

Sample Polyurethane Foam Roofs

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THERE ARE NO sprayed foam equivalents to ASTM standards D 2829 or D 3617.* However, cutting samples often reveals more about the installation of the foam than any other inspection technique. This can be done for purposes of quality control or the forensic investigation to determine the mode of failure. Foam sampling can be used to determine thicknesses of the foam passes or coatings, adhesion of the sprayed foam to the substrate, foam-to-foam knit lines and quality of the cellular structure of the foam itself.

There are three common methods of sampling foam roofs:

- slit sample
- core sample
- modified core sample

The purpose dictates the method of selection.

THE SLIT SAMPLE FOR COATING EVALUATION

The slit sample is a "surface cut," used to evaluate coating thickness and adhesion and top pass thickness. Using a sharp utility knife (a dull blade will stretch the coating yielding a poor sample), make an initial cut about 3/4 inch deep and 2-3 inches long *perpendicular* to the coated surface. An angled, curved final cut (Figure 1) will free the sample for examination. If top pass thickness does not need to be examined, a shallower slit sample may be cut as shown in Figure 2.

Coatings are usually applied in several applications. Typically, a base coat is applied the same day as the foam application with a top coat applied later. The base coat is often a different color from the top coat (the color difference

*ASTM D 2829: Sampling and Analysis of Built-Up Roofs; ASTM D 3617: Sampling and Analysis of New Built-Up Roof Membranes.

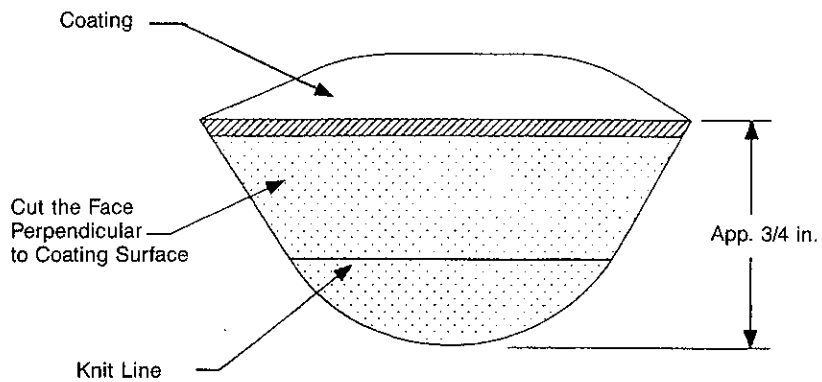


FIGURE 1. Slit sample.

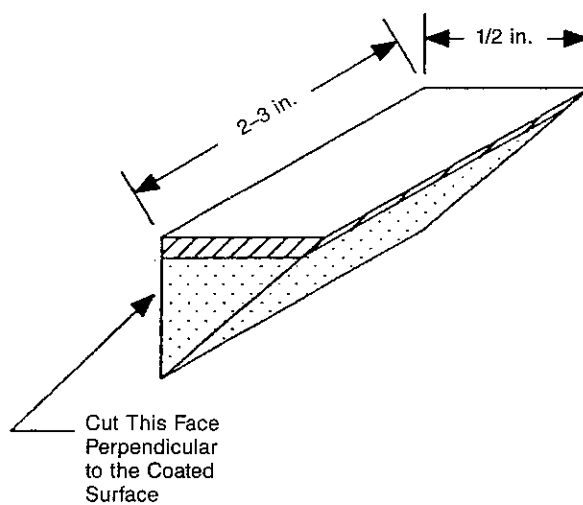


FIGURE 2. Alternate slit sample.

can represent pigmentation or chemical differences). Examining the split sample for color differences in the coating profile determines the minimum number of coating applications. (Note: The *total* number of coating applications cannot be determined because multiple applications of identical colored coatings usually cannot be seen.)

Foam Surface

The base coating needs to be applied to the foam the same day as the foam application to insure good adhesion. If base coating was delayed, the surface of the foam directly beneath the base coat will be a rusted-orange color. The foam should be of uniform color and cell size. Foam surface texture should be relatively smooth (manufacturers usually require "smooth" to "coarse orange peel" surface textures with "verge of popcorn," "popcorn," and "treebark" being unacceptable**).

SAMPLING POLYURETHANE ROOFS

Coating Thickness

Use an optical comparator (Figures 3 and 4) to measure coating thickness. The optical comparator has a reticle (scale) which should be held directly in contact with the perpendicular face of the slit sample. The base, top, and total coating thickness is measured in mils (thousandths of an inch). If thickness is not specified by the manufacturer, take three or four thickness readings to calculate an average and measure the thinnest points to determine minimum thickness (Figure 5).

Coating Adhesion

Try to peel the coating from the foam surface and try to peel the top coat from the base coat.

On coated polyurethane foam roofs, take a minimum of ten slit samples for the first 10,000 ft². Larger roofs are sampled at a reduced frequency of sampling.

If a slit sample reveals any coating defect, three or four additional slit samples should be cut within a 10 ft radius to determine whether this defect occurs frequently.

