

Basics of Conducting Adhesion Testing

Introduction

It is important to determine the quality of the bond between materials prior to any application of new materials. A field adhesion test is a basic screening procedure that helps determine the acceptability of an existing finished surface for application of new coatings, finishes or adhered systems. It may also help discover issues such as improper surface preparation or the presence of surface contaminants that could impede the bond.

There are several methods that are applicable to different situations. For example,

1. The bond of a coating to an existing coating or smooth surface,
2. The bond of a base coat or AWRB product to an existing surface, or
3. The bond within an assembly (between layers).


The following procedures will provide information on performing the various testing; anyone with basic knowledge and competency can perform these tests.

Coating Adhesion

ASTM D3359 - Standard Test Methods for Rating Adhesion by Tape Test

Simply known as the “tape test”, this basic method is a screening test used to evaluate lower-level adhesion of coatings to a substrate. The methods in ASTM D3359 provide subjective results, have limited value over EIFS and stucco applications and are restricted to smooth coatings applied to smooth substrates.

Note: not for use on textured finish/coating or textured substrate.

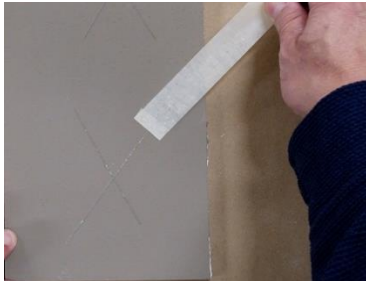
1. For testing a new coating, required surface preparation to the substrate should be completed and the coating is applied according to application instruction, then allowed to dry.
2. Score the dry coating with a knife, or other cutting device, to create an X or cross hatch pattern, depending on which method in ASTM D3359 is used. See photo. 



3. Tape is applied over the center of the cuts and pressed firmly to ensure good contact. A portion on the end of the tape is left loose in order to pull.



4. The tape is removed by grabbing the free end and pulling it off rapidly back on itself at a 180° angle, or as close to 180° as possible.



5. Compare the resulting amount of coating that is left intact to the levels included in ASTM D3359 for a rating.

Note: Elcometer 99 Tape or other tapes qualified for use for ASTM D3359 testing may be used.



Base Coat or AWRB to Substrate - Mesh/Fabric Embedment - Simple Method

This method is a simple screening test for the adhesion of base coat or Finestop products to a substrate. It involves application of the respective material and embedding either reinforcing mesh for base coat adhesion, or Sheathing Fabric for Finestop into the material. The main limitation of the test is that it does not provide a quantitative result with a numerical value for the bond strength of the Finestone material. Conclusions from this testing are based on visual observations and judgement on the amount of force to pull the mesh or fabric from the Finestone material.

1. Ensure the test areas are clean and free from any loose material and allowed to dry prior to Finestone material application. If testing proves acceptable, the same cleaning methods would be used prior to new Finestone material application on the project.


Note: For chalky surfaces the use of Surface Stabilizer WB by Master Builders Solution is recommended.

2. Apply the Finestone base coat or Finestop product to the prepared areas to recommended application thickness. The test area should be approximately 6" x 6".



3. For the base coat, embed a 4" wide strip of Finestone reinforcing mesh into wet material; for Finestop products embed 4" Sheathing Fabric into the wet material. Additional base coat or a Finestop air barrier can be applied to ensure full embedment. Use sufficient mesh or Sheathing Fabric so that 6" is embedded and 6" is left exposed for a pull tab.



4. For base coats it is recommended to allow 48 hours cure time; for Finestop products 24 hours of dry time is recommended prior to pull testing. See photo. 



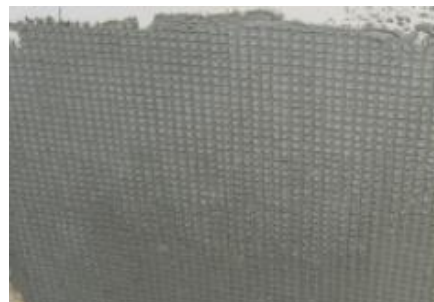
5. Once the test material has cured/dried, take the loose end of mesh or fabric and pull it straight out from the wall surface.



