



Industrial Adhesives and Tapes Division



Test Report

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Project(s): ACM Panel Bonding

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3M TSR #: USA-IATD-9657

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I. Application Description:

The use of 3M™ VHB™ Architectural Panel Tape G16F (VHB APT G16F) for bonding aluminum composite material (ACM) panels to fiberglass and aluminum profiles in a new architectural panel system.

II. Test Objective(s):

Evaluate the bonding performance of VHB APT G16F to the customer supplied ACM panels and fiberglass and aluminum profile substrates. These substrates were provided to 3M for adhesion testing. A 90° peel adhesion test was performed with VHB APT G16F applied to these substrates. The 90° peel adhesion test is the most sensitive test for determining how well adhesive tape will bond to a substrate finish. The VHB APT G16F evaluated in this study is 0.062" thick.

III. Test Procedures:

Adhesion was measured using a 90° peel adhesion test based on test method ASTM D3330. 0.5" wide strips of tape were used for this test. The strips of tape were applied to the customer supplied substrates after the application surfaces were prepared utilizing the surface preparation methods listed in Section IV. Three strips of tape were used for each different surface preparation method. The tape was then backed with a 5 mil thick anodized aluminum foil strip and allowed to dwell for 3 days at room temperature conditions to allow bond strength to develop. The 90° peel adhesion tests were completed at 70°F/50% RH environmental conditions. Laboratory retained production samples of the VHB APT G16F were used for this study and average peel test data is reported in pounds per inch width of adhesive tape (lbs/in).

IV. Surface Preparation:

The following different surface preparation methods were evaluated in this study. Proper surface preparation is critical for achieving high bond strength. Kimberly-Clark WypAll X60 towels were utilized for all surface preparation techniques involving a wiping/cleaning procedure.

- a. IPA/Water ONLY - Clean bonding surface area with a 50:50 mixture of isopropyl alcohol (IPA) and water.
- b. 3M Adhesion Promoter 111 (AP 111) - Clean bonding area with 50:50 IPA/water solution first and then prime surface with AP 111 solution. This primer was applied by wiping the bonding surface with a clean wetted towel. Tape was applied at least 30 seconds after cleaning/priming.
- c. 3M Primer 94 - Clean bonding area with 50:50 IPA/Water solution first and then prime with 3M Primer 94. This solution is applied wet and then allowed to dry without further wiping.

V. Summary of Results:

A 90° peel force result of >25 lbs/in and a consistent cohesive failure mode of foam splitting (fs) is generally desired for 3M™ VHB™ Architectural Panel Tape bonding applications. An average peel force value of >25 lbs/in and a consistent cohesive failure mode was observed on all samples highlighted **green** in the data table below.



Initial Results after 3 Day Dwell

| Substrate | 3M VHB Tape | Surface Preparation | Peel Test #1 | | Peel Test #2 | | Peel Test #3 | | Avg Peel |
|---|-------------|-----------------------|--------------|--------------|--------------|--------------|--------------|--------------|----------|
| | | | lbs / ½ in | Failure Mode | lbs / ½ in | Failure Mode | lbs / ½ in | Failure Mode | lbs/in |
| Fiberglass Tube | G16F | IPA/Water Only | 8.6 | cp | 8.9 | cp | 7.1 | cp | 16.4 |
| | | IPA/Water + AP 111 | 11.7 | cp | 14.4 | cp | 20.9 | mfs | 31.3 |
| | | Abrasion + Primer 94 | 19.5 | fs | 19.9 | fs | 19.5 | fs | 39.3 |
| Aluminum "J" Channel (mill finish) | G16F | IPA/Water Only | 19.1 | fs | 20.2 | fs | 19.4 | fs | 39.1 |
| | | IPA/Water + AP 111 | 17.9 | fs | 18.5 | fs | 17.9 | fs | 36.2 |
| | | IPA/Water + Primer 94 | 18.5 | fs | 18.7 | fs | 18.5 | fs | 37.1 |
| ACM Panel (backside - dark gray paint) | G16F | IPA/Water Only | 17.7 | cp | 23.2 | pfs | 22.4 | mfs | 42.2 |
| | | IPA/Water + AP 111 | 20.0 | fs | 20.8 | fs | 20.3 | fs | 40.7 |
| | | Abrasion + Primer 94 | 20.6 | fs | 19.3 | fs | 19.8 | fs | 39.8 |
| ACM Panel (backside - light gray paint) | G16F | IPA/Water Only | 13.4 | cp | 11.5 | cp | 12.9 | cp | 25.2 |
| | | IPA/Water + AP 111 | 19.8 | fs | 16.2 | cp | 20.7 | mfs | 37.8 |
| | | IPA/Water + Primer 94 | 20.6 | pfs | 20.5 | fs | 21.0 | fs | 41.4 |

