concrete block**
- **Expanded polystyrene foam**
- **Building paper/felts**
- **Open cell foam**
- **High permeance house wraps**
- **Perlite board**
- **Fiberboard**
- **Un-treated sheathing**
- **Glass fiber rigid board**
- **Cellulose insulation**
- **Metal roof decking**
- **Standing seam roof**

<u>Specifications</u>:

___ 13. Air barrier membranes and their air permeance and water vapor permeance are specified in other specification sections. Examples: Mechanically fastened sheet films, fluid-applied membranes, self-adhering membranes, spray-applied foams.

Air barrier materials have a maximum air permeance of 0.02 L/s-m^2 0.004 CFM/sq.ft. of surface area at a pressure difference of 75 Pa. Films, membranes, and

coatings intended as air barrier components must meet this rating when tested in accordance with ASTM E 2178.

___ 14. The allowable leakage requirements of window, curtain wall, and door components is specified in other specification sections.

___ 15. The allowable leakage requirements of HVAC intake and exhaust dampers is specified in other specification sections.

Calculations:

___ 16. The surface area (sq. m(sq.ft.) of each air barrier envelope to be tested has been calculated.

___ 17. The maximum allowable leakage (L/s(CFM) for both the Architectural Only Test and the Architectural Plus HVAC System Test has been calculated and shown for each air barrier envelope to be tested.

___ 18. Moisture migration and dewpoint calculations have been performed. WUFI software available from Oak Ridge National Laboratory or similar moisture migration analysis software is recommended.

Note: Air barrier materials will have low air permeance by definition. However, beware of the vapor permeance of air barrier membranes. For example, if the air barrier material has a low vapor permeance, it may act as an effective vapor retarder. With this in mind, the location of the membrane within the wall or roof relative to the thermal insulation becomes important. Be sure that the vapor permeance and location has been considered by the design. Perform vapor transmission calculations or dew point calculations as required to assure that moisture condensation within the building envelope will not occur.

HVAC Note: The HVAC designer should coordinate with the architectural designer regarding the indoor temperature and humidity conditions and the simultaneously occuring outdoor air conditions. With this information the architectural designer can determine the envelope component configuration conducive to maintaining a dry thermal envelope.

(End Designer Checklist)

****

1.1 SUMMARY

This Section specifies the construction and quality control of the installation of an air barrier system. Construct the air barrier system indicated, taking responsibity for the means, methods, and workmanship of

the installation of the air barrier system. The air barrier must be contiguous and connected across all surfaces of the enclosed air barrier envelope indicated. The maximum leakage requirements of individual air barrier components and materials are specified in the other specification sections covering these items.[

****

NOTE: Refer to UFC 3-101-01 to determine when testing is required. If testing is required, retain the bracketed paragraph below and include the referenced testing specification section in the construction documents.

****

This section also defines the maximum allowable leakage of the final air barrier system. The workmanship must be adequate to meet the maximum allowable leakage requirements of this specification. Test the assembled air barrier system to demonstrate that the building envelope is properly sealed and insulated. Passing the air barrier system leakage test and thermography test will result in system acceptance. Conform air barrier system leakage and thermography testing and reporting to the requirements of Section 07 05 23 PRESSURE TESTING AN AIR BARRIER SYSTEM FOR AIR TIGHTNESS.]

1.2 REFERENCES

****

NOTE: This paragraph is used to list the publications cited in the text of the guide specification. The publications are referred to in the text by basic designation only and listed in this paragraph by organization, designation, date, and title.

Use the Reference Wizard's Check Reference feature when you add a Reference Identifier (RID) outside of the Section's Reference Article to automatically place the reference in the Reference Article. Also use the Reference Wizard's Check Reference feature to update the issue dates.

References not used in the text will automatically be deleted from this section of the project specification when you choose to reconcile references in the publish print process.

****

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

ASTM INTERNATIONAL (ASTM)

ASTM D4541	(2017) Standard Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers
ASTM E96/E96M	(2016) Standard Test Methods for Water Vapor Transmission of Materials

ASTM E2178	(2013) Standard Test Method for Air Permeance of Building Materials
ASTM E2357	(2017) Standard Test Method for Determining Air Leakage of Air Barrier Assemblies

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 285	(2012) Standard Fire Test Method for Evaluation of Fire Propagation Characteristics of Exterior Non-Load-Bearing Wall Assemblies Containing Combustible Components

1.3 DEFINITIONS

The following terms as they apply to this section:

1.3.1 Air Barrier Accessory

Products designated to maintain air tightness between air barrier materials, air barrier assemblies and air barrier components, to fasten them to the structure of the building, or both (e.g., sealants, tapes, backer rods, transition membranes, fasteners, strapping, primers).

