



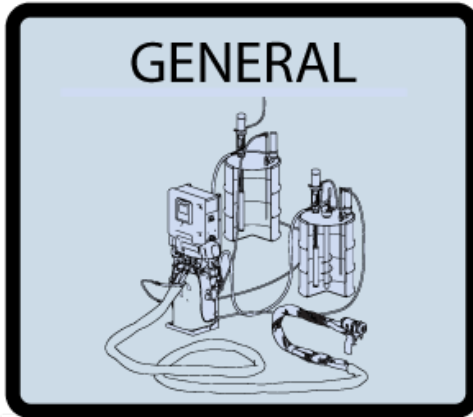
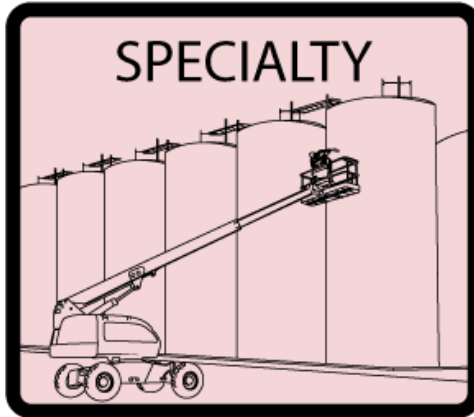
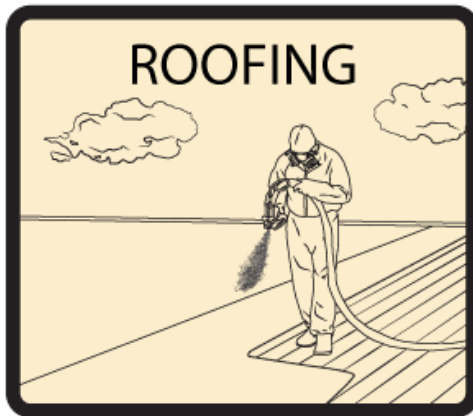
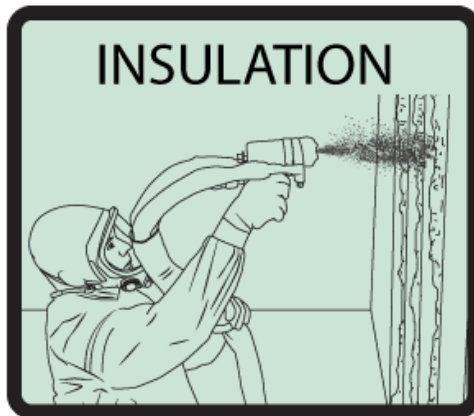
## Spray Polyurethane Foam for Residential Building Envelope Insulation and Air Seal

### Recommended Design Considerations and Guide Specifications

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SPFA-112

# RESIDENTIAL INSULATION



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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

**NOTE:** This document was developed to aid building 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, but is made WITHOUT WARRANTY, EITHER EXPRESS OR IMPLIED, AS TO FITNESS, MERCHANTABILITY, OR ANY OTHER MATTER. SPFA DISCLAIMS ALL LIABILITY FOR ANY LOSS OR DAMAGE ARISING OUT OF ITS USE. Individual manufacturers and contractors should be consulted for specific information. Nominal values which may be provided herein are believed to be representative, but are not to be used as specifications nor assumed to be identical to finished products. SPFA does not endorse the proprietary products or processes of any individual manufacturer, or the services of any individual contractor.

## DOCUMENT HISTORY

Date	Sections Modified	Description of Changes
1994		
August 2015	All	Administrative changes

## TECHNICAL OVERSIGHT COMMITTEE

### Mission Statement

The mission of the Technical Committee is to provide a wide range of technical service to the SPF (spray polyurethane foam) industry such as, but not limited to:

- (1) Review existing documents and serve as a clearing house to ensure the “Continuity of Value” of technical information published by SPFA and others concerning the products and services to the SPF industry;
- (2) Review, research, develop, and issue documents concerning new products, systems and services; and
- (3) To identify, explore, develop, and communicate an understanding of technical issues facing to the SPF industry.



Participating Members	
Roger Morrison, Chairman North Carolina Foam Industries	Bruce Schenke BASF
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## Design Consideration

### GENERAL CONSIDERATIONS

The performance of a spray-applied polyurethane foam (SPF) insulation system can be affected by all the component parts of a structure, as well as the atmospheric conditions inside and outside the structure.

Structural design, specification review, and contractor and material selection, coupled with the compatibility and positioning of the various structural components, are necessary to produce a successful building envelope insulation system.

