What is High Temperature Performance?

Existing Industry Standards and Specifying for Performance in Adhered Air & Water Barrier Membranes

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High-Temperature Comparison is Difficult Today

Specifiers of air and water-resistive barrier (AWB) systems frequently reference high-temperature performance for project requirements. These specifications are often cobbled from an array of non-comparable manufacturing literature and claims, using terms such as “service temperature”, “temperature stability”, “exposure temperature”, and “application temperature”. However, these terms lack clear definitions and consistency across the industry. This ambiguity complicates product specifications and performance expectations, particularly for adhered flashing membranes.

Material Behavior Under High Temperatures

Adhered flashings consist of two primary components: an adhesive layer and a top sheet. The adhesives commonly used—asphaltic-, butyl-, or acrylic-based —have distinct thermal performance characteristics. Asphaltic adhesives exhibit good initial adhesion but tend to soften and flow at elevated temperatures. Butyl adhesives offer both strong initial adhesion and better high-temperature stability. Acrylic adhesives provide high-temperature resistance but often have lower adhesive coat weights, which can impact other aspects of performance (i.e. sealability, adhesion, conforming to the substrate).

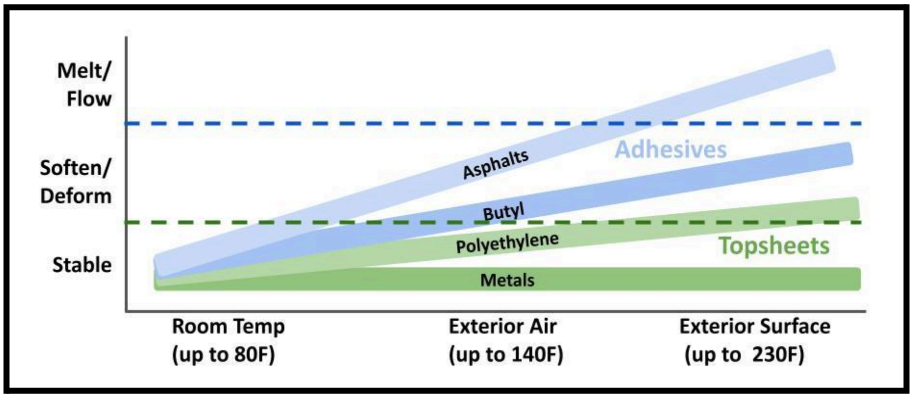


Figure 01
Illustration of typical behavior of differing materials used for adhering flashing membranes when exposed to different temperature ranges.

The choice of top sheet material also significantly influences performance. Polyethylene-based top sheets, though effective vapor barriers, can wrinkle and distort at high temperatures, affecting long-term durability. In contrast, metal-based top sheets like aluminum and stainless steel provide superior stability and compatibility with adhesives and sealants. These material behaviors highlight the need for test methods that evaluate the performance of the entire system—not just the adhesive layer.

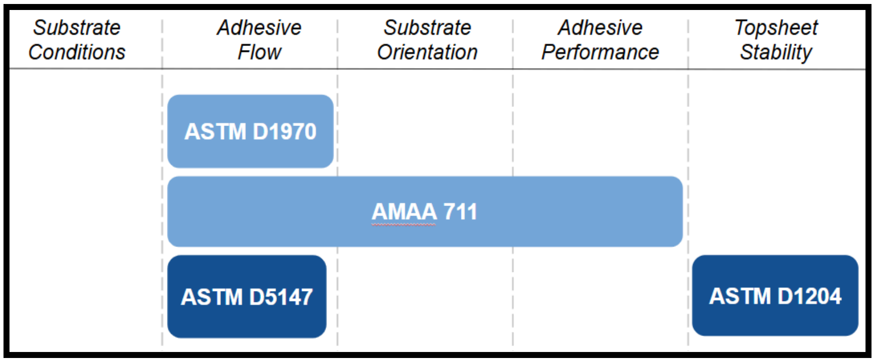


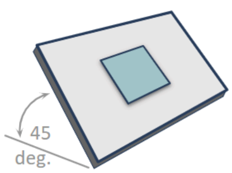
Figure 02
Representation of the elements of high-temperature exposure evaluated under standards commonly used in the industry

Existing Test Methods And High-Temperature Evaluation

Currently, the high-temperature performance of adhered flashing membranes are assessed using various ASTM and AAMA test methods *(Figure 02)*. However, each standard evaluates only a portion of the performance attributes required for real-world applications.