1.3.2 Air Barrier Assembly

The combination of air barrier materials and air barrier accessories that are designated and designed within the environmental separator to act as a continuous barrier to the movement of air through the environmental separator.

1.3.3 Air Barrier Component

Pre-manufactured elements such as windows, doors, dampers and service elements that are installed in the environmental separator.

1.3.4 Air Barrier Envelope

The combination of air barrier assemblies and air barrier components, connected by air barrier accessories that are designed to provide a continuous barrier to the movement of air through an environmental separator. There may be more than one air barrier envelope in a single building. Also known as Air Barrier System.

1.3.5 Air Barrier Material

A building material that is designed, tested and/or produced to provide the primary resistance to airflow through an air barrier assembly of a wall system.

1.3.6 Air Barrier System

Same as AIR BARRIER ENVELOPE.

1.3.7 Air Leakage Rate

The rate of airflow (L/sCFM) driven through a unit surface area (sq. m sq.ft.) of an assembly or system by a unit static pressure difference (Pa) across the assembly. (example: 1.27 L/s-$m^2$0.25 CFM/sq.ft. @ 75 Pa)

1.3.8 Air Leakage

The total airflow (L/sCFM) driven through the air barrier system by a unit static pressure difference (Pa) across the air barrier envelope. (example: 3070 L/s 6500 CFM @ 75 Pa)

1.3.9 Air Permeance

The tested rate of airflow (L/sCFM) through a unit area (sq. msq.ft.) of a material driven by unit static pressure difference (Pa) across the material (example: 0.02 L/s-m^2 0.004 CFM/sq.ft. @ 75 Pa) as established by ASTM E2178.

1.3.10 Environmental Separator

The parts of a building that separate the controlled interior environment from the uncontrolled exterior environment, or that separate spaces within a building that have dissimilar environments. Also known as the Control Layer.

1.3.11 Vapor Permeance

Vapor permeance is separated into three classes based on the water vapor permeance of a material as tested via ASTM E96/E96M

Class I Vapor Barrier/Retarder	0.1 perm or less
Class II Vapor Barrier/Retarder	0.1 perm to 1.0 perm
Class III Vapor Barrier/Retarder	1.0 perm to 10 perm

1.4 PREPARATORY PHASE OR PRECONSTRUCTION CONFERENCE

Organize pre-construction conferences between the air barrier inspector and the sub-contractors involved in the construction of or penetration of the air barrier system to discuss where the work of each sub-contractor begins and ends, the sequence of installation, and each sub-contractor's responsibility to ensure airtight joints, junctures, penetrations and transitions between materials. Discuss the products, and assemblies of products specified in the different sections to be installed by the different sub-contractors.

1.5 SUBMITTALS

****

NOTE: Review submittal description (SD) definitions in Section 01 33 00 SUBMITTAL PROCEDURES and edit the following list, and corresponding submittal items in the text, to reflect only the submittals required for the project. The Guide Specification technical editors have classified those items that require Government approval, due to their complexity

or criticality, with a "G." Generally, other submittal items can be reviewed by the Contractor's Quality Control System. Only add a "G" to an item, if the submittal is sufficiently important or complex in context of the project.

For Army projects, fill in the empty brackets following the "G" classification, with a code of up to three characters to indicate the approving authority. Codes for Army projects using the Resident Management System (RMS) are: "AE" for Architect-Engineer; "DO" for District Office (Engineering Division or other organization in the District Office); "AO" for Area Office; "RO" for Resident Office; and "PO" for Project Office. Codes following the "G" typically are not used for Navy, Air Force, and NASA projects.

The "S" classification indicates submittals required as proof of compliance for sustainability Guiding Principles Validation or Third Party Certification and as described in Section 01 33 00 SUBMITTAL PROCEDURES.

Choose the first bracketed item for Navy, Air Force and NASA projects, or choose the second bracketed item for Army projects.

****

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are [for Contractor Quality Control approval.][for information only. When used, a code following the "G" classification identifies the office that will review the submittal for the Government.] Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Air Barrier System Shop Drawings; G[, [_____]], Manufacturer produced warranted air barrier system

SD-03 Product Data

Air Barrier System Product Data; G[, [_____]]

SD-04 Samples

****

NOTE: Refer to UFC 3-101-01 for guidance on implementing mock-ups.