When slit samples are cut, it's an ideal time to check foam thickness. Foam

**Photographs of foam textures may be found in "A Guide for Selection of Protective Coatings over Sprayed Polyurethane Foam Roofing Systems," pp. 8-9; and "Spray Polyurethane Foam Systems for New and Remedial Roofing," pp. 25-27. Both publications are available from Polyurethane Foam Contractors Division, Society of the Plastics Industry, Inc., 1-800-523-6154.

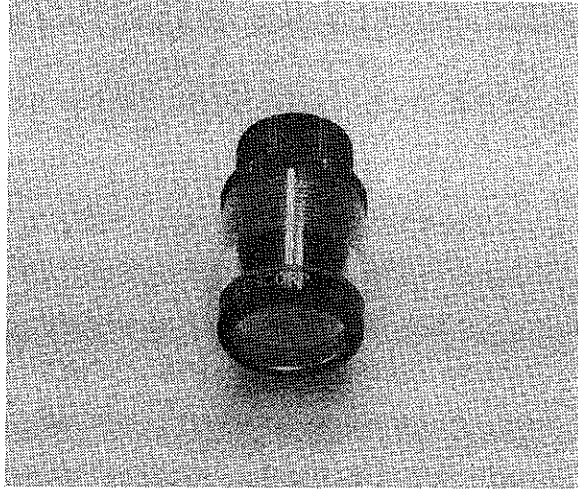


FIGURE 3. Optical comparator.

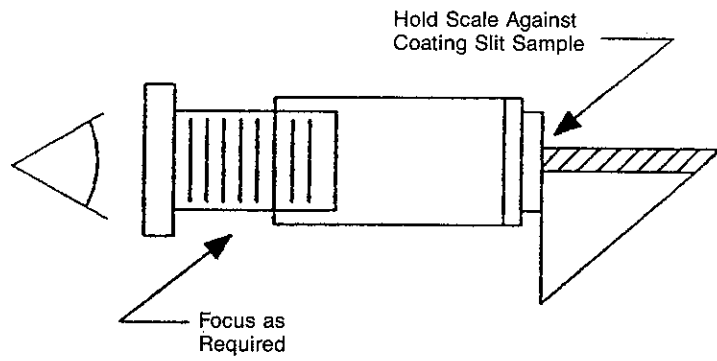


FIGURE 4. Use of optical comparator.

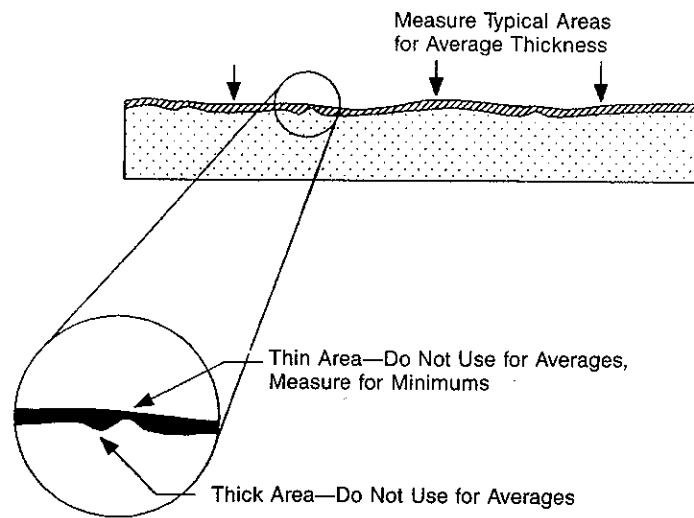


FIGURE 5. Measuring coating thickness.

thickness can be measured by extending the knife blade or probe (i.e., a stiff wire or long nail) down to the substrate immediately prior to cutting the sample. The hole thus created can be sealed along with the slit sample cut.

Slit sample cuts are repaired by caulking. Moisture cured urethane or silicone caulks are the most commonly used. Check with the coating manufacturer, if known, to ascertain which caulk is compatible with the coating.†

CORE CUTS FOR FOAM EVALUATION

A 2" or 3" diameter core cut is used when polyurethane foam physical properties are to be measured. Since ASTM D 1621 (Compressive Properties of Rigid Cellular Plastics) requires samples with 4 in² surface area and 1 inch minimum thickness, the core must be cut with a 3" diameter coring tool. For visual examination, a 2" diameter coring tool may be used. (Note: the CRREL†† 2" coring tool used for built-up roof cores was found to be not suitable for polyurethane foam because the teeth on the edge of this par-

†Silicone caulks and coatings need to be used together for good adhesion of the caulk to the coating and vice-versa. Acrylic and urethane caulks and coatings will normally adhere to one another, given clean dry surfaces.

††Cold Regions Research and Engineering Laboratory, U.S. Army Corps of Engineers, Hanover, New Hampshire.