The specifier should consult with the respective material suppliers and the 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, expansion joints, load design, vapor retarders, and flashing details.

SPF can be applied to most surfaces successfully. However, the following general practices must be observed.

### DETERMINING INSULATION THICKNESS

The following method should be considered when determining insulation thickness:

- (1) Building and Energy Codes: Most code agencies require certain buildings to meet the energy conservation standards prescribed by the Council of American Building Officials (CABO) Model Energy Code.
- (2) Condensation Control: Condensation can occur inside a building when the interior surface is lower than the dew point of the inside air. The insulation thickness to control this condensation must be based on the design dew point and the design exterior ambient temperature.
- (3) Economic Thickness: Greater insulation thickness decreases heat and cooling costs and the cost of HVAC equipment. However, there is a diminishing return to adding thickness, where the time-weighted costs of additional insulation exceed the expected energy savings. The economic thickness calculation determines the added incremental insulation thickness that meets a specified return on investment from energy cost savings.

The best method to determine insulation thickness is to determine the minimums for each of the previously described situations and to choose the method that prescribes the greatest insulation thickness.

### SURFACE PREPARATION

- (1) When a primer and/or vapor retarder is specified, there must be adhesion between components of the system to secure the entire system against movement.

- (2) Prior to application of primer, vapor retarder, or SPF, the surface must be cured, 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 air pressure, vacuum equipment, a hand power broom, chemical solvents, sandblasting, manual scraping, etc.

### **SELECTION OF PRIMER**

If a primer is required, it should be considered in accordance with the type substrate to be sprayed, the intended end use of the wall assembly, and the spray polyurethane foam and/or primer manufacturer.

### **SELECTION OF A VAPOR RETARDER**

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)
- (2) Compatibility with adjoining materials
- (3) Manufacturer's recommendation

### **SELECTION OF THE SPRAY POLYURETHANE FOAM SYSTEM**

The contractor, in the case of SPF applications, fabricates the product on-site in accordance with manufacturer instructions.

Many different SPF systems are available in various densities, each exhibiting different temperature limitations, combustibility characteristics, etc. The use of these systems, in combination with each other or with other insulation products, offers a wide range of economical installations.

Most published data is based on laboratory produced samples. The thickness of the polyurethane foam sprayed, the number of passes, the temperature of the substrate, ambient temperatures, etc., have a pronounced effect on all properties.

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.

**Polyurethane foam insulation is combustible and should be treated as such. Flame spread ratings provided for polyurethane products using small scale tests are not intended to reflect the hazards presented by this or any other materials under actual fire conditions. Care must be taken to ensure that the foam is not exposed to temperatures in excess of 200°F.**

### **SELECTION OF A THERMAL BARRIER**

When polyurethane foam is spray applied to interior surfaces, it must be protected by a thermal barrier.

The thermal barrier must be a product that when sprayed, troweled, or mechanically fastened to the foam, forms a 15-minute thermal barrier. The thermal barrier must meet the minimum design characteristics of the generic type specified.

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

## Recommended Guide Specification for Residential Building Envelope Insulation

### PART 1 – GENERAL

This guide discusses the application of seamless SPF for use as a building envelope insulation system. Your contractor, the selected system’s manufacturer, and local code agencies can assist you, as each project must be assessed individually.

#### 1.01 SCOPE OF WORK

Furnish all labor, materials, tools, and equipment necessary for the application of a spray polyurethane team-building envelope insulation system, including accessory items, subject to the general provisions of the contract.

#### 1.02 RELATED WORK SPECIFIED ELSEWHERE

- |                       |               |
|-----------------------|---------------|
| (1) Rough Carpentry   | Section 06100 |
| (2) Insulation, Other | Section 07200 |
| (3) Thermal Barrier   | Section 07220 |
| (4) Vapor Retarder    | Section 06100 |
| (5) Mechanical        | Division 15   |
| (6) Electrical        | Division 16   |

#### 1.03 QUALITY ASSURANCE

**Contractor Qualifications:** The contractor should provide information concerning projects that are similar in nature to the one proposed, including the location and person to be contacted. Some manufacturers of SPF systems have approval programs and/or licensing methods that could be required.



#### 1.04 SUBMITTALS

- (1) Manufacturers are to provide published data sheets or letters of certification that their products comply with the materials specified. This is to include primers (if required), SPF, thermal barriers, and the vapor retarder (if required).
- (2) Shop drawings on sheet metal, accessories, or other fabricated items, if required.
- (3) Manufacturer's application or installation instructions.
- (4) Contractor/applicator certification from the SPF supplier and/or thermal barrier manufacturers and experience. (See Section 1.03.)
- (5) Approval and information guides for applicable local or national building codes.
- (6) Safety and handling instructions for storage and the handling and use of the materials including the Materials Safety Data Sheets (MSDS).
- (7) Field Quality Control Procedures are to be utilized by the contractor/applicator to ensure proper preparation and installation of the SPF and thermal barriers, detail work, and follow-up inspection.