****

Mock-Up; G[, [_____]]

Material Samples For Air Barrier System; G[, [_____]]

SD-05 Design Data

Design Data And Calculations For The Air Barrier System; G[, [_____]], Manufacturer produced warranted air barrier system

SD-06 Test Reports

Design Review Report; G[, [_____]]

Testing and Inspection; G[, [_____]]

SD-07 Certificates

****
NOTE: Include submittals for Air Barrier Inspector Qualifications and for a Design Review Report whenever UFC 3-101-01 requires the air barrier system to be tested.
****

Air Barrier Inspector; G, RO

[1.6 AIR BARRIER ENVELOPE SURFACE AREA AND LEAKAGE REQUIREMENTS

****
NOTE: Include this paragraph defining the air barrier leakage requirements whenever UFC 3-101-01 requires the air barrier to be tested. If pressure testing of the air barrier system is not required, delete this paragraph. If pressure testing is required, on the drawings, identify the air barrier envelopes to be tested. Provide the area and leakage information for each six-sided air barrier envelope to be tested below. Optionally, include a table on the drawings summarizing the envelope information. If that is the approach, simply refer to the drawings at this point in the specification and delete the envelope area and leakage information below.
If only a portion of the air barrier envelope is being test as in the case of the barracks building described in the opening notes above, indicate the test rooms; for example, change "Air Barrier Envelope 1", to "Room 214". For a description of the test process, Refer to UFGS 07 05 23 PRESSURE TESTING AN AIR BARRIER SYSTEM FOR AIR TIGHTNESS paragraph Pressure Testing a Multiple Isolated Zoned Building. If an Air Barrier Envelope is an isolated zone within the larger building (eg: single room in a barracks) and if it is impossible to test that isolated zone without sealing the HVAC ducts that interconnect adjacent rooms, perform the Architectural Only test and delete the Architectural Plus HVAC System test for that particular Air Barrier Envelope.
****

The building air barrier systems must meet the following leakage requirements. The allowable leakage rate and the maximum leakage are at a

differential test pressure of 75 Pa.

****
NOTE: Add or delete air barrier envelopes to be tested as required.
****

****
NOTE: Edit the Allowable air leakage rates as required by UFC 3-101-01 Architecture. A leakage value less than 0.25 CFM/SQFT for Army/Navy facilities and 0.4 for Air Force facilities is recommended on projects where design and construction teams have experience in attaining lower rates of leakage to increase energy reduction, on projects with specific mission/functional requirements, or on building construction types (i.e pre-cast concrete panels and insulated concrete forms) where low allowable leakage values are easily attained. Additionally, the leakage rate can be set to any leakage value less the 0.25 CFM/SQFT for Army/Navy facilities and 0.4 for Air Force facilities is recommended to meet project specific energy targets. This should be correlated back to the energy model for validation.
****

Air Barrier Envelope 1	
Surface Area	[_____] square meter square feet
Architectural Only Test:	
Allowable leakage rate	[1.27][2.03][_____] L/s per square meter [0.25][0.40][_____] CFM/sq.ft
Maximum leakage	[_____] total L/s CFM
Architectural Plus HVAC System Test:	
Allowable leakage rate	[1.52][2.29][_____] L/s per square meter [0.30][0.45][_____] CFM/sq.ft
Maximum leakage	[_____] total L/s CFM

Air Barrier Envelope 2	
Surface Area	[_____] square meter square feet
Architectural Only Test:	
Allowable leakage rate	[1.27][2.03][_____] L/s per square meter [0.25][0.40][_____] CFM/sq.ft
Maximum leakage	[_____] total L/s CFM

Architectural Plus HVAC System Test:	
Allowable leakage rate	[1.52][2.29][_____] L/s per square meter [0.30][0.45][_____] CFM/sq.ft
Maximum leakage	[_____] total L/s CFM

Air Barrier Envelope 3	
Surface Area	[_____] square meter square feet
Architectural Only Test:	
Allowable leakage rate	[1.27][2.03][_____] L/s per square meter [0.25][0.40][_____] CFM/sq.ft
Maximum leakage	[_____] total L/s CFM
Architectural Plus HVAC System Test:	
Allowable leakage rate	[1.52][2.29][_____] L/s per square meter [0.30][0.45][_____] CFM/sq.ft
Maximum leakage	[_____] total L/s CFM

