SPRAY POLYURETHANE FOAM ALLIANCE

SPFA-134

Spray Polyurethane Foam Insulation for Metal Buildings

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ABOUT SPRAY POLYURETHANE FOAM ALLIANCE (SPFA)

Founded in 1987, the Spray Polyurethane Foam Alliance (SPFA) is the voice, and educational and technical resource, for the spray polyurethane foam industry. A 501(c)6 trade association, the alliance is composed of contractors, manufacturers, and distributors of polyurethane foam, related equipment, and protective coatings; and who provide inspections, surface preparations, and other services. The organization supports the best practices and the growth of the industry through a number of core initiatives, which include educational programs and events, the SPFA Professional Installer Certification Program, technical literature and guidelines, legislative advocacy, research, and networking opportunities. For more information, please use the contact information and links provided in this document.

DISCLAIMER

This document was developed to aid building construction and design professionals in choosing spray-applied polyurethane foam systems. The information provided herein, based on current customs and practices of the trade, is offered in good faith and believed to be true to the best of SPFA's knowledge and belief.

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DOCUMENT HISTORY

Date	Sections Modified	Description of Changes
August 2015	All	Administrative changes
January 2021	Cover and Header	New SPFA Logo
February 2025	All	Several technical updates throughout regarding insulation thickness, primers, vapor retarders and fire protective coatings and coverings.

BUILDING ENVELOPE COMMITTEE

MISSION STATEMENT

The mission of the Building Envelope Committee is to:

1. To identify, explore, develop, and communicate an understanding of technical issues, including building codes and other standards, for the SPF industry.
2. Provide a wide range of technical information for members and building design professionals to properly specify and install spray foam insulation.
3. Maintain current and develop new SPFA TechDocs and TechTips applicable to application of spray foam insulation.

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document.

TABLE OF CONTENTS

ABOUT SPRAY POLYURETHANE FOAM ALLIANCE (SPFA) 2
DISCLAIMER 2
DOCUMENT HISTORY 2
BUILDING ENVELOPE COMMITTEE 3
MISSION STATEMENT 3
TABLE OF CONTENTS 5
LIST OF FIGURES 5
DESIGN CONSIDERATION 6
General Considerations 6
DETERMINING INSULATION THICKNESS requirements 6
SURFACE PREPARATION AND APPLICATION GUIDANCE 7
SELECTION OF PRIMER 8
SELECTION OF A VAPOR RETARDER 8
SELECTION OF THE SPRAY POLYURETHANE FOAM SYSTEM 9
SELECTION OF A PROTECTIVE COATING SYSTEM 10
BUILDING CODE REQUIREMENTS 11
GUIDANCE FROM THE METAL CONSTRUCTION ASSOCIATION (MCA) 11
RECOMMENDED GUIDE SPECIFICATIONS FOR INSULATING METAL BUILDINGS 12
Interior Application 12
Exterior (Roofing) Application 12
OTHER PROGRAMS AND SERVICES OFFERED BY SPFA 17
Professional Training 17
SPFA Technical Documents (TECHDOCS) 17

LIST OF FIGURES

Figure 1 - Vapor Drive Toward Inside, SPF Applied to Exterior 13
Figure 2 - Vapor Drive Toward Exterior, SPF Applied to Exterior 14
Figure 3 - Vapor Drive Toward Inside SPF Applied on Interior. Details A and B from Metal Building Manufacturers Association (MBMA) document 15
Figure 4 - Vapor Drive Toward Outside SPF Applied on Interior. Details A and B from Metal Building Manufacturers Association (MBMA) document 16

DESIGN CONSIDERATION

GENERAL CONSIDERATIONS

Spray polyurethane foam (SPF) can provide an excellent insulating and weatherproofing augmentation to metal buildings. SPF applied directly to the metal substrate conforms to irregular surface profiles and provides an effective air seal. SPF may be applied to metal building skin from the inside or outside. When applied on the outside, the SPF must be covered with an elastomeric coating for weather protection. When applied to interior surfaces, the SPF must be installed in accordance with the applicable building code regarding fire safety. Vapor retarders, installed on the warm side of the insulation may be required depending on the intended use of the structure and IECC climate zone.

