

# Adhesion of Caulks to Surface – Testing Product Quality

**Developers:**

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**Grade Level:**

11 and 12

**Disipline:**

Physics and/or Chemistry

**Specific Objectives:**

- To test the adhesive quality of 3 commercially available caulks
- To observe that vast differences do exist in materials that appear similar
- To analyze, statistically, one or two of the samples tested by the students.

**Background:**

The function of a caulk is to seal out moisture and air from a building. If this is not done, heating and air conditioning efficiency is reduced, and energy is wasted. In order for a caulk to perform well, it must adhere well to the material which it contacts, and it must not crack as it moves due to temperature changes. The purpose of this lab is to test its adhesion.

There are a lot of different caulks available to the consumer. How does the consumer know which is the best. This lab will offer a method used by industry to test the adhesion of caulks and paints to various substrates (surfaces).

**Materials and Equipment:**

1. One caulk from each of the following groups should be used for the test - All should be white.

**Group A**  
(Vinyl Acetates)

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Red Devil Vinyl Painter's Latex Caulk  
Rely On - DAP  
5 Year Caulks (Home Master)

**Group B**  
(Acrylic Latex)

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15 Year Acrylic Latex (Home Master)  
25 Year Siliconized Acrylic Caulk\*

\*This caulk was not tested therefore may fall in Group B or C.

**Group C**  
(Silicon Acrylic)

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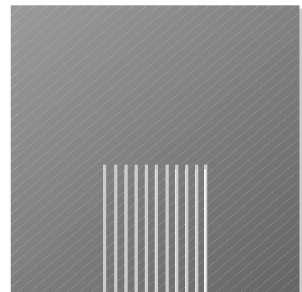
DAP 230 Sealant  
Siliconized 25 Year Acrylic Caulk\*

If 5, 10, 15 and 25 year caulks are used, cover container labels so students are not prejudiced.

2. Substrate - There is a wide variety of surfaces that can be used although a soft surface will be damaged when scoring the cured samples. Below is a partial list with the underlined ones giving good results. All surfaces should be at least 12 cm x 12 cm .

**Materials and Equipment:**  
(continued)

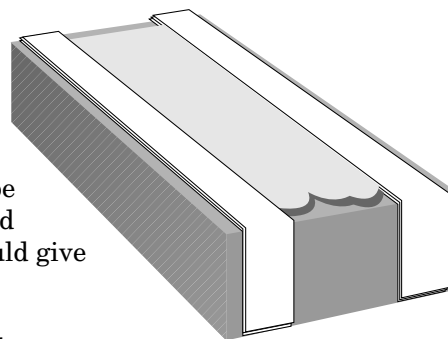
- a. Double thick glass plates
  - b. Vinyl siding
  - c. Plastic trays - made of polyethylene or polystyrene
  - d. Laboratory tote trays
  - e. Aluminum sheets
  - f. Painted wood surfaces - semigloss and high gloss paints
3. Tape - masking, fiberglass
  4. Vernier caliper or micrometer
  5. 30cm Ruler
  6. Scoring template (see diagram)  
*Specifications:*
    - Rigid metal - aluminum, stainless steel (1/8" thick), steel, copper, etc.
    - Cut as follows - 11 slits each 1.1/8" long
    - Width of slit = .027" approximately
    - Space between slits - .055" approximately
  7. Razor blade or utility knife for scoring
  8. Caulk guns
  9. Tongue depressor or spatulas for spreading and forming thin layers of caulk



**Procedures:**

**Day 1**

1. Lay a thin film of each caulk on each surface. The layer of film should be at least 3cm wide. To lay the thin film apply 3 layers of masking tape across the substrate (see diagram). Apply caulk in between layers of tape and spread. Press straight edge across tape and smooth layer (do not press too hard). This should give a uniform thickness to your layer of caulk.
2. Immediately remove the masking tape from the substrate and then label the substrate with the type of caulk used.
3. Set aside to cure (dry). Allow 2 days for caulk to cure.



**Day 2**

4. When caulk is cured, it is ready to score using the template.
5. To score the caulk, place the template over a section of the thin film that appears fairly uniform in thickness and tape the template to the substrate. Using a utility knife, cut through the caulk using the slits as your guide. After making the 11 slits, rotate the template 90° so that you can score the caulk into small squares by repeating the above cutting (scoring) over the same area you just scored.
6. Remove the template; take a long piece of fiberglass tape and firmly press it to the area scored into little squares.
7. When this is completed, pull the fiberglass tape away from the substrate and the caulk. In some cases, no caulk will be removed by the fiberglass tape and, in others, the caulk will be removed by the fiberglass tape. How much adheres to the tape and how much adheres to the surface should be measured and recorded.

8. Count the number of squares removed from each substrate, and record this data in table form.
9. Compare your results with other groups and, if their thin layers are similar to yours, record their data.
10. If time permits, repeat the experiment several times on a different section of cured caulk, and compare to your earlier results. Record these results in your table. Comparison will provide a measure of the reliability of your data.

**Questions:**

1. How did caulk A adhere to each substrate?
2. How did caulk B adhere to each substrate?
3. How did caulk C adhere to each substrate?
4. Is there a surface on which all caulks' adhesion quality was excellent?
5. Is there a surface on which all caulks' adhesion quality was poor?
6. When you repeated the experiment yourself, did you get similar results to the first test?
7. When you compared your results to those of other groups was there some consistency, or did the results strongly depend on the persons performing the experiment?
8. What are possible sources of error in the experiment?
9. Are you confident in the reported values, or do you believe the errors in the experiment are too great?
10. How could you alter the experiment to place more reliability in your results?
11. Are the differences significant enough to conclude that one caulk is better than another one when comparing on the same substrate? If so, which and why? If not, why not?
12. Based on all of the evidence, which of the following conclusions would you draw?
  - a. There are significant differences between these caulks, and one can definitely see these from our adhesion results.
  - b. There may be differences between the caulks, but the experimental error is too great to draw any definitive conclusions.
  - c. There are definitely no adhesion differences among the caulks we tested.

\* **Note:** This last question (#12) could be used as part of a quiz or test on the unit to which this lab is related. You could just ask the students to write their own conclusions, and hopefully theirs will be somewhat similar to one of the above choices.

**References:**

"Test Procedures for Evaluating Aqueous Caulking Compounds and Elastomeric Solvent-Base Sealants," a reprint from Resin Review, Volume XVI, #3, 1966, found in Caulks and Sealants, a binder compiled by Rohm and Haas Company.