#### 1.05 MATERIALS, DELIVERY AND STORAGE

- (1) Materials shall be delivered in the manufacturers' original, tightly sealed containers, or unopened package, all clearly labeled with the manufacturers' name, product identification, safety information, and batch or lot numbers where appropriate. Where materials are covered by a referenced specification, the labels shall bear the specification number, type, and class, as applicable.
- (2) Containers shall be stored out of the weather and direct sun, where the temperatures are within the limits specified by the manufacturer.
- (3) All materials shall be stored in compliance with local fire and safety requirements.

#### 1.06 ENVIRONMENTAL CONDITIONS

- (1) Do not apply the SPF below the temperature and/or above the humidity specified by the manufacturer.
- (2) Apply thermal barriers and the vapor retarder (if required) in accordance with the manufacturer's application instructions.

#### 1.07 SEQUENCE AND SCHEDULING

In new construction projects, the SPF is installed when the preparation of the perimeter wall/roof are in place and in coordination with other building trades.

#### 1.08 SAFETY REQUIREMENTS

- (1) API Bulletin AX-119, "MDI-Based Polyurethane Foam Systems: Guidelines for Safe Handling and Disposal."
- (2) Refer to the appropriate Material Safety Data Sheets (MSDS) for additional safety information.
- (3) Proper disposal of waste materials and containers must be done in compliance with the manufacturer's guidelines and/or federal, state, and local regulatory agencies.
- (4) Proper disposal of waste materials and containers must be done in compliance with the manufacturer's guidelines and/or federal, state, and local regulatory agencies.

- (5) For protection against exposure to higher levels of MDI (greater than 1 ppm) or for entry into confined spaces, workers must wear either a self-contained breathing apparatus, with a full face-piece operated in a pressure-demand or other positive-pressure mode; a combination respirator, including a Type C air-supplied respirator, with a full face-piece operated in a pressure-demand or other positive-pressure mode; or an auxiliary self-contained breathing apparatus operated in a pressure-demand or other positive-pressure mode. (See API Bulletin, AX-119, “MDI based Polyurethane Foam Systems: Guidelines for Safe Handling and Disposal.”)
- (6) Personal protective clothing should be worn. This includes wearing the appropriate protective clothing, including eye protection (face shield or chemical worker’s goggles), gloves, and coveralls. This is essential to preventing skin exposure and is strongly recommended for most individuals who work with PMDI.

## PART 2 – PRODUCTS

### 2.01 POLYURETHANE FOAM

- (1) The polyurethane foam to be applied shall be a two component system made by combining an isocyanate (A-component) with a polyol (B-component) and shall possess the following physical characteristics:

#### INTERIOR POLYURETHANE FOAM: CLOSED CELL TYPE

PROPERTIES	ASTM TEST	SI UNITS	U.S. UNITS
Density (sprayed-in-place)	D-1622	24-48 kg/m <sup>3</sup>	1.5-3.0 lbs/ft <sup>3</sup>
Compressive Strength	D-1621	100 kPa (min.)	15 lb/in. <sup>2</sup> (min.)
R-Value per inch	C-177, C-236, C-518	1.1 K•m <sup>2</sup> /W average aged value	6.2 °F•ft <sup>2</sup> •hr/Btu average aged value
Closed Cell Content	D-2856	90% (min.)	90% (min.)
Flammability* (FSI)	E-84	75 or less	75 or less
Smoke*	E-84	450 or less, smoke developed rating	450 or less, smoke developed rating

**INTERIOR POLYURETHANE FOAM: OPEN CELL TYPE**

PROPERTIES	ASTM TEST	SI UNITS	US UNITS
Density (sprayed-in-place)	D-1622	6-10 kg/m <sup>3</sup>	0.4 - 0.6 lbs/ft <sup>3</sup>
R-Value per inch	C-177, C-236, C-518	0.60 K•m <sup>2</sup> /W average aged value	3.4 °F•ft <sup>2</sup> •hr/Btu average aged value
Flammability* (FSI)	E-84	75 or less	75 or less
Smoke*	E-84	450 or less, smoke developed rating	450 or less, smoke developed rating

\* This standard is used solely to measure and describe the properties of products in response to heat and flame under controlled laboratory conditions. This numerical flame spread rating is not intended to reflect hazards presented by this or any other material under actual fire conditions

- (2) Polyurethane Foam Primers: Primers used shall be as recommended by the manufacturer of the spray foam materials specified.
- (3) Fire Safety Requirements: See API Bulletin AX-119, “MDI-Based Polyurethane Foam Systems: Guidelines for Safe Handling and Disposal.”

