Sto Corp.
3800 Camp Creek Parkway
Building 1400, Suite 120
Atlanta, GA 30331
Tel: 404-346-3666
Toll Free: 1-800-221-2397
Fax: 404-346-3119
www.stocorp.com

Tech Hotline

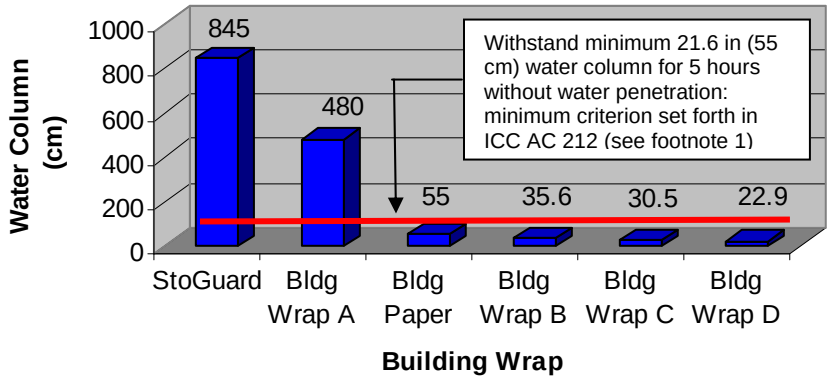
No. 1211-BSc

Not All Air Barriers are WRBs (Water-Resistive Barriers)

Many air barrier materials are assumed to function as WRBs in wall assemblies, but not all air barriers are WRBs. An air barrier and WRB must not only resist air leakage, but must also resist water penetration and remain durable when exposed to water and stresses that can be experienced in service.

Standard criterion for a material to qualify as an air barrier is air leakage not exceeding 0.004 cfm (0.02 L/s·m^2) at a pressure differential of 1.57 psf (75 Pa) when tested in accordance with ASTM E 2178. While many common building materials meet this criterion, they do not function as WRBs. For example, ½ inch (13 mm) thick gypsum wall board is an air barrier material, but is water-sensitive and is not permitted as a WRB in wall assemblies. In some cases house wraps may meet criteria as an air barrier but fail to meet criteria to perform effectively as a WRB. Figure 1 represents results of independent laboratory testing administered by Sto Corp. on StoGuard® waterproof air barrier compared to code prescribed building paper, and several sheet building wraps.

Figure 1. Water Penetration Resistance of Building Wraps



So, how can one be sure that a material is capable of performing both functions? The answer is simple. Look for independent testing and evaluation and a building code evaluation report. Specifically, in the United States ICC ES (International Code Council Evaluation Service) has established stringent criteria for coatings intended to function as WRBs that evaluate durability under a wide range of conditions. Evaluation reports published by ICC ES will state whether or not a product can be approved for use as both an air barrier and WRB. Similarly, in Canada, CCMC (Canadian Construction Materials Centre) has developed a Technical Guide for air barriers and has recently published one for liquid applied WRBs (called sheathing membranes in Canada), and publishes evaluation reports for each.

1. For reference 21.6 in (55 cm) water column pressure would correlate to approximately 112 psf (5.36 kPa) or 209 mph (337 kph) wind speed, well in excess of Category 5 hurricane force wind speeds. ICC AC 212 specifically addresses liquid applied WRBs, not sheet goods, for which a separate criteria exists, ICC AC 38, however, the water column test is listed in both criteria.

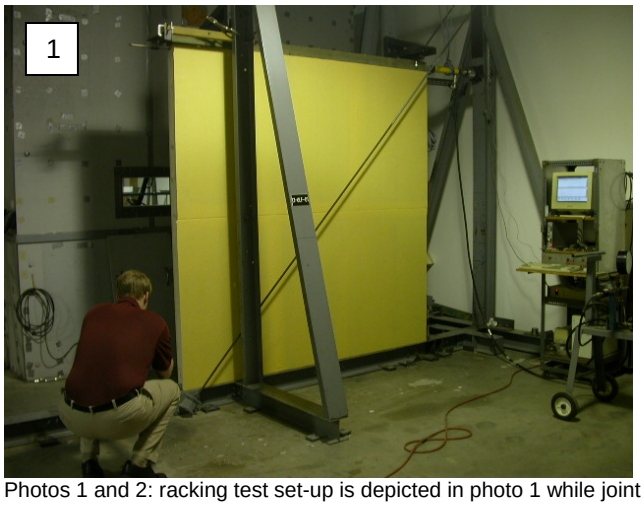
Together, the tests required by ICC AC 212 and the CCMC Technical Guides are a severe set of performance criteria for liquid applied air barriers/WRBs used over sheathing. Important to note is that the tests often include the most critical element for performance, the joint treatment. **Both small and full scale tests are conducted and factor aging, racking stress, wind load, environmental exposure, and water penetration resistance at fastener penetrations**. Table 1 summarizes these tests, while the examples below highlight some of the extreme exposure conditions intended to fatigue the air barrier/WRB material (including joints) before subjecting it to water penetration testing:

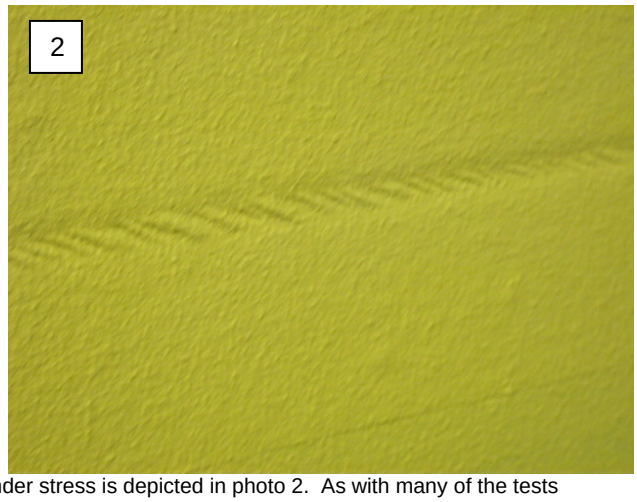
- Structural, racking, and restrained environmental cycling tests (Photos 1 and 2) in ICC AC 212 begin by subjecting an 8 x 8 foot (2.4 x 2.4 m) panel to 10 cycles of positive loading at the manufacturer's specified deflection criteria in accordance with ASTM E 1233. This is followed by racking tests in accordance with ASTM E 72. The restrained environmental cycling portion of the test series exposes the panel to 5 cycles of heat exposure at 120°F (48.9°C) for 24 hours, then water spray for 24 hours. At the completion of this test series the panel is evaluated for water penetration resistance in accordance with ASTM E 331 at 2.86 psf (137 Pa or approximately 33.4 mph [53.8 kph]) pressure with water spray for 15 minutes. The criteria require no water penetration at sheathing joints.

- Hydrostatic pressure testing in ICC AC 212 is performed after accelerated aging that consists of simulated UV and high heat exposure (minimum 135°F [57.2°C]) for 210 hours, followed by 25 cycles of: oven drying at 120°F (48.9°C) for three hours, immersion in water at room temperature for 3 hours, then drying for 18 hours. After 25 cycles the material (including joint treatment) must then withstand a 21.6 inch (55 cm) hydrostatic pressure test without leakage for a minimum of 5 hours.

- Resistance to water penetration at fasteners in TG MF 07 25 10.05 is evaluated by pre-conditioning the air barrier/WRB material with fastener penetration by heat aging at 122°F (50°C) for 96 hours, then dynamic conditioning consisting of 1000 cycles of positive and negative loading at 16.7 psf (800 Pa or approximately 81 mph [130 kph]), then saturation with water spray for 15 minutes at 8.35 psf (400 Pa or approximately 57 mph [92 kph]). This is followed by water spray again at 3 pressure increments of 1.57 psf, 3.13 psf, and 6.27 psf (75 Pa, 150 Pa, and 300 Pa or approximately 25, 35, 49 mph, [40, 56, 79 kph]) for 15 minutes each. The weight gain of the air barrier/WRB is measured in grams and compared to the weight gain of a code prescribed sheathing membrane as a basis for determining compliance with the NBC (Canadian National Building Code).

Few if any materials have undergone such comprehensive and rigorous testing to qualify as an air barrier and WRB in wall construction. In fact, StoGuard is the only fluid applied air barrier and WRB material that has been evaluated by ICC-ES and CCMC and meets both sets of criteria as an air barrier and WRB (sheathing membrane in Canada). For complete information on the products listed in these evaluation reports, refer to ICC ESR 1233 and CCMC ER 13120-R (air barrier, CCMC ER on StoGuard sheathing membrane is pending).





Photos 1 and 2: racking test set-up is depicted in photo 1 while joint under stress is depicted in photo 2. As with many of the tests identified in ICC AC 212 and the Canadian Technical Guides for air barriers and liquid applied WRBs (sheathing membranes), resistance to water penetration is evaluated after stress or fatigue tests.

Table 1. Summary of Performance Criteria for Code Compliance of Liquid Applied Materials Intended to Function as WRBs (sheathing membranes) in Wall Assemblies in the US and Canada