The effectiveness of a spray-applied polyurethane foam insulation assembly will be impacted by the performance of all the components as well as ambient conditions inside and outside the building. Therefore, it is recommended specifiers consult with the respective material suppliers and contractor to receive written confirmation of their agreement to all facets of the insulation system. This should include, but not be limited to, material selection, treatment of expansion joints, load design, the need for vapor control layers and their location within the assembly, fire protection layers and their location, and flashing details. See details in Figures 1 through 4 of this document.

Spray polyurethane foam can successfully be applied to most metal building surfaces and components. However, the following general practices must be followed:

DETERMINING INSULATION THICKNESS REQUIREMENTS

The following considerations should be included when determining insulation thickness:

(1) Building and Energy Codes: Most code agencies require certain buildings to meet the energy conservation standards prescribed by the International Codes Council (ICC) Model Energy Code.
(2) Condensation Control: Condensation can occur inside a building when the surface temperature of the material is lower than the dew point of the surrounding air. Insulation thickness to control where condensation occurs must be based on the design dew point and the design exterior ambient temperature. Specific building uses will generate higher levels of humidity and must be considered, e.g., vegetable and fruit storage, livestock, and poultry. See SPFA-156 *"Spray Polyurethane Foam Systems for Buildings with High Interior Humidity Conditions"* to be published in 2025.
(3) Economics: Greater insulation thickness decreases heat and cooling costs and reduces the initial size and cost of HVAC equipment. However, there is a diminishing return to adding thickness, where the time-weighted cost of additional insulation exceeds the expected energy savings.
(4) Minimum Thickness: Spray polyurethane foam applications must be sprayed to a minimum thickness to conform to the substrate and to achieve proper foam cure. For

most relatively smooth substrates, the minimum practical thickness is 1 inch, but corrugated or unusual substrate configurations may require greater thickness to achieve a suitable finished foam surface. surface. Contact the SPF chemical system manufacturer regarding minimum application thicknesses.

SURFACE PREPARATION AND APPLICATION GUIDANCE

The surface or substrate should be prepared as follows:

(1) Metal building components must be secured against movement prior to the application of the SPF system.
(2) Prior to application of primer, vapor retarder, or SPF, the surface must be dry and free of loose dirt or any contaminants that may interfere with adhesion of any of the respective components.
(3) Contaminants may be removed by use of pressure washing, steam cleaning, vacuum equipment, a hand power broom, chemical solvents, cleaning solutions, grit blasting, manual scraping, etc.

Spray foam should preferably be applied via flash pass (1 inch max) for the initial pass. Begin the foam application with a thin pass of foam, no more than 1 inch thickness. Allow the foam to cure/cool to near ambient temperature before applying additional passes to build up the desired thickness/insulation R-value. Depending on the gauge of steel used, thicker pass applications can yield metal deformation as the foam cools. A thin flash pass will provide a strong base layer to keep the substrate stiff to handle the thermal stress associated with spray foam as it cools.

For cold ambient conditions, it is recommended to provide heat to the metal surface. Metal is a very strong heat sink and cold metal can slow the cure profile of the foam. Cold metal should be warmed indirectly by warming the surrounding air.

***NOTES ON SURFACE PREPARATION*:**

1. **A thin first pass may be desirable for thin-gage metal panels.**
2. **In some cases, weather resistant barrier (e.g., a house wrap such as TYVEK®) or non-woven fabric is used between the metal and the support structure. This allows the metal to be removed if damaged without needing to remove the spray foam. Adhesion to some weather resistant barriers is typically very low. Fabric or other loose substrates are not suitable for the application of SPF.**
3. **In some cases, a thin felt-like fabric may be fully adhered to the inside surface of the panel. Adhesion should be checked prior to installation of the spray foam. Using thin initial passes will help maintain a quality installation.**
4. **Overspray during the spray foam installation is very difficult to remove without damage to painted surfaces. Mask off all areas where foam is not intended to be applied. If any**

area is not able to be masked, consider applying a wax or oily film to prevent overspray adhesion and easy removal after spraying is complete.

