TECHNICAL BULLETIN

Spray Polyurethane Foam Insulation on Interior Surfaces of Metal Panels

Overview

This Technical Bulletin is intended to serve as a guide for the application of spray polyurethane foam insulation (SPF) used in metal panel assemblies. Single skin metal walls and roofs are durable and sustainable components of a building envelope system, however the cladding offers no inherent insulation value to the building. To improve the energy efficiency of buildings, insulation, air barriers and vapor retarders are commonly used.

Metal roof and wall panels with spray polyurethane foam insulation (SPF) are one method to insulate the building envelope. SPF on metal roof and wall panels provide thermal insulating and air barrier capabilities as well as the ability to seal panel joints and act as a vapor barrier. This guide is intended to outline the proper use and applications of SPF on metal panels.

SPF can be used to fill spaces in the panel assemblies and function as a key component of an air barrier system to minimize air leakage, however there are design parameters to be aware of when considering the use of SPF insulation for metal roof or wall panels. MCA and the Spray Polyurethane Foam Alliance (SPFA) have conducted research on the installation of SPF onto steel and aluminum panels and have concluded the following best practice suggestions for SPF applied to the interior surface of metal panels:

- Closed-cell foam is recommended due to its water resistant capabilities.
- SPF is a recognized insulation material to be used below and in contact with through-fastened metal roof assemblies.
- Using SPF below and in contact with standing seam metal roofs that are specifically designed for thermal expansion and contraction movement is discouraged due to the potential for restricting panel movement during temperature changes.
- The surface of the metal panel being sprayed should be free from moisture, lubricants, dirt or other contamination.
- The technique used to apply the SPF can affect the performance and appearance of the foamed panels (see page 2).
- Using a release fabric membrane between foam and a metal panel in a wall assembly is not recommended due to the potential of creating voids between the SPF and the wall panel.
- There is potential for stress-induced deformation (or "oil canning") on 29 gauge or thinner material. (This can be minimized by following the foam manufacturers' recommended application technique.)
- Always follow national and local code requirements for fire protection. Exposed SPF may require the use of an additional thermal barrier or other means for fire protection.
- Energy code compliance should be based on national and/or local code requirements for thermal performance.
- Inform electrical contractors of the use of SPF to prevent junction boxes from being covered.
- Inform HVAC contractors of the use of SPF to ensure that equipment is properly sized and that adequate make-up air is provided.
- Prevent SPF chemicals from being drawn into a building's ventilation system.
- Consider using a SPF contractor accredited by SPFA's Professional Certification Program[(1)] (compliant with ISO 17024) to provide high quality and safe installation of SPF insulation.
- Consult with the metal panel system manufacturer before applying SPF.

Discussion

Foam Insulation

SPF insulation is a chemical mixture of two components that are brought together using a spray gun. Mixing initiates polymerization through an exothermic reaction.

During curing, the foam may reach core temperatures as high as 325°F for short periods of time. Research suggests that during the curing process of closed cell SPF, the temperature of a metal panel in contact with the foam can increase in temperature as much as 80°F. Control of these temperature increases, and the potential deformation or oil canning of metal wall panels can be avoided utilizing SPFA installation guidelines.

Open-Cell and Closed-Cell Foam

There are two classes of SPF products: open cell and closed cell.

Open-cell SPF provides both insulation and the air sealing for the building assembly. The aged R value of open-cell SPF is approximately 3.5 Hr·ft^2°F/btu per inch[(2)], however, the open cellular structure will permit water to migrate within the insulation and does little to restrict the movement of moisture vapor making it vapor permeable. With these limitations, open-cell foam is not recommended for applications where the foam is likely come into contact with water and an additional vapor retarder to control condensation.

Closed-cell SPF insulation uses chemistry similar to open-cell SPF, however a different blowing agent is used to create the foam. The cellular structure is a series of adjoined closed cells, which holds the blowing agent gas, providing better insulation than air. The closed-cell structure prevents the entry of water and reduces the movement of moisture vapor. Separate vapor retarders or water-resistant barriers are usually not necessary. Closed-cell SPF typically has a permeability less than 1 perm when applied at 2" thickness and an aged R value of 6 or 7 Hr·ft^2°F/btu per inch[(2)]. Closed-cell spray foam insulation is the more commonly used type of SPF applied on metal panels.