ASTM D1970

Standard Specification for Self-Adhering Polymer Modified Bituminous Sheet Materials Used as Steep Roofing Underlayment for Ice Dam Protection



Substrate	Test Angle	Temperature	Exposure Time	High-Temp Wall Elements Addressed
Plywood	45°	70°C (158°F)	14 days	Adhesive flow

ASTM D1970, Section 7.5, *Thermal Stability*, is commonly referenced for high-temperature performance but is limited in scope. It measures only the flow of the adhesive layer when a sample is adhered to plywood and conditioned at 70°C for 14 days. ASTM D1970 should not be solely relied upon for evaluating high-temperature performance, as it has several key limitations. The standard overlooks topsheet stability, provides no performance measurement after heat aging, and uses a 45-degree test orientation that does not accurately represent vertical applications. Additionally, the substrate used in the test does not reflect conditions typical of common adhered flashing installations, further limiting its relevance in real-world scenarios.

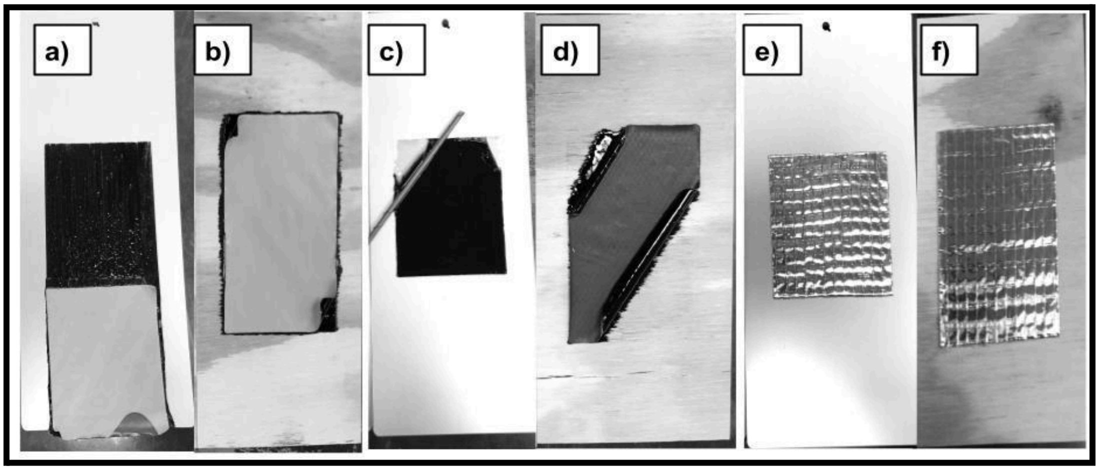
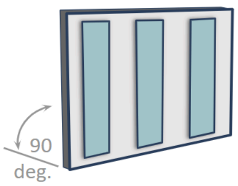


Figure 03
Images postconditioning for three different representative materials in the industry. a) and b) are the same material on anodized aluminum and plywood, respectively. c) and d) are the same material on anodized aluminum and plywood, respectively. e) and f) are the same material on anodized aluminum and plywood, respectively. All materials are conditioned at 70 °C for 14 days at 45-degree angles before visual inspection.

Performing the ASTM D1970 thermal stability test on the standard plywood substrate and an anodized aluminum substrate *(Figure 03)* with the same materials, reveals that materials performing well on plywood may fail on non-porous surfaces like anodized aluminum. These variations underscore the need for broader evaluation methods to establish high-temperature performance.

AAMA 711

Specification for Self Adhering Flashing Used for Installation of Exterior Wall Fenestration Products

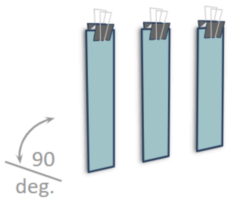


Substrate	Test Angle	Temperature	Exposure Time	High-Temp Wall Elements Addressed
Anodized Aluminum	90°	80°C (176°F)	7 days	Adhesive Flow Substrate Orientation Adhesive Performance

AAMA 711, Section 5.5, *Exposure to Elevated Temperature*, assesses adhered flashing membranes at exposure levels of 50°C, 65°C, and 80°C for 7 days. After conditioning, samples undergo peel adhesion testing, and visual inspections identify defects such as wrinkling and delamination. However, AAMA 711 does not specify performance thresholds for observed top sheet distortions, which can still impact real-world functionality.

