TechTip I-7 – High-Lift Closed-Cell SPF Insulations

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 dimensional stability.

In recent years, several foam manufacturers have introduced high-lift medium density spray foam insulations. Using new formulations that reduce peak exothermic temperatures, these high-lift foams may be sprayed at maximum pass thicknesses from 4" to 8", depending on product.

It should be noted that high-lift foams may also have a higher minimum pass thickness 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-I-6: SPF on Wiring 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
- 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 techniques and/or 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 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.

Special Note on HFO Blowing Agents:

Extra caution should be exercised when spraying around piping and wiring while using closed cell foams utilizing the new HFO blowing agents Solstice and Opteon. HFO blowing agent foams have interior temperatures much higher than the traditional closed cell foams using 245FA blowing agent. Peak temperatures measure 290F plus or minus for Solstice and another 15-20 F higher for Opteon. These peak numbers last much longer as well. It takes approximately 15 minutes to reach peak and then approximately an additional 30 minutes to cool down to below 190F. When compared to 245FA products high temps of less than 250F, 1-3 minutes to peak and approximate 5 minutes to cool below 190F.

These higher temperatures and longer heat times subject pipes and wiring to heats above the products rated temperatures for a much longer time resulting in melted pipes and wiring. An additional consideration is that water in pipes can boil creating high pressure steam as well as high pressure air that can rupture pipes.

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 2000 and 2200F 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). When the temperature of the foam begins to drop, more foam can be installed over the first lift.

3. After these samples have cured, use a coring tool to cut cylindrical specimens from each sample. Allow these cylindrical specimens sit for 24 and 168 hours (one day and one week) at room temperature and observe the shape.

4. Also, consider spraying assembly mockups before using high pass thicknesses in the field.

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. 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.

    a. Thumb Test: An experienced foam applicator or inspector can typically tell within 5 psi the compressive strength of the foam by using the thumb test. Obtain a core sample of foam from the substrate. Cut off the top and bottom 1/3 of the core. Apply firm pressure with the thumb to the top of the sample. If the foam depresses ¼ inch, then it is approximately 25 psi. If it depresses 1/8 or less, then it is greater than 40 psi. Perform the same test to the sides of the sample as well. It should have similar compressive strength. If it is much softer then the foam is more likely to shrink or contract.

    b. Field Compression Tester: If the foam is suspected of inadequate compressive strength, a sample can be obtained and measured with a field compressive strength tester such as a Com-Ten tool. Typically, a 2-pcf (pounds per cubic foot) density ccSPF would exhibit between 20 to 30 psi. If the foam is softer or harder than this, it is an indication of an off-ratio or poor mix.

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