SELECTION OF PRIMER

Metal panels are typically provided with galvanized, galvalume or coated surfaces. These surfaces may need additional primers or surface treatment to promote foam adhesion. If a primer is required, select it based on the surface to be sprayed, the building's intended use, and the recommendations of the SPF and primer manufacturers.

NOTE: Most metal used will likely have a primer already applied during the roll forming process. Spray foam adhesion should be checked on a small section before spraying the entire structure. Adhesion testing can be performed using an adhesion pull testing device.

SELECTION OF A VAPOR RETARDER

The need for and the location of a vapor retarder is based on the following factors:

(1) Direction and degree of the vapor drive:
   a. Interior design temperature
   b. Interior design humidity
   c. Exterior design temperature
   d. Exterior design humidity

(2) Location of the intended SPF application:
   a. Interior surface of the exterior wall/ceiling surface
   b. Exterior surface of the exterior wall/roof surface

For example, if a metal building is intended to be used as a cooler, (inside temperature cooler than the outside temperature) an additional vapor barrier applied to the exterior of the SPF insulation may be required if the SPF is applied to the cooler's exterior surface (the warm side of the cooler). Conversely, if the metal building is in a cool climate and the building will be heated, a vapor retarder may be required on the interior side of the SPF when SPF is applied to the building's interior surface. In cases where the interior relative humidity is controlled at levels greater than 50%, the use of a vapor barrier is recommended. A hygrothermal analysis can determine if an additional vapor retarder or vapor barrier is necessary.

See publications SPFA-118 "*Moisture Vapor Transmission",* and SPFA-156 *"Spray Polyurethane Foam Systems for Buildings with High Interior Humidity Conditions"*

If a vapor retarder is required, its selection should be based on the following criteria:

(1) Perm rating required (based on moisture vapor drive and perm ratings of other components). It is recommended to conduct a hygrothermal (condensation potential) analysis to determine the need and location of additional vapor control layers.
(2) Compatibility with adjoining materials
(3) Manufacturer's recommendation

SELECTION OF THE SPRAY POLYURETHANE FOAM SYSTEM

Spray-applied polyurethane foam is the product of reaction of two chemical components. When SPF is sprayed onto a substrate, a seamless layer is created. Thickness can be varied to meet insulation requirements as well as air leakage and moisture control. The contractor, in the case of SPF applications, fabricates the product on site in accordance with the manufacturer's instructions.

The choice of spray foam to be used are primarily based on two factors - density and closed cell content. These two physical properties impact the characteristics and performance of spray foam.

SPF is generally separated into three categories by density: low density (LD), medium density (MD), and high-density (HD); and two categories by closed cell content: open cell and closed cell. Foams with a closed cell content of >90% are defined as closed cell foam; they tend to be medium density or high-density materials and have characteristics that perform well under high humidity conditions.

For metal buildings, the three categories of SPF are typically used as follows:

SPF Type	Application	Density Range (lb/ft3)	R-value/inch	Air Impermeable Thickness (in)	1 perm Vapor Retarder Thickness (in)
Low-Density Open-Cell	Interior Insulation	0.4-0.7	3.6-4.2	3.5-5.5	[*]
Medium-Density Closed-cell	Interior or Exterior Insulation	1.8-2.2	6.0-7.4	1.0-1.5	1.0-2.0
High-Density Closed-cell	Exterior Insulation on Roofs	2.5-4.0	6.0-7.4	1.0-1.5	1.0-2.0

*Open-cell SPF insulation may require a vapor retarder in colder-climates (zone 5 and above). A 1-perm vapor retarder is required by most building codes in colder climates for normal interior activities, unless a hygrothermal analysis is performed and accepted by the authority having jurisdiction. For high-humidity applications see SPFA-156 "Spray Polyurethane Foam Systems for Buildings with High Interior Humidity Conditions"

Additionally, with metal being more thermally conductive than other substrates, spraying directly to metal in colder temperatures may require a winter blend or formulation. Consult with the contractor and the polyurethane foam chemical manufacturer to determine which system best suits the project.

From a fire safety standpoint, SPF can be used safely. It is important, however, that all persons associated with the design, fabrication, storage, and installation understand the materials and environments involved.