**2.02 RELATED PRODUCTS**

- (1) ONE COMPONENT POLYURETHANE FOAM SEALANT, SPRAYED-IN-PLACE

PROPERTIES	ASTM TEST	SI UNITS	U.S. UNITS
Density (sprayed-in-place)	D-1622	16-33 kg/m <sup>3</sup>	1.0-2.0 lbs/ft <sup>3</sup>
R-Value per inch	C-177, C-236, C-518	0.60 K•m <sup>2</sup> /W average aged value	3.4 °F•ft <sup>2</sup> •hr/Btu average aged value
Flammability** (FSI)	E-84	75 or less	75 or less
Smoke* *	E-84	450 or less, smoke developed rating	450 or less, smoke developed rating

\* \* Measured as a sealant at 12.5% coverage and 20mm (3/4 in.) bead. This standard is used solely to measure and describe the properties of products in response to heat and flame under controlled laboratory conditions. This numerical flame spread rating is not intended to reflect hazards presented by this or any other material under actual fire conditions.

- (2) 15-MINUTE RATED THERMAL BARRIERS
  - a. Sprayed-in-place cementitious materials
  - b. Sprayed-in-place fiber
  - c. Minimum 1/2-in. gypsum board
  - d. Other

- (3) VAPOR RETARDER (if required)
  - a. Asphaltic
  - b. Butyl
  - c. Chloro-sulfonated polyethylene
  - d. Polyethylene film
  - e. Other

- (4) SUBSTRATE PRIMERS (if required)

The primer to be applied must be specifically selected for the given substrate to be primed and must be compatible with the SPF.

- a. Wood: chlorinated rubber, modified alkyds, and others
- b. Steel: modified alkyds, epoxy, acrylics, and others
- c. Galvanized: vinyl copolymer, “wash primer,” modified alkyds, and others
- d. Concrete/masonry: chlorinated rubber, vinyl copolymer acrylic, asphaltic, and others

## PART 3 – EXECUTION

### 3.01 APPLICATION OF PRODUCTS

The products intended for use in the building envelope insulation system must be applied within the manufacturer’s guidelines for temperature, humidity, and other atmospheric conditions. In addition, the products must be sequenced so as to take into consideration substrate preparation, proper cure times, and inter-coat adhesion.

### 3.02 SUBSTRATE CONSIDERATION AND PREPARATION

The following outlines the surface preparations for those substrates that are to be insulated and statements regarding the selection of materials related to the successful performance of the SPF insulation:

- (1) WOOD

- a. Plywood shall contain no more than 18% water, as measured in accordance with ASTM D-4449 and 4444-84.
- b. Most untreated and unpainted wood surfaces need not be primed. The SPF can be applied directly to the dry wood. Priming may be required in certain instances. See the SPF manufacturer for specific details.

- (2) STEEL

- a. Primed: If the primed metal surface is free of loose scale, rust, and weathered or chalking paint. It can be cleaned using vacuum equipment and hand or power tools to remove loose dirt. Grease, oil, or other contaminants shall be removed with proper cleaning solutions.

- b. Previously Painted: Clean the painted metal surface using hand or power tools to remove loose scale and dirt. Grease, oil, and other surface contaminants can be cleaned using a power wash technique.
  - c. Galvanized: When required, clean galvanized steel as recommended by the primer manufacturer.
  - d. Unpainted Steel: Clean as recommended by the primer manufacturer in order to prepare the steel surface for the primer.
- (3) CONCRETE AND MASONRY
- a. Must be cured, and loose dirt and any other contaminants removed.
- (4) SHEATHING BOARD
- a. Most sheathing boards need not be primed prior to the application of SPF.

### 3.03 PRIMER APPLICATION

When required, the primer shall be applied to the properly prepared substrate in accordance with the manufacturer's guidelines so as to achieve a minimum thickness of dry mils. Many primers require a curing time of 24 hours prior to the application of SPF or other products.

### 3.04 SPRAY POLYURETHANE FOAM APPLICATION

- (1) The SPF A- and B-components shall be processed in accordance with the manufacturer's instructions.
- (2) The polyurethane foam shall be sprayed within the manufacturer's guidelines for temperature, humidity, and other atmospheric conditions.
- (3) The polyurethane foam shall be sprayed in minimum 1/2 in. thick passes (lifts) with the overall thickness to be a minimum thickness per contract requirements and/or building code. The full thickness of the SPF to be applied within any given area should be completed in one day.