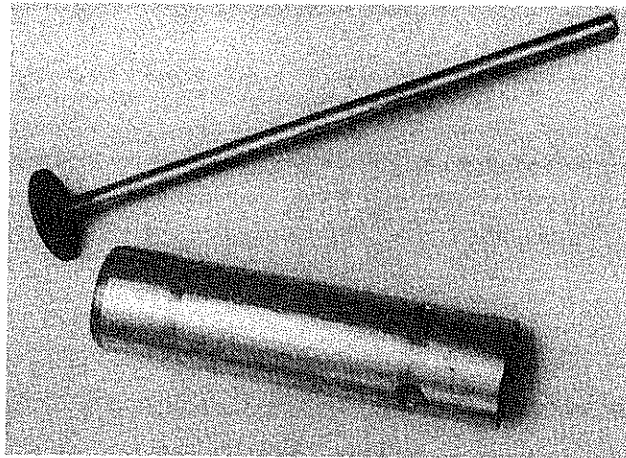


FIGURE 6. Foam coring tool.

particular coring device will tear the foam.) A simple and effective foam coring tool (Figure 6) can be made from 2" or 3" diameter electrical conduit. Machine a knife edge on one end and drill two holes near the opposite end to insert a handle. Roofing foam is remarkably hard; therefore, the edge of the coring tool may require frequent sharpening with a file.

In addition to testing for the compressive strength (ASTM D 1621) and the density (ASTM D 1622), the core should be examined for the following:

1. Adhesion to substrate—The core should be difficult to remove from the substrate (often the core cannot be removed without damaging the sample). A useful technique is to cut out a wedge-shaped piece exposing the base of the core so that a prying tool may be gently forced under the core to break the foam-substrate bond.
2. Knit line adhesion—Knit lines (the bonds between foam passes) should be firm. Knit lines should not break easily when attempting to pull them apart by hand. (Try cutting a segment from the cylindrical core sample and use this for the "hand pull test.") Knit lines should have uniform, tight foam cells above and below the knit line. Elongated or enlarged cells adjacent to the knit line offer a possible future rupture zone leading to delamination and blistering. Look for orange or brown skins at the knit lines, which is indicative of applying foam to an aged foam surface. Adhesion is generally poor unless a suitable primer is used.
3. Coating adhesion—Use the same procedure as described for Split Samples.

4. Wet foam—Look for signs of moisture in the foam. Trace amounts can be qualitatively detected with moisture-detecting paper strips. Larger amounts will be visually observable.
5. Foam appearance—In general, the foam mass should be uniform in color and cell structure. Off-ratio foam may result in soft, irregular cells (resin rich, lacking isocyanate) or brittle, dark, irregular cells (isocyanate rich, lacking resin). Foam passes (lifts) should have a thickness of 1/2 inch or more.

The usual frequency of sampling is two core samples for the first 10,000 ft² and one for each 10,000 to 20,000 ft² of larger roofs. As previously discussed, additional core samples (or modified core cuts) should be taken to determine the extent of any observed problem.

To fill the holes in the roofing foam, use extra foam plugs cut from the foam sprayed to cardboard or plastic sheeting. Insert the foam plug (and wedge) and spread caulk over the seams and surface of the cut area. Apply caulk to the bottom and sides of the core hole (and the wedge cut, if it was made).

MODIFIED CORE CUTS FOR FOAM EVALUATION

If laboratory testing is not required, a simple and less destructive sampling technique can be used. The modified core cut is made with two knife cuts, the full depth of the foam (Figure 7). The sample can then be visually and manually inspected for the same characteristics as the core sample.

The obvious advantage of the modified core is the ease of repair of the resulting holes: fill and seal it with caulk.

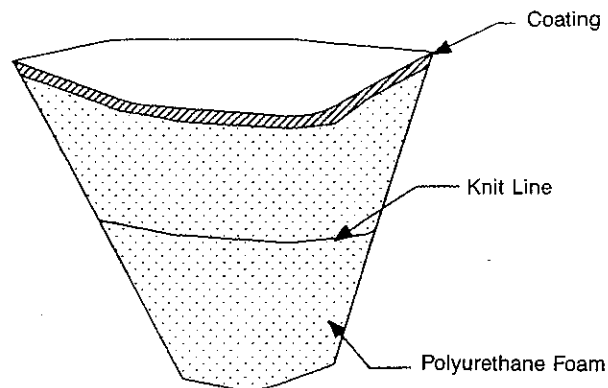


FIGURE 7. Modified core cut.

Tools for Sampling Foam Roofs	
S	= Used for <i>Slit</i> samples
C	= Used for <i>Core</i> samples
M	= Used for <i>Modified Core</i> samples
Caulk and Caulking Gun	S,C,M
Coring (Foam) Tool (2-3" diameter)	C
Knife, Long (6-9" blade)	C
Knife, Utility	S
Knife, Pen (2-3" blade)	M
Optical Comparator	S
Plastic Bags	S,C,M
Prying Tool	C
Ruler	C,M

The disadvantages of the modified core are that adhesion of the foam to the substrate cannot be assessed, and physical properties, such as density and compressive strength (which require a larger sample) cannot be tested.

The modified core cut is useful to verify core cuts (e.g., if a core sample indicates a defect in the foam, the extent of the defect can be ascertained by taking modified core cuts).

SUMMARY

Use one of the three sample cutting techniques described to determine the character of the foam and coating system. Sample cuts are a necessary addition to the visual inspection of foam roofs. Cuts are easily repaired using caulk (and foam plugs with core cuts).