SPF insulation is combustible and must include any fire protective coating or coverings based on applicable building code requirements. Flame spread ratings provided for SPF products using small scale tests are not intended to reflect the hazards presented by SPF under actual fire conditions. Care must be taken to ensure that the SPF is not exposed to constant temperatures more than 180 °F.

During construction, shield exposed SPF from open flames, cutting and welding torches, electric heaters, high intensity lamps, and smoking materials. If hot work must be performed near exposed SPF, shield the SPF from heat and sparks by a fire-resistant materials, and post a fire watch. Do not weld or cut metal that is in contact with SPF.

SELECTION OF A PROTECTIVE COATING SYSTEM

When SPF is applied to the exterior of a metal building, the SPF must be covered with a protective cladding or a fluid applied protective coating. The coating system protects the SPF from deterioration due to the sun's ultra-violet rays, mechanical damage and other weather-related phenomena. The coating must bond to the SPF to become an integral part of the insulation system.

Coating systems designed for use over foam cure to form a protective membrane. The DFT (dry film thickness) of the protective coating should be compliant with the coating manufacturer's specifications.

Consider the following items in the selection of the coating system:

(1) Physical Characteristics
   a. Chemical resistance
   b. Water vapor permanence
   c. Tensile and elongation properties
   d. Retention of physical properties upon aging
   e. UV resistance

(2) Performance Characteristics
   a. Environment in which it is to be used (abrasion and impact)
   b. Life expectancy
   c. Ease of maintenance
   d. History of similar applications or laboratory data relating to the application in question
   e. Adhesion to the polyurethane foam.
   f. Combustibility characteristics, individually and in combination with the selected polyurethane foam systems
   g. Aesthetic qualities

For additional information on protective coating systems, see SPFA-102 "*A Guide for Selection of Protective Coatings Over Sprayed Polyurethane Foam".*

BUILDING CODE REQUIREMENTS

SPF applied onto the interior surfaces of metal siding and roofing

Building codes typically require SPF to have specific flame spread and smoke development ratings as determined by ASTM E-84 depending on the application. In addition, the SPF must be (1) separated from the building interior by one-half-inch gypsum board or an equivalent thermal barrier as determined by NFPA 275, or (2) classified as an *Alternative Thermal Barrier Assembly* as determined by NFPA 286, UL 1715, UL 1040, or FM 4880 large-scale fire tests. Prior to the 2024 IBC, one-story, sprinklered, buildings, SPF can be installed in metal building exterior walls in a maximum thickness of 4 inches when the SPF has a flame spread of 25 or less and is separated from the interior of the building with a thickness not less than 0.032-inch-thick aluminum or corrosion-resistant steel having a base metal thickness of 0.0160 inches.

SPF applied onto the exterior surface of metal roofing

Thermal barriers are not required for SPF that is part of a Class A, B, or C roof-covering assembly and passes the NFPA 276 or UL 1256 fire test standards.

See *SPFA-126 Thermal and Ignition Barriers for Spray Polyurethane Foam Insulation* for additional information.

Consider the following in the selection of a thermal barrier:

(1) Building code requirements
(2) Adhesion to the SPF
(3) Environment in which it is to be used
(4) Aesthetic qualities
(5) Ease of maintenance

GUIDANCE FROM THE METAL CONSTRUCTION ASSOCIATION (MCA)

The Metal Construction Association (MCA) has published Technical Bulletin *"Spray Polyurethane Foam Insulation on Interior Surfaces of Metal Panels"* September 2023, that provides guidance when installing SPF on metal roofs and siding. As noted, for larger buildings, standing seam metal roofs are often designed to expand and move relative to the building structure. Ongoing research is underway by the SPFA and the metal buildings industry to identify potential issues and design details that may be needed when applying SPF below standing seam metal roofs to accommodate this movement. This section will be updated upon completion of this research.

RECOMMENDED GUIDE SPECIFICATIONS FOR INSULATING METAL BUILDINGS

Interior Application

SPFA has developed a complete CSI-compliant architectural specification for SPF insultation. This specification can be found in TechDoc SPFA-149 *"Architectural Specification for Spray Polyurethane Foam Insulation",* available on the SPFA Website.