### 3.05 VAPOR RETARDER APPLICATION

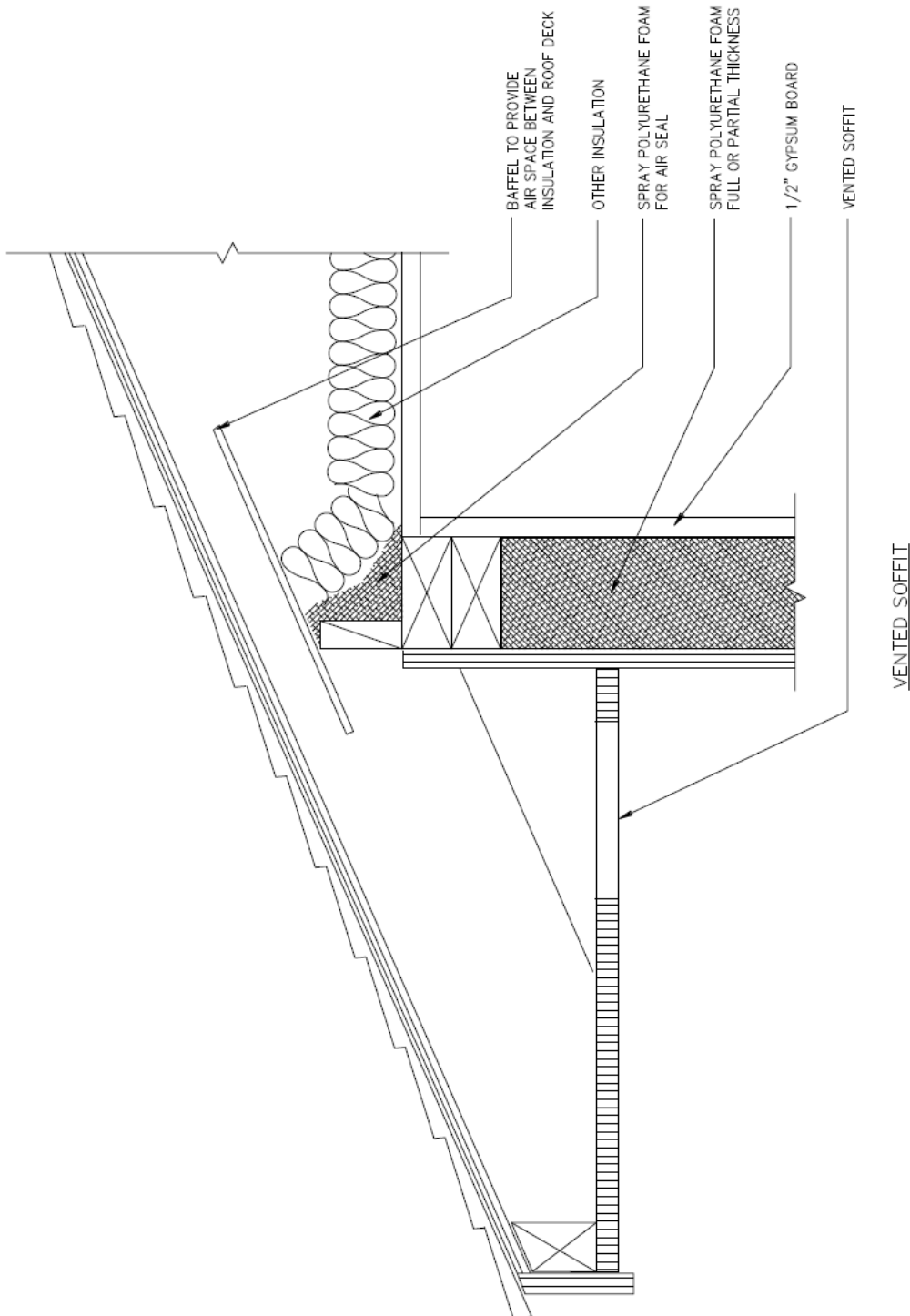
- (1) When required, a vapor retarder shall be applied to the substrate to be insulated or to the finished SPF insulation. The predominant direction of the vapor drive determines the location of the vapor retarder relative to the SPF. (Refer to SPFA-118, Moisture Vapor Transmission.)
- (2) The vapor retarder shall be applied in accordance with the manufacturer's specifications so as to achieve the desired perm rating per ASTM E-96, Method E.

### 3.06 THERMAL BARRIER APPLICATION

