



Evaluating the Ability of Fenestration Products to Control Water Intrusion in FEMA MHUs: TEST PLAN

Prepared by

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Control of Water Intrusion: Test Plan

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Location Test site: Selma, AL	
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Goal

To address bulk water intrusion issues experienced by FEMA’s MHUs in storage and service, this task will characterize the construction practices that result in water intrusion, identify installation practices that are likely to resolve the issues, develop a robust testing protocol and evaluate the efficacy of fenestration products through controlled testing.

The goals of the effort are twofold:

1. Develop a comprehensive test protocol for verification of fenestration performance; and,
2. Develop designs, details and construction methods that minimize chances of water intrusion.

The key questions to be addressed by this research plan include but are not limited to the following:

- What are the mechanisms in which bulk water infiltrates through the building envelope?
- What is the reason for bulk water infiltration-deficiencies in design, craftsmanship, or a combination of both?
- What components or a combination of components best stop bulk water infiltration?
- What is the best method for evaluating and verifying the ability of fenestration products to resist bulk water intrusion?

Scope of Work

Task 1. Develop specifications and install fenestration in test MHUs (Completed Nov 2017)

Two prototype MHUs were built with door and window products and construction details expected to resist bulk water intrusion.

The installation process was documented and construction quality documented.

Task 2. Conduct testing of fenestration specimens

Tests will be conducted on the installed fenestration products that are shown in **Error! Reference source not found.**

Table 1 List of window/door specimens to be tested

Window Tests	Door Tests
Test 1: KINRO 9450 single hung window (36 X 60)	Test 2: KINRO 5140 Outswing Door (36 X 80)
	Test 3: KINRO 5140 Outswing TPS Exterior door (38 X 80)
	Test 4: KINRO 7660 Inswing door with storm door (36 X 80)

Before testing, locations of the fenestration products being tested shall be noted. All operable portions of the specimens being tested shall be closed and locked.

A temporary test chamber shall be sealed to the exterior side of the fenestration specimen(s) being tested. Air leakage shall be tested before the wall is wetted for water leakage testing to avoid water trapped within the wall components from reducing air leakage.

- **Air Leakage Test:** Air shall be evacuated from the test chamber. A minimum uniform static test pressure of 75 Pa (1.6 psf) shall be maintained, but shall not exceed 300 Pa (6.2 psf). The subsequent air infiltration rate shall be noted to ensure that it is within the allowable rate as stated in the 'Evaluation Criteria' section.
- **Water leakage Test:** A static test pressure equal to 2/3 of the tested and rated laboratory performance of the product shall be applied. The pressure shall not be less than 91 Pa (1.9 psf). A calibrated spray-rack shall be used to apply water against the exterior fenestration surface. Four water spray cycles of five minutes each shall be applied under pressure, interspersed by one minute with the pressure released. Any penetration of water beyond a plane parallel to the fenestration product's innermost edges will be observed. The test apparatus is shown in Figure 1.