Exterior (Roofing) Application

SPFA has developed guide specification for SPF roofing systems as part of SPFA-104 *Spray Polyurethane Foam Systems for New and Remedial Roofing*, available on the SPFA Website.

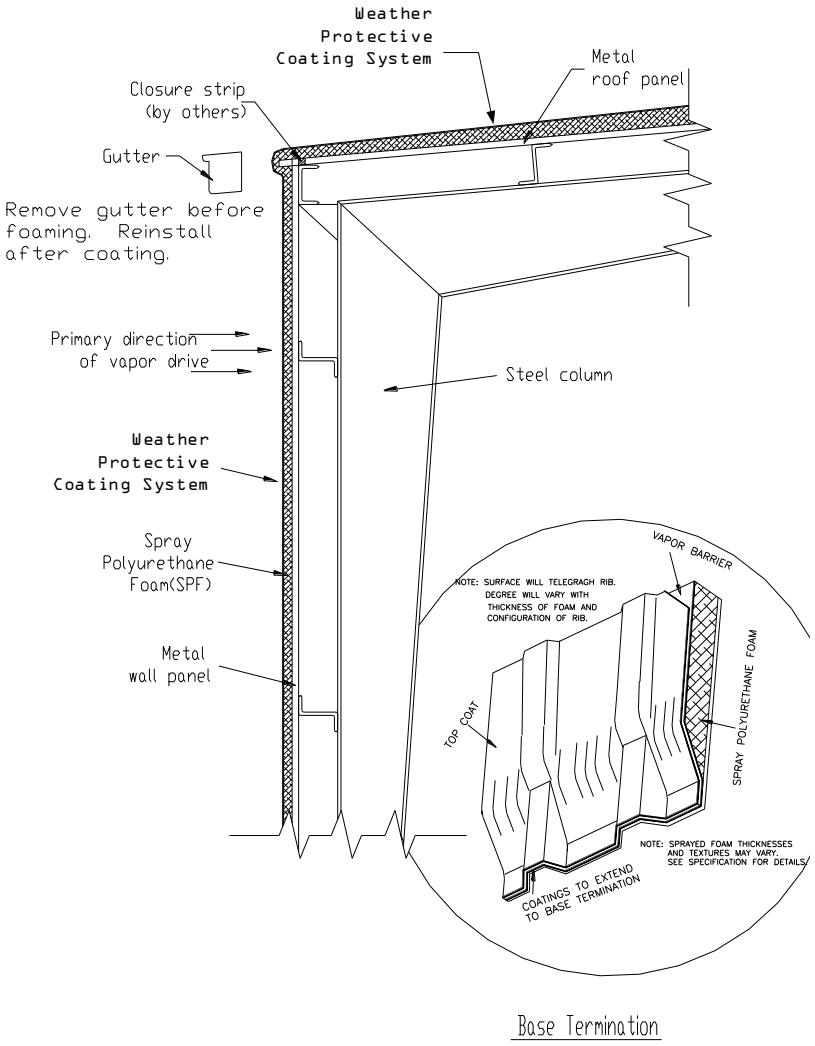

Figure 1 - Vapor Drive Toward Inside, SPF Applied to Exterior

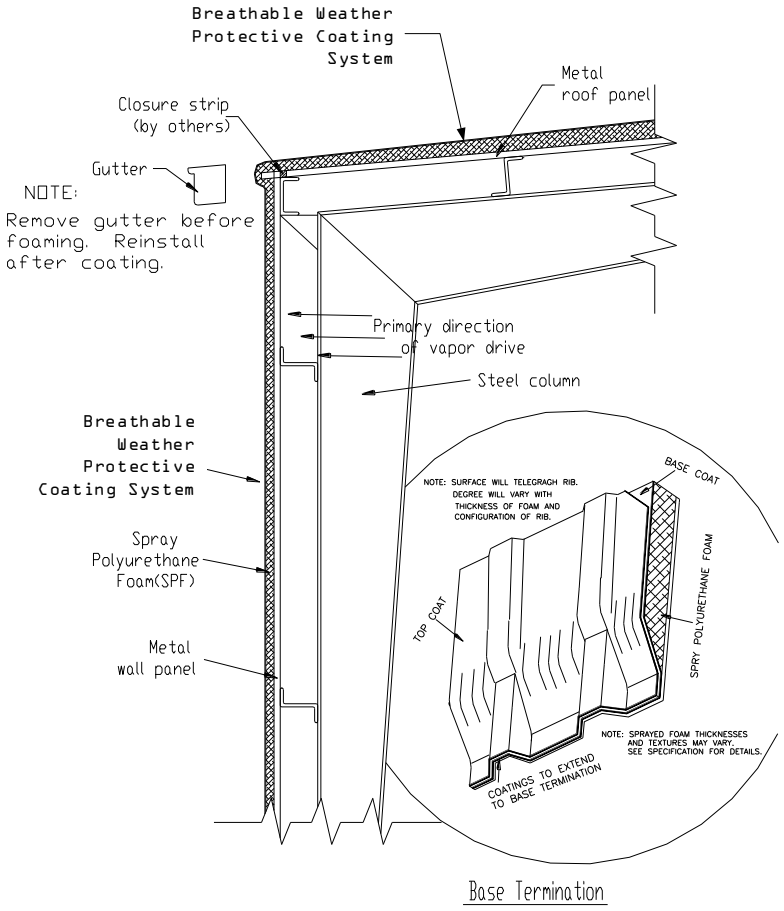

Figure 2 - Vapor Drive Toward Exterior, SPF Applied to Exterior

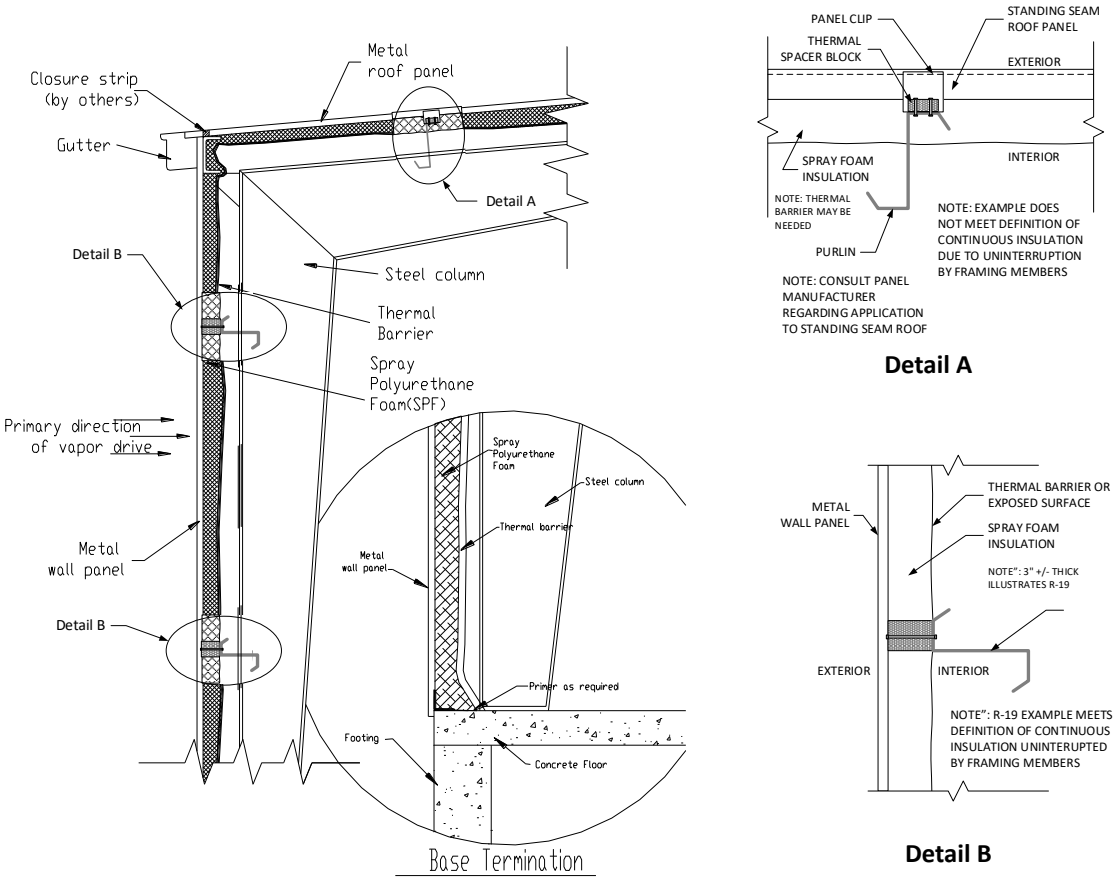