6. Several outcomes may be observed:
 - Adhesive Failure – when the base coat or Finestop pulls cleanly from the substrate, this is a sign of poor adhesion or poor surface preparation. This would indicate further need for surface prep or an unacceptable substrate.
 - Cohesive failure of substrate – when the base coat or Finestop pulls from the wall with substrate material attached, this indicates that the adhesive strength of the Finestone material is greater than the cohesive strength of the substrate. Further instrumented testing may be needed to show quantitative results.
 - Cohesive failure of Finestone material – this is when the mesh or fabric pulls from the Finestone material leaving Finestone material firmly bonded to substrate. This indicates that the adhesive strength is satisfactory and that the Finestone material is a candidate for use.

Example of a Passing Test

When the Reinforcing Mesh pulls through the patch and all the adhesive stays adhered to the tested surface, the bond of the adhesive to the paint and paint to the wall is good.



Pull-Off Strength of Coatings Using Portable Adhesion Testers Instrumented Test – ASTM D4541

This method delivers quantitative results of the bond strength between materials, providing numerical results that can be compared to building code requirements. It will also demonstrate the mode of failure, or where the weakest plane within the assembly occurs. The modes of failure include, cohesive failure of the substrate, adhesive failure of the test material to the substrate, or cohesive failure of the test material.

1. Ensure the test areas are clean and free from any loose material and allowed to dry prior to Finestone material application. If testing proves acceptable, the same cleaning methods should be used prior to new Finestone material application on the project.
2. Apply the Finestone material to the prepared test areas in recommended thickness per Finestone product bulletins and allow to dry. It is recommended to cover a minimum 6" x 6" area for each test, and a minimum of 5 test areas are recommended.
3. Allow base coats 48 hours cure time. For Finestop products or finishes/coatings please allow 24 hours of dry time prior to application of test blocks.
4. Once the test material has cured/dried, adhere the test blocks with a 5-minute epoxy, being careful to spread the epoxy over the entire surface of the test block. Allow the epoxy to dry at least 2 hours before doing the pulls.

Note: The epoxy is readily available at big box stores with Loctite, Devcon and Gorilla being common brands.

5. Before doing any pulls, score the Finestone test material around the test block. This isolates the test area to the material under the test block.
6. Position the portable pull tester over the test block, using shims as necessary between the base and surface to ensure the tester is perpendicular to the test surface. Care should be taken to connect the portable pull tester to the test block without prestressing the test block. Support the weight of the pull tester and take up any slack between the tester and test block.
7. Ensure the force indicator on the pull tester is set to zero.
8. In a smooth and continuous manner, increase the load on the test block by turning the pull tester handle until the test is completed.
9. Record the force attained at failure or the maximum force applied.

Note: The gauge on the portable pull tester reads in pounds of force. The psi will need to be calculated based on the pounds of force divided by the area of the test block. Example: the pounds of force at failure was 270 pounds, the test block is 3" x 3" (9 square inches), the psi at failure is $270/9 = 30$ psi.

Example:

$$\frac{\text{Pounds of Force}}{\text{Area of the Test Block}} = \frac{270 \text{ lbs.}}{3" \times 3" = 9 \text{ sq. in.}} = 30 \text{ psi}$$

10. Record the mode of failure for each test specimen. Examples: adhesive failure of base coat; cohesive failure of substrate.

In general, bond strength of EIFS materials or AWRB products to a substrate should be a minimum of 15 psi (ABAA designates 16 psi for fluid applied air barriers). Master Builders Solutions can provide a portable pull tester and wood test blocks to complete this testing.

CONSIDERATIONS AND CONDITIONS

- Perform enough tests over representative areas to obtain a good set of data (no less than 5 tests per substrate condition/type; larger projects should include more testing). At least one test should be performed on every elevation.
- Any result that is significantly different than the average result of other tests should be investigated to ensure it's not due to procedural mistakes (poor surface prep, application, etc.). If it is, then this data should not be included.
- Protect test areas from rain, freezing and other detrimental environmental conditions until the materials on the test areas are cured/dried.
- In cases of adhesive failure, the numerical value at failure must be sufficiently high to justify the application of materials.
- It is ultimately the responsibility of the design team to accept adhesion test results and qualify substrate conditions. Finestone is not responsible for any delamination that may occur due to application of Finestone materials over unsound or unapproved substrates.

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