TechTip I7 – Installing High-Lift Closed-Cell SPF

For many years the maximum pass or lift thickness for closed-cell SPF products has been limited to about 2". This limitation on pass thickness is needed to control peak exothermic temperatures which impact cell structure and density and ultimately foam performance including thermal resistance and air leakage control (due to dimensional stability issues).

In recent years, several foam manufacturers have introduced high-lift or high-loft medium-density closed-cell spray foam insulations. Using new formulations that reduce susceptibility to peak exothermic temperatures, these high-lift foams may be sprayed at maximum pass thicknesses from 4" to 8", depending on product, without having charring or burnout.

It should be noted that high-lift foams have a higher minimum pass thicknesses than traditional closed-cell SPF products. Spraying below the minimum pass thickness recommended by the manufacturer may lower yield and alter the performance of the foam. Some high-lift foams may also have higher peak core temperatures than traditional closed-cell foams; this should be considered when applying high-lift foams on plastic wiring and piping (see TT-I6 "*SPF Application over Wire and Plastic Pipes*")

There have been reported problems with these high-lift foams sprayed to the maximum lift thickness. Most notably some foam properties appear to be outside of those cited in the manufacturer's TDS:

- Increased shrinkage (poor dimensional stability)
- Reduced core density*VSD
- Reduced compressive strength
- Differences in yield

Three 1.5" Lifts
- Core density within mfg. spec.
- No voids
- No shrinkage

One 4.5" Lift
- Core density 10% below mfg. spec.
- Noticeable voids.
- Core is soft
- Shrinkage observed within hours of core sample

FIGURE 1 - General observed behavior of high-lift foams sprayed in multiple lifts and a single high lift using *conventional spraying methods*. **To avoid these issue, manufacturers of high-lift foams may require different spray equipment.**

These concerns have been discussed with manufacturers, as SPF installers want to be sure the high-lift foams installed to the reported maximum pass thickness perform as reported in the manufacturers technical data sheet.

Manufacturers have noted that there are slight yet important changes to the installation instructions for many high-lift products compared to their standard lift foams. These changes vary by product, but can include one or more the following:

- Ambient/Substrate temperature and RH
- Chemical Temperature Settings of Proportioner and Hoses
- Throughput of Equipment (proportioner size)
- Chamber Size
- Spray Nozzle Selection
- Spray Technique

To avoid these reported problems with high-lift foams, installers should first read, understand, and follow the manufacturers installation instructions (MII) for the new high-lift products. Installers should also become accustomed to the new high-lift foams before installation in a project. This includes testing the new high-lift foams with their equipment to determine the maximum lift thickness possible under specific conditions.

We all know that pass and total thicknesses vary during a typical installation. It has been observed that if these higher pass thicknesses, beyond the manufacturer's maximum thickness, are exceeded, shrinkage will often occur. Testing the dimensional stability of too-thick passes of foam indicate that early cracking is likely, and the foam will have to be removed and replaced locally.

Below are some tips for contractors to evaluate the foam prior to installation.

1. Before using a new foam, spray some samples onto a board or cardboard at different lift thickness, starting at 1 inch, then continuing at approximately 1 inch increments up to the manufacturer's maximum recommended lift thickness.

2. Using a digital meat thermometer, measure the maximum interior temperature of the foam at the mid-thickness of the lift during cure and the time it takes to reach maximum temperature before the temperature starts to drop. *Somewhere between 200˚and 220˚F is the maximum temperature for most foams before they exhibit excessive exothermic heat (blowholes, soft foam in the middle, discoloration, odor and poor dimensional stability). Temperatures as high as 320˚F have been observed in some high-lift products installed at or below the recommended maximum thickness*. Ask the manufacturer what the core temperature should drop down to before adding another pass, and verify how

long this will take, given your equipment and settings.

3. After these samples have cured, use a coring tool to cut cylindrical specimens from each sample. Allow these cylindrical specimens to sit for the published cure period at room temperature and observe the shape. If possible, compare the initial and fully-cured volumes using the measurement or displacement method.

4. Also, consider spraying assembly mockups before using high-pass thicknesses in the field. Use the slit test or the ASTM 2126 method to verify dimensional stability.

5. Obtain quality control samples before and during application. Check out the middle of the foam core for discolored foam, elongated cells, cracks and fissures.

6. Measure the density of the middle third of the sample. If the core of a 2.0 lb/ft^3 product is below about 1.75 lb/ft^3, it will likely have dimensional stability issues.

7. Use the 'thumb test' or a field compression tester to determine the compressive strength of the foam both perpendicular and parallel to rise. If it is softer in the middle than at the top and bottom, there is a good chance that foam could shrink.

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