Figure 3 - Vapor Drive Toward Inside SPF Applied on Interior. Details A and B from Figures 5.2.11 and 5.2.14 in Metal Building Manufacturers Association (MBMA) document

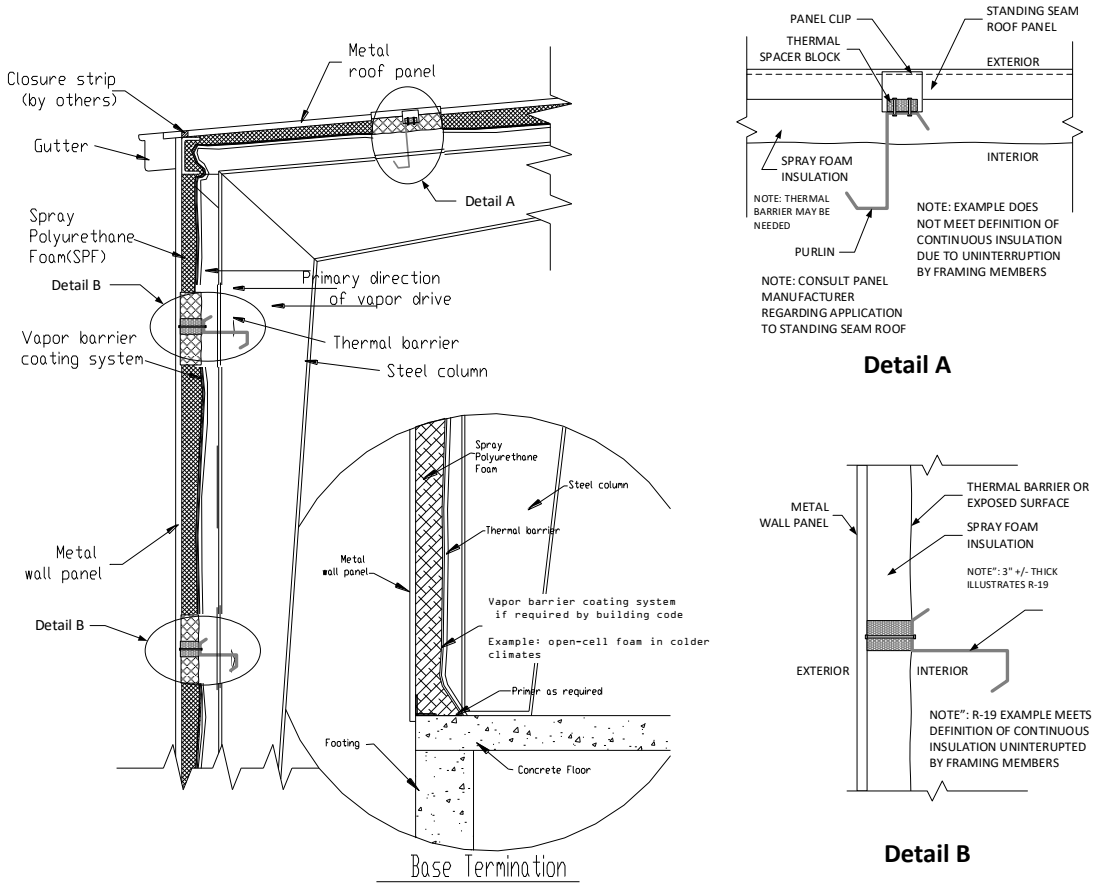

Figure 4 - Vapor Drive Toward Outside SPF Applied on Interior. Details A and B from Figures 5.2.11 and 5.2.14 in Metal Building Manufacturers Association (MBMA) document

OTHER PROGRAMS AND SERVICES OFFERED BY SPFA

PROFESSIONAL TRAINING

The SPFA Professional Program offers individual certification and company accreditation in five areas: Contractor, Distributor, Elastomeric Coating Supplier, Foam Supplier, and Independent Inspector. The objectives of the program are to **PROVIDE** an established set of criteria, to **IDENTIFY** and **RECOGNIZE** individuals and companies, and to **ENCOURAGE** individual and company responsibility for the quality of work through self-education.