No.	Test	Method	Criteria
United States: ICC AC 212			
1.	Tensile bond	ASTM C 297	15 psi (103 kPa) minimum
2.	Freeze-thaw	ASTM E 2485	10 cycles: no surface changes such as checking, cracking, crazing, erosion or delamination
3.	Water resistance	ASTM E 2247	14 days: no deleterious effects
4.	Water vapor transmission	ASTM E 96	Meet one of the grade requirements in Table 1 of ICC-AC 38, report value
5.	Structural, racking, and restrained environmental cycling	ASTM E 1233, ASTM E 72, AC 212, par 4.7.3,	10 cycles of loading at deflection specified by manufacturer, followed by racking with ½ inch (13 mm) net deflection (or 1/8 inch [3 mm] with hold-downs), followed by 5 cycles water spray and radiant heat at 24 hours each, followed by water penetration resistance testing: no cracking of the material within the field or at joints
6.	Water penetration resistance	ASTM E 331	15 minutes water spray at 2.86 psf (137 Pa), no water penetration visible at sheathing joints, no cracking of material within the field or at joints after exposing the panel to the test conditions in test no. 5
7.	Weathering	AC 212, par 4.8	210 hours UV light at 135-140°F (57.2-60°C), 25 cycles drying and soaking – oven dry at 120°F (48.9°C) for 3 hours, immerse in water for 3 hours, and air dry for 18 hours at 75°F (24°C): no cracking of the material or bond failure
8.	Hydrostatic pressure	AATCC Method 127 modified	21.6 inch (55 cm) water column: no water penetration after exposure to the conditions in test no. 7
Canada: CCMC TG MF 07240			
1.	Adhesion to wood under different moisture conditions	ASTM D 5651	43.5 psi (0.3 MPa) mean value minimum dry, after 1 hour soak, and after 24 hours soak
2.	Joint disruption resistance	TG MF 07240, Appendix A4, art. A4.3.2	Transverse bending at L/180 assembly deflection: no cracking, delamination, or any other deleterious effects at the joints
3.	Resistance to relaxation under environmental cycling conditions	TG MF 07240, Appendix A4, art. A4.3.3	Extend joint 3/64 inch (1.3 mm, approximately 40%), followed by 15 cycles hot and cold – hot at 149°F (65°C) and 90± 5%RH for 18 hours, cold at 14°F (-10°C) for 5 hours, evaluate visually for loss of joint integrity
4.	Water transmission resistance	TG MF 07240, Appendix A4, art. A4.3.4	1 inch (25 mm) water head with desiccant on opposite side: water transmission $\leq 2 \times 10^{-7}$ kg/m^2•s
5.	Water vapor transmission resistance	ASTM E 96	Report value at 1 and 2 times thickness
6.	Accelerated weathering	ASTM D 822, ASTM G 155	250 hours total light exposure minimum, no cracking, delamination, or other deleterious effects
7.	Nail popping resistance	TG MF 07240, Appendix A4, art. A4.3.8	1 mm nail head protrusion, no cracking or delamination around the nail head
Canada: CCMC TG MF 07 25 10.05			
Material must meet the base requirements 1-7 of TG MF 07240 and durability performance of ICC AC 212 test nos. 2-8 in addition to:			
1.	Water penetration resistance at fastener penetrations	TG 07 25 10.05 Appendix D	Heat aging at 122°F (50°C) for 96 hours, dynamic conditioning 1000 cycles positive and negative loading at 16.7 psf (800 Pa), saturation with water spray for 15 minutes at 8.35 psf (400 Pa), water spray again at 3 pressure increments of 57 psf, 3.13 psf, and 6.27 psf (75 Pa, 150 Pa, and 300 Pa) for 15 minutes each: weight gain ≤ benchmark sheathing membrane

References

1. ASTM C 297, Standard Test Method for Flatwise Tensile Strength of Sandwich Constructions
2. ASTM D 2247, Standard Practice for Testing Water Resistance of Coatings in 100% Relative Humidity
3. ASTM D 822, Standard Practice for Filtered Open-Flame Carbon-Arc Exposure of Paint and Related Coatings
4. ASTM D 5651, Standard Test Method for Surface Bond Strength of Wood-Base Fiber and Particle Panel Materials
5. ASTM E 96, Standard Test Method for Water Vapor Transmission of Materials
6. ASTM E 72, Standard Test Methods of Conducting Strength Tests of Panels for Building Construction
7. ASTM E 331, Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference
8. ASTM E 1233, Standard Test Method for Structural Performance of Exterior Windows, Curtain Walls and Doors by Cyclical Static Air Pressure Difference
9. ASTM E 2178, Standard Test Method for Air Permeance of Building Materials
10. ASTM E 2485, Standard Test Method for Freeze-Thaw Resistance of Exterior Insulation and Finish Systems
11. ASTM G 155, Standard Practice for Operating Xenon Arc Light Apparatus for Exposure on Non-Metallic Materials
12. CN TG MF 07240, Technical Guide for Adhered Exterior Insulation and Finish Systems (EIFS) Class PB
13. CN TG MF 07 25 10.05, Technical Guide for Liquid Applied Sheathing Membrane Coatings
14. ICC AC 38, Acceptance Criteria for Water-Resistive Barriers
15. ICC AC 212, Acceptance Criteria for Water-Resistive Coatings Used as Water-Resistive Barriers over Exterior Sheathings

Referenced documents are available at:
http://www.astm.org
http://www.nrc-cnrc.gc.ca/ccmc-ccmc/index.html
http://www.icc-es.org