ASTM D5147

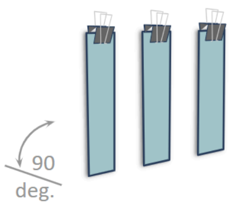
Standard Test Methods for Sampling and Testing Modified Bituminous Sheet Material



Substrate	Test Angle	Temperature	Exposure Time	High-Temp Wall Elements Addressed
None	90°	<121°C (250F)	Varies, until failure	Adhesive Flow

ASTM D1204

Linear Dimensional Changes of Nonrigid Thermoplastic Sheeting or Film at Elevated Temperature



Substrate	Test Angle	Temperature	Exposure Time	High-Temp Wall Elements Addressed
Anodized Aluminum	90°	Varies	Varies, until failure	Topsheet Stability

ASTM D5147, Section 11, *Dimensional Stability*, and ASTM D1204, *Standard Test Method for Linear Dimensional Changes of Nonrigid Thermoplastic Sheeting or Film at Elevated Temperature*, are similar dimensional stability tests looking at different aspects of the material. ASTM D5147 also includes tests for heat conditioning (70°C for 90 days) and compound stability (up to 121°C). The D5147 dimensional stability test method is very similar to ASTM D1204 except that there is no set temperature range and the performance criteria is a measurement of topsheet shrinkage from heat aging. While these methods provide insights into material aging, it does not fully replicate real-world conditions where flashing materials experience peak temperatures exceeding 110°C under conditions such as copings and metal claddings.

A More Representative Benchmark

Research suggests that peak temperatures under high solar exposure areas such as copings, below dark metal claddings, south-oriented facades, and high UV index climates can reach 240°F (115°C). Evaluating high-temperature performance under these realistic conditions may provide additional insights into material durability. AAMA 711 Level X, which extends the standard exposure to 240°F (115°C), could offer a useful reference point for assessing material performance more comprehensively. Tests at this level *(Figure 04, next page)* reveal significant differences in material performance:

- Some materials fail completely at 80°C, while others only exhibit wrinkling.
- At 240°F (115°C) (i.e., AAMA 711 Level X), performance disparities become more pronounced, exposing weaknesses not evident in lower-temperature tests.

For projects where high-temperature performance is critical, considering such benchmarks could offer a more reliable indicator of long-term durability in extreme conditions.