SPFA TECHNICAL DOCUMENTS (TECHDOCS)

GENERAL

SPFA-118 Moisture Vapor Transmission

SPFA-119 Glossary of Terms

SPFA-121 Spray Polyurethane Foam Estimating Reference Guide

SPFA-137 High-Pressure Spray Foam Equipment Guidelines

SPFA-143 Primers: Why, When and How to Use Them

SPFA-144 Coating Equipment Guidelines

SPFA-145 Surface Texture of Spray Polyurethane Foam

SPFA-155 Low-Pressure Spray Foam Equipment Guidelines

INSULATION

SPFA-112 Spray Polyurethane Foam for Residential Building Envelope Insulation and Air Seal

SPFA-126 Thermal and Ignition Barriers for the SPF Industry

SPFA-134 Guideline for Insulating Metal Buildings with Spray Applied Polyurethane Foam

SPFA-140 Spray Polyurethane Foam for Exterior Subgrade Thermal and Moisture Protection

SPFA-141 Spray Polyurethane Foam for Cathedralized Ceilings and Unvented (Conditioned) Attics

SPFA-146 Spray Polyurethane Foam for Hybrid Insulation Systems - Part 1: Climate Zones 1-3

SPFA-147 Spray Polyurethane Foam for Hybrid Insulation Systems - Part 2: Climate Zones 4-7

SPFA-148 SPF Insulation Installation Certificate

SPFA-149 Architectural Specification for High-Pressure Spray Polyurethane Foam Insulation

SPFA-152 Spray Polyurethane Foam Insulation for the Interior of Basement and Crawlspace Walls

SPFA-153 Spray Polyurethane Foam Insulation for Below-Slab Applications

ROOFING

SPFA-102 A Guide for Selection of Elastomeric Protective Coatings Over Sprayed Polyurethane Foam

SPFA-104 Spray Polyurethane Foam Systems for New and Remedial Roofing

SPFA-104 Roofing Details - File location of AutoCAD DXF files for all details shown in SPFA-104.

SPFA-107 Spray Polyurethane Foam Blisters

SPFA-110 Spray Polyurethane Foam Aggregate Systems for New and Remedial Roofing

SPFA-122 The Renewal of Spray Polyurethane Foam and Coating Roof Systems

SPFA-127 Maintenance Manual for Spray Polyurethane Foam Roof Systems

SPFA-130 Spray Polyurethane Foam Roofing

SPFA-138 Guideline for Roof Assembly Evaluation for Spray Polyurethane Foam Roof System

SPFA-139 Recommendations for Repair of Spray Polyurethane Foam Roof Systems due to Hail and Wind Driven Damage

SPFA-142 A Guideline for Securing Roofing Components with SPF Adhesives

SPFA-150 Photo-Voltaic Systems and SPF Roof Systems

SPECIALTY

SPFA-103 Spray Polyurethane Foam Insulation Systems for Metal Service Vessels Operating Between -35oC (-30oF) and 93oC (200oF)

SPFA-111 Spray Polyurethane Foam Systems for Cold Storage Facilities Operating Between - 40oC and + 10oC (- 40oF and + 50oF)

SPFA-157 Polyurethane Foam for Concrete Lifting (Slab Jacking)

SPFA-158 Polyurethane Foam for Concrete Repair

The **SPFA website** (www.sprayfoam.org) is a public website. All SPFA TechDocs referenced in this document are available as PDFs for purchase by non-members or at no charge to SPFA members.

A **"Support Line" 800-number** is available for your use to answer technical questions (800-523-6154). The SPFA sponsors research and development and product testing that allows for approval of generic types of spray foams, coverings, and related products.