][1.7 AIR BARRIER INSPECTOR

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NOTE: Include the requirement for an AIR BARRIER INSPECTOR whenever UFC 3-101-01 requires the air barrier to be tested.
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Employ a designated Air Barrier Inspector on this project. The Air Barrier Inspector performs a Design Review, oversees quality control testing specified in these specifications, performs quality control air barrier inspection as specified, interfaces with the designer and product manufacturer's representatives to assure all installation requirements are met, and verifies that the constructed work is in accordance with both the manufacturer's recommendations for products used, the content of this specification and other contract drawings or docouments. Qualification for the Air Barrier Inspector are as follows:

a. Training and certification as an Air Barrier Auditor from the Air Barrier Association of America (ABAA) or other third party air barrier association.

b. Or, provide documentation in resume format that demonstrates that the individual proposed has the experience, knowledge, skills and abilities to fulfill the above stated duties as the air barrier inspector.

c. It is acceptable that this individual be employed by the firm who will be performing the building pressurization test or another independent third party entity, provided they meet the above requirements but shall not be a member of the installing contractor or firm.

Provide copies of Air Barrier Inspector qualifications 30 days after Notice to Proceed.

][1.8 DESIGN REVIEW

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NOTE: Include the requirement for a DESIGN REVIEW whenever UFC 3-101-01 requires the air barrier to be tested.

This Design Review is conceptually similar to the Design Review Report required by the TESTING, ADJUSTING, AND BALANCING FOR HVAC specification where the TAB specialists reviews the plans and specs and submits a report either indicating that the system can be balanced or describing deficiencies that preclude the TAB team from accomplishing their work and describing necessary changes. Similarly, with the air barrier system Design Review, the contractor is asked to review the design and point out any deficiencies that prevent a successful air barrier system installation.

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Review the Contract Plans and Specifications and advise the Contracting Officer of any deficiencies that would prevent the construction of an effective air barrier system. Provide a Design Review Report individually listing each deficiency and the corresponding proposed corrective action necessary for proper air barrier system. Provide copies of the Design Review Report not later than [14] [_____] days after approval of the Air Barrier Inspector Qualifications. Submit design data and calculations for the Air Barrier System for a manufacturer produced warranted air barrier system.

]PART 2 PRODUCTS

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NOTE: Air barrier membranes and their air permeance and water vapor permeance are specified in other specification sections. Add specification sections as required. Examples: Self-adhered sheets, fluid-applied membranes, spray foams, boardstock air barrier materials, mechanically attached flexible sheet materials. The ABAA website is one source of air barrier material specifications. Indicate all pertinent material properties including air permeance, water vapor permeance, adhesion requirements, and flame and smoke spread requirements. Also, indicate that the manufacturer's instructions for the storage, installation, and application of air barrier products must be followed.

Air barrier materials have a maximum air permeance of 0.02 L/s-m^2 0.004 CFM/sq.ft. of surface area at a pressure difference of 75 Pa. Films, membranes, and coatings intended as air barrier components must meet this rating when tested in accordance with ASTM E2178.

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2.1 AIR BARRIER

Provide air barrier system of compatible parts from one or several manufacturers coordinated by the contractor or provide a single warranted system provided by a primary manufacturer. The air barrier system as part of a tested exterior wall assembly must meet the conditions of acceptance as tested in accordance with NFPA 285. Materials used for roof assembly air barrier must conform to the appropriate UL and FM wind and fire requirements for the specified roof assemblies.

If a complete air barrier system from a single manufacturer is utilized, whether warranted on not warranted, the air barrier system must conform to ASTM E2357.

Materials in the following categories as used in the air barrier system or assembly of the exterior wall system are tested and are required to conform to ASTM E2178: Self-adhered sheet membranes, fluid applied membranes, spray polyurethane foam, mechanically fastened commercial building wrap, factory bonded membranes to sheathing, and adhesive backed commercial building wrap and accessory products.

Other materials used as an air barrier such as concrete, glass, wood, metal or gypsum board may or may not conform to ASTM E2178 but are acceptable provided that when integrated into the air barrier system or assemblies that they are not subject to material or environmental induced degradation in their final produced state and once incorporated in the permanent construction.

All materials used must be identifiable through manufacturer testing data and/or literature to be compatible with all the attached or adjoining materials or substrates used in the system.

Provide Air Barrier System Shop Drawings, Material Samples for Air Barrier System and Air Barrier System Product Data.