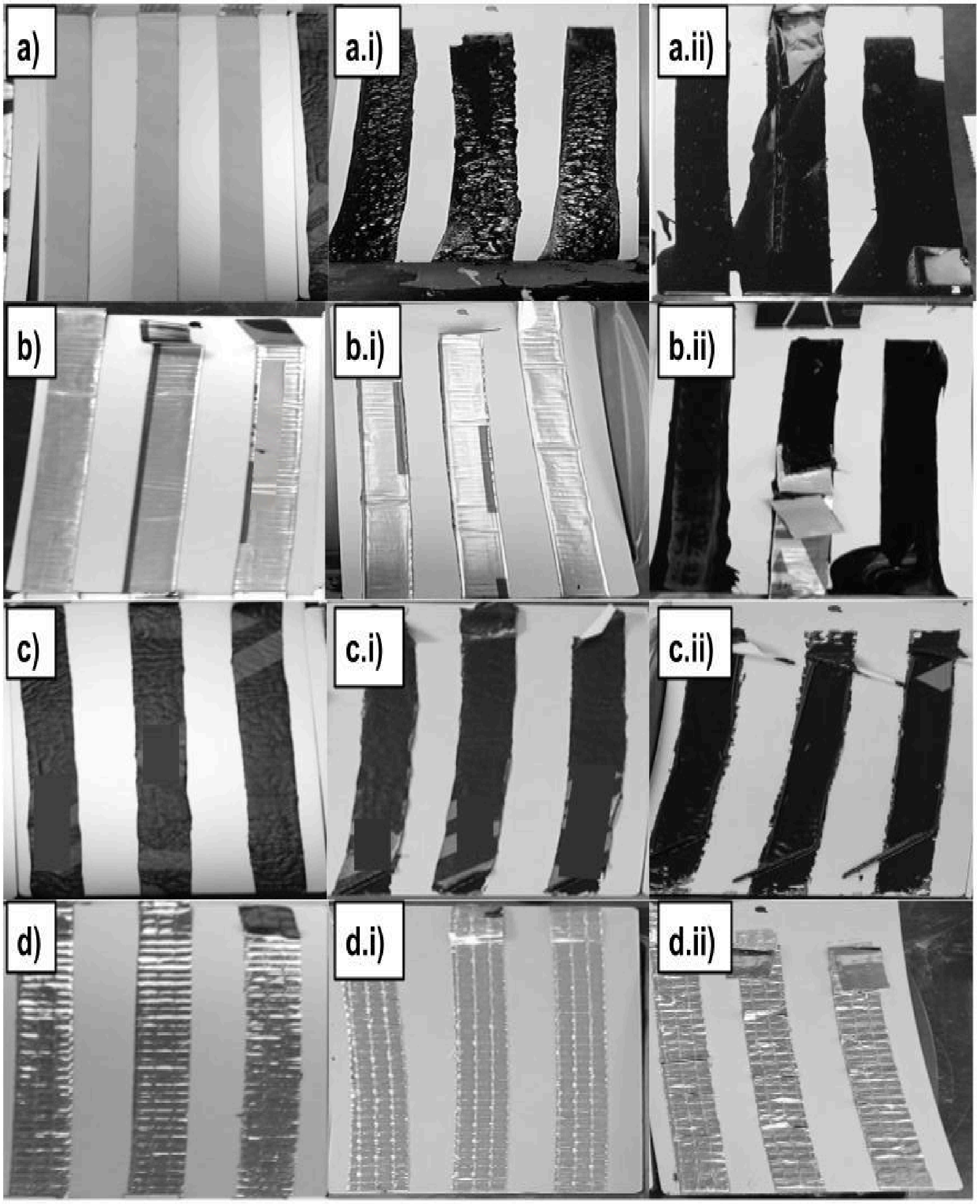


Figure 04

Collection of images before conditioning for four materials [a through d], conditioned per AAMA 711 Level 3 - 240°F / 80°C [a.i through d.i], and conditioned per AAMA 711 Level X - 240°F / 115°C [a.ii though d.ii].

Summary of Findings

This analysis[1] revealed several inconsistencies and limitations in current test methods and standards. There is a weak correlation between ASTM D1970 and AAMA 711, partly due to inconsistent substrate conditions and orientation during testing. Additionally, the criteria for success in ASTM D1970 may be inadequate or misaligned with actual project specifications. AAMA's temperature classification system (Types 1, 2, and 3) also fails to account for many common high-temperature scenarios. In some cases, materials cannot be properly tested for peel adhesion at the published temperatures when applied to vertical surfaces. Substrate porosity was found to significantly influence performance, further complicating test accuracy. Notably, seven of the eight materials reviewed claimed temperature resistance above 70°C in ASTM D1970 tests. However, elevated temperatures were shown to degrade the integrity of topsheets—even in cases where the butyl adhesive remained stable and resisted flow.

Short-term exposure to high temperatures, such as 240°F, can cause irreversible damage and permanently reduce material performance. Long-term heat resistance can be evaluated both quantitatively and qualitatively using vertical, non-porous substrates. However, current test standards are not adequately designed to support performance claims across all high-temperature applications. For projects where temperature is a critical factor, additional clarification in specifications and supplemental manufacturer data may be necessary to ensure suitability.

While industry standards continue to evolve, design professionals and specifiers may need to take a closer look at how products perform under realistic thermal conditions. Expanding research efforts and considering enhanced test benchmarks could help ensure that material selections align more closely with real-world exposure conditions. In turn, a more detailed evaluation of high-temperature performance may support better-informed specification practices and lead to improved long-term outcomes for building enclosures.

Specifying For High-Temperature Performance

If the project requires additional high-temperature resistance, it should be explicitly specified. Avoid simply listing a "service temperature" in project specifications. The term is undefined and lacks an associated test method, making it an unreliable and confusing basis for performance expectations. Specifying a temperature without a validated method or measurable performance requirement does not establish meaningful or enforceable project criteria.

[1] *Testing Footnotes*

All testing referenced was conducted by Siplast over a two-year period, using between three and five samples of each material. The images included throughout this document represent typical samples from the testing. For material selection and analysis, eight key adhered products currently available in the market were evaluated. These products are marketed as "high temperature" and are rated to perform within a range of 65°C (150°F) to 150°C (302°F). Among the tested products, five used asphaltic-based "HT" (high-temp) adhesives, while three incorporated butyl-based adhesives. In terms of topsheet materials, seven products utilized high-density polyethylene (HDPE), and one used reinforced low-density polyethylene (LDPE). Additionally, four of the products featured an aluminum foil surface.

Instead, specifications should include both a performance value and an associated test method to ensure clarity and validation. A standard example would be: Adhered Flashing Membrane per AAMA 711: Pass all test criteria as Type A (without primer), and Level 3 (176°F [80°C] for 7 days).

If the application requires greater heat resistance, this should be explicitly stated. For instance, an enhanced specification could read: Adhered Flashing Membrane per AAMA 711: Pass all test criteria as Type A (without primer), and modify Section 5.5.3 to Level X (240°F [115°C] for 7 days).