Definitions of failure modes:

cp = clean peel; over 95% clean peel of tape from substrate

mcp = mostly clean peel; 75-95% clean peel of tape from substrate – remainder is foam split

pfs = partial foam split; 25-75% foam split of the tape

mfs = mostly foam split; 75-95% foam split of the tape

fs = foam split; over 95% foam split of the tape

sh = "shocky" peel

3M™ VHB™ Architectural Panel Tape G16F formed high bond strength to both ACM panel (backside paint) substrates and the fiberglass and aluminum profile substrates evaluated in this adhesion study. The use of 3M™ Primer 94 led to high bond strength of the tape all four substrate surfaces. See photos below for cohesive failure modes with 3M™ Primer 94 on all four substrates.



Fiberglass and Aluminum Profiles



ACM Panels

VI. Additional Considerations:



1. **Work Area & Substrate Temperatures:** While surface preparation is critical to achieving good bonding performance of 3M™ VHB™ Tapes, it is equally important to apply the adhesive tape in a work area with a temperature >60°F. In addition, the bonding substrates and tape should be at or above this temperature. The use of an adhesion promoter will likely lower the minimum application temperature to approximately 50°F if this is a requirement for an application. However, this should be verified by the customer prior to fabricating parts at temperatures <60°F. Once fabrication is complete and full bond strength is achieved, the bonded parts are capable of withstanding cold exterior temperatures.
2. **Application Pressure:** It is critical to provide adequate pressure to the tape after it has been applied to the first prepared substrate surface and then after the two parts are joined together. The application of pressure facilitates good contact and adhesion of the adhesive tape to both substrate surfaces. Hand pressure alone should not be considered adequate pressure for the final application of pressure to the assembled parts. The use of pressure application equipment (J-roller, pressure rollers, bar clamps, etc...) is required for the final pressure application step.
3. **Static Loads:** 3M™ VHB™ Tapes have a static load design guideline strength of 0.25 psi to minimize creep after months/years of service. This means there should be a minimum of 4 in² of 3M™ VHB™ Tape for every 1 lb of weight it will support on a constant basis. If an application will involve a constant static load acting on the 3M™ VHB™ Tape for months/years, the customer should verify that an appropriate amount of tape is utilized to satisfy this design guideline.
4. **Dynamic Loads:** 3M™ VHB™ Tape has a dynamic load design guideline strength of 12 psi. Dynamic loads are short term forces applied to the 3M™ VHB™ Tape such as a high wind gust. The customer should verify that their design will satisfy 3M's design guideline should the architectural panel substrates be subject to dynamic loads such as wind loads in exterior applications when the 3M™ VHB™ Tape is utilized for panel attachment.
5. **Force/Stress Types:** In general, when designing with 3M™ VHB™ Tapes, forces acting on the tape should consist of either shear or tensile type stress loads. This allows the stress or force to be applied over the whole tape area. Applications placing cleavage or peel type stress on the tape (e.g., bonding of warped/bowed panels) should be avoided as this will place the stress on the leading edge of the peel or cleaving.

Testing should be conducted by the customer to determine if a 3M™ VHB™ Tape will meet all the performance requirements for their application. The data reported in this document is to be used as a representation of how well the tested 3M™ VHB™ Tape will bond to the specific customer-supplied substrates with the same surface preparation methods and environmental conditions. A thorough evaluation should be done by the customer to verify if a 3M™ VHB™ Tape is capable of meeting the total needs of the application, including those that were not anticipated with this testing.

Sincerely,

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