PART 3 EXECUTION

3.1 QUALITY CONTROL

3.1.1 Documentation and Reporting

Document the entire installation process on daily job site reports. These reports include information on the Installer, substrates, substrate preparation, products used, ambient and substrate temperature, the location of the air barrier installation, the results of the quality control procedures, and testing results.

[3.1.2 Construction Mock-Up

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NOTE: Refer to UFC 3-101-01 for guidance on when to implement mock-ups. Delete this paragraph if a mock-up is not required.

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Build mock-up prior to building envelope construction.

a. Prepare a construction mock-up to demonstrate proper installation of

the air barrier assemblies and components. Include air barrier system connections between floor and wall, wall and window, wall and roof. Also, include the sealing method between membrane joints at transitions from one material or component to another, at pipe or conduit penetrations of the wall and roof, and at duct penetration of the wall and roof. Work will not begin until the mock-up is satisfactory to the Contracting Officer.

b. Size the mock-up to approximately 2 m long by 2 m high 8 feet long by 8 feet high. The mock-up must be representative of primary exterior wall assemblies and glazing components including backup wall and typical penetrations as acceptable to the Contracting Officer. A corner of the actual building may be used as the mock-up.

c. Mock-Up Tests for Adhesion: Test the mock-up of materials for adhesion in accordance with manufacturer's recommendations. Perform the test after the curing period recommended by the manufacturer. Record the mode of failure and the area which failed in accordance with ASTM D4541. When the air barrier material manufacturer has established a minimum adhesion level for the product on the particular substrate, the inspection report must indicate whether this requirement has been met. Where the manufacturer has not declared a minimum adhesion value for their product/substrate combination, simply record the value.

]3.1.3 Quality Control Testing And Inspection

Conduct the following tests and inspections as applicable in the presence of the Contracting Officer during installation of the air barrier system, and submit quality control reports as indicated below.

a. Provide a Daily Report of Observations with a copy to the Contracting Officer.

b. Inspect to assure continuity of the air barrier system throughout the building enclosure and that all gaps are covered, the covering is structurally sound, and all penetrations are sealed allowing for no infiltration or exfiltration through the air barrier system.

c. Inspect to assure structural support of the air barrier system to withstand design air pressures.

d. Inspect to assure masonry surfaces receiving air barrier materials are smooth, clean, and free of cavities, protrusions and mortar droppings, with mortar joints struck flush or as required by the manufacturer of the air barrier material.

e. Inspect and test to assure site conditions for application temperature, and dryness of substrates are within guidelines.

f. Inspect to assure substrate surfaces are properly primed if applicable and in accordance with manufacturer's instructions. Priming must extend at least 50 mm2 inches beyond the air barrier material to make it obvious that the primer was applied to the substrate before the air barrier material.

g. Inspect to assure laps in materials are at least a 50-mm2-inch minimum, shingled in the correct direction or mastic applied in accordance with manufacturer's recommendations, and with no fishmouths.

h. Inspect to assure that a roller has been used to enhance adhesion. Identify any defects such as fishmouths, wrinkles, areas of lost adhesion, and improper curing. Note the intended remedy for the deficiencies.

i. Measure application thickness of liquid applied materials to assure that manufacturer's specifications for the specific substrate are met.

j. Inspect to assure that the correct materials are installed for compatibility.

k. Inspect to assure proper transitions for change in direction and structural support at gaps.

l. Inspect to assure proper connection between assemblies (membrane and sealants) for cleaning, preparation and priming of surfaces, structural support, integrity and continuity of seal.

m. Perform adhesion tests for fluid-applied and self-adhered air barrier membranes to assure that the manufacturer's specified adhesion strength properties are met. Determine the bond strength of coatings to substrate in accordance with ASTM D4541.

n. Provide cohesion tests for spray polyurethane foam (SPF). [Perform the tests in accordance with the specification sections which specify these materials.] [Perform adhesion tests as follows: Using a coring tool remove a sample and determine the relative adhesion quality of the foam. If the foam is hard to remove and leaves small bits of foam on the substrate it is called cohesive foam failure and is considered the best adhesion. If the foam comes away from the substrate with some force but is clean, it is called a mechanical bond. If it comes away easily from the substrate, the adhesion is poor. Cohesive foam failure and a good mechanical bond are acceptable.]

o. Provide written test reports of all tests performed.

3.2 REPAIR AND PROTECTION

Upon completion of inspection, testing, sample removal and similar services, repair damaged construction and restore substrates, coatings and finishes. Protect construction exposed by or for quality control service activities, and protect repaired construction.

-- End of Section --