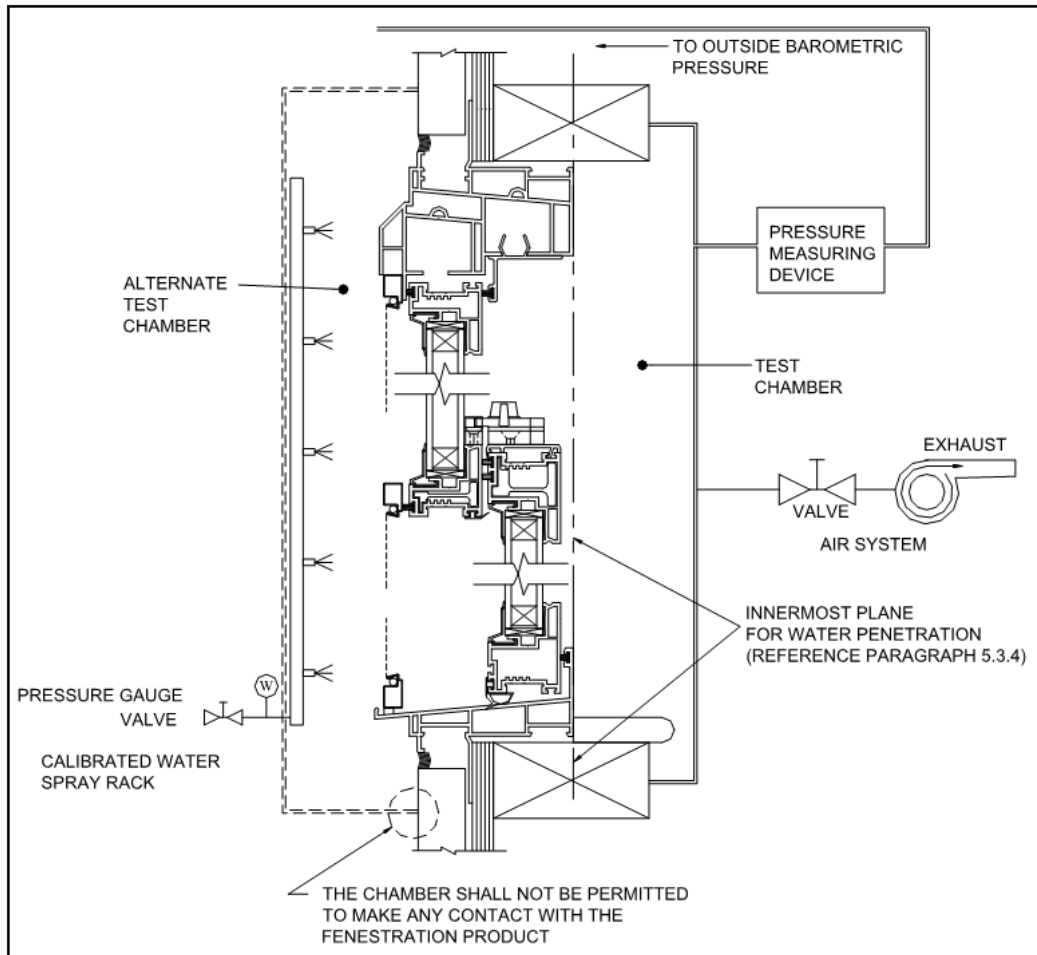


Figure 1 Test chamber and apparatus (Source: AAMA 502-08)

Task 3. Document results and refine designs and specifications

Results of the tests conducted on the installed doors and windows shall be documented. If issues are identified with installation of the products, recommendations shall be made to improve the construction steps and details. The outcome of this testing shall inform the specifications and design details for fenestration assemblies to be used on future MHUs. If installed products do not pass the tests, an action plan and future course of action will be determined based on the nature of failure experienced.

Evaluation Criteria

The following criteria will be used to evaluate fenestration products for bulk-water resistance:

- Pre-test checks:
 - Is the specimen installed correctly, level and square within the frame?
 - Are there any irregular gaps between the door and the door frame?
 - What is the physical condition of the specimen? Are there any cracks or visible signs of transportation damage/racking etc.?
 - Is the specimen operating correctly (open/close)?

- Are there any weather seals missing?
- What is the designated drainage path of the specimen?
- Does the specimen have a J-channel or drip edge?
- Are there any other concerns observed with the installation or flashing of the specimen?
- Air Leakage testing:
 - What is the actual air leakage for the specimen? Is it limited to the allowable leakage of 2.3 L/s•m² (0.45 cfm/sf)?
- Water Leakage Testing:
 - Is there any penetration of water through the fenestration product itself?
 - Is there any water penetration at the joints of the specimen? Is the flashing effective at the perimeter?
 - Is there any water penetration through gaps between the specimen and its frame?
 - Are there any leaks due to missing weather seals?
 - Is water being seeped into any cracks or imperfections in the frame?
 - Are the J-channels/drip edges effective in channeling water away from the fenestration?
 - Is there any accumulation of water at thresholds, sills or floor decking?
 - Are there any leaks observed in the interior of the homes?

Post Evaluation Tasks

Task 4. Develop a comprehensive fenestration testing process

Based on the experience gained during testing in Task 3, the test protocol shall be modified to achieve extremely reliable and verifiable results, allowing no room for skewing of the test to attain compliance. Third parties will be engaged in this process to ensure that the testing procedure developed is truly representative of the performance of fenestration products. Fenestration manufacturers interested to have their products installed in the next gen MHUs, shall be directed to solicit individual laboratories to conduct testing as per the stipulated testing protocol to qualify for use in the future MHUs.

Deliverables

The following deliverables will be provided:

1. **A draft testing protocol** that includes:
 - A recommended sampling rate
 - Step-by-step instructions for conducting the test(s)
 - Pass/fail criteria
 - Procedure to be followed in case of performance failure, and related considerations.
2. **Summary report**, containing the following:
 - A summary of the tests performed at Selma, AL
 - Photographs of test procedures
 - Qualitative and quantitative results of each of the tests
 - Conclusions on suitability of installed products

Bulk water Test Plan

- Recommendations to improve the current design or workmanship flaws, if any
- 3. Revisions to fenestration specifications, details and construction steps** reflecting lessons learnt during construction and testing
- 4. A revised comprehensive test protocol** for independent fenestration testing and verification

Timeline

Tasks/Subtasks		2017	February				March				April				May				June				July					
			5-9	12-16	19-23	26-2	5-9	12-16	19-23	26-30	2-6	9-13	16-20	23-27	30-4	7-11	14-18	21-25	28-1	4-8	11-15	18-22	25-29	2-6	9-13	16-20		
Bulk Water Testing																												
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