Application Technique

It is important that SPF is applied by a **certified foam spray technician** in order to apply the required insulation thickness to achieve the optimum insulation density, adhesion, and thickness. The recommended application approach is to spray the foam in controlled thickness with a "picture frame" technique. SPFA describes this picture framing motion in which the applicator surrounds the interior perimeter of the wall framing stud, allowing the foam to rise along the stud.[(3)] This technique can also help to prevent SPF from getting between girts and architectural metal wall panels which could cause metal deformation.

The thickness of the initial pass fillet during picture framing should be at least 0.5 inch and should not exceed the maximum pass thickness recommended by the foam manufacturer. The minimum thickness of the initial pass is specified to provide enough material to activate the blowing agent and initiate the cure.[(4)] After picture framing the perimeter of the area, the applicator fills in the center of the cavity using the maximum thickness recommended by the foam manufacturer. Maximum pass thickness varies by foam formulation and is listed in the technical data for each SPF product. Excessive pass thickness can result in poor quality by elevating the foam temperature beyond acceptable limits during cure. For most closed-cell SPF, the maximum pass thickness is 1.5 to 2 inches. It is important for applicators of closed-cell SPF to follow manufacturers' installation instructions on pass thickness limits and proper cooling times between subsequent passes made to develop the desired total thickness of the insulation.

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8735 W. Higgins Road, Suite 300, Chicago, IL 60631
847.375.4718 | mca@metalconstruction.org | www.metalconstruction.org

Photo of SPF being applied to wood deck using picture framing technique. Spraying foam onto a metal panel surface would be done in the same fashion.

(Courtesy of Spray Foam Professional Magazine)

Installers are trained to check the substrate surface for moisture, dirt, oils, rust or other conditions that can interfere with proper foam adhesion. The surface should be cleaned of these contaminants prior to spraying the insulation. Adhesion to the metal surface can be determined on-site using a pull-tester in accordance with ASTM D 4541 (Standard Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers).

Some SPF contractors use a release material such as building wrap or fabric to allow for easier change out of damaged panels, however the use of a release material poses the potential of creating air gaps between the back of the SPF foam and the metal panel. These gaps could allow condensation to accumulate between the SPF and the panel and framing members.

Blown In Blanket System (BIBS) non-woven fabric systems were evaluated by MCA to determine if SPF would adhere properly while allowing for easier metal panel disassembly. Results suggest the SPF had good adhesion with the BIBS membrane and would allow easier replacement of metal panels, however it can be difficult to install SPF directly onto the light-weight BIBS fabric in windy conditions. MCA research suggests the BIBS fabric is no better than SPF applied directly onto the metal panels in terms of appearance of the panels.

Paint Performance

A long-term investigation is underway to determine the impact of the SPF insulation on the performance of the paint systems used on the exterior surface of insulated pre-painted metal panels due to heat build-up from solar gain. Samples of materials from wall assemblies are being exposed over a three-year period at a test site in South Florida for evaluation of color, chalk, fade, and degradation.

Inspection

It is recommended that a building owner periodically inspect a metal roof assembly for potential leaks. Visual detection of roof leaks, in general, may be more difficult with the use of SPF. Undetected leaks can potentially cause accelerated panel corrosion.

Conclusions

The metal panel manufacturer should be consulted when considering using SPF on the underside of standing seam metal roofing due to the possibility of restricting the intended thermal movement of the roof panels.

Closed-cell Spray Polyurethane Foam is a viable insulation material for the interior surfaces of steel and aluminum metal wall panels and through-fastened roof assemblies.

Possible deformation, distortion, or oil canning caused by the application of SPF depends on the installation conditions, installation application methods, proper product selection, and applicator training.

SPFA-PCP accredited contractors and certified installers familiar with SPFA guidelines have access to SPFA resources.

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References

1. Spray Polyurethane Foam Alliance Professional Certification Program (SPFA-PCP) for individual installer certification as well as contractor and suppler accreditation.
2. Spray Polyurethane Foam Alliance
3. Tech Tip: SPF Picture Framing Technique, Spray Polyurethane Foam Alliance, 2010
4. Tech Tip: Spray Polyurethane Foam – Exotherm vs. Thickness, Spray Polyurethane Foam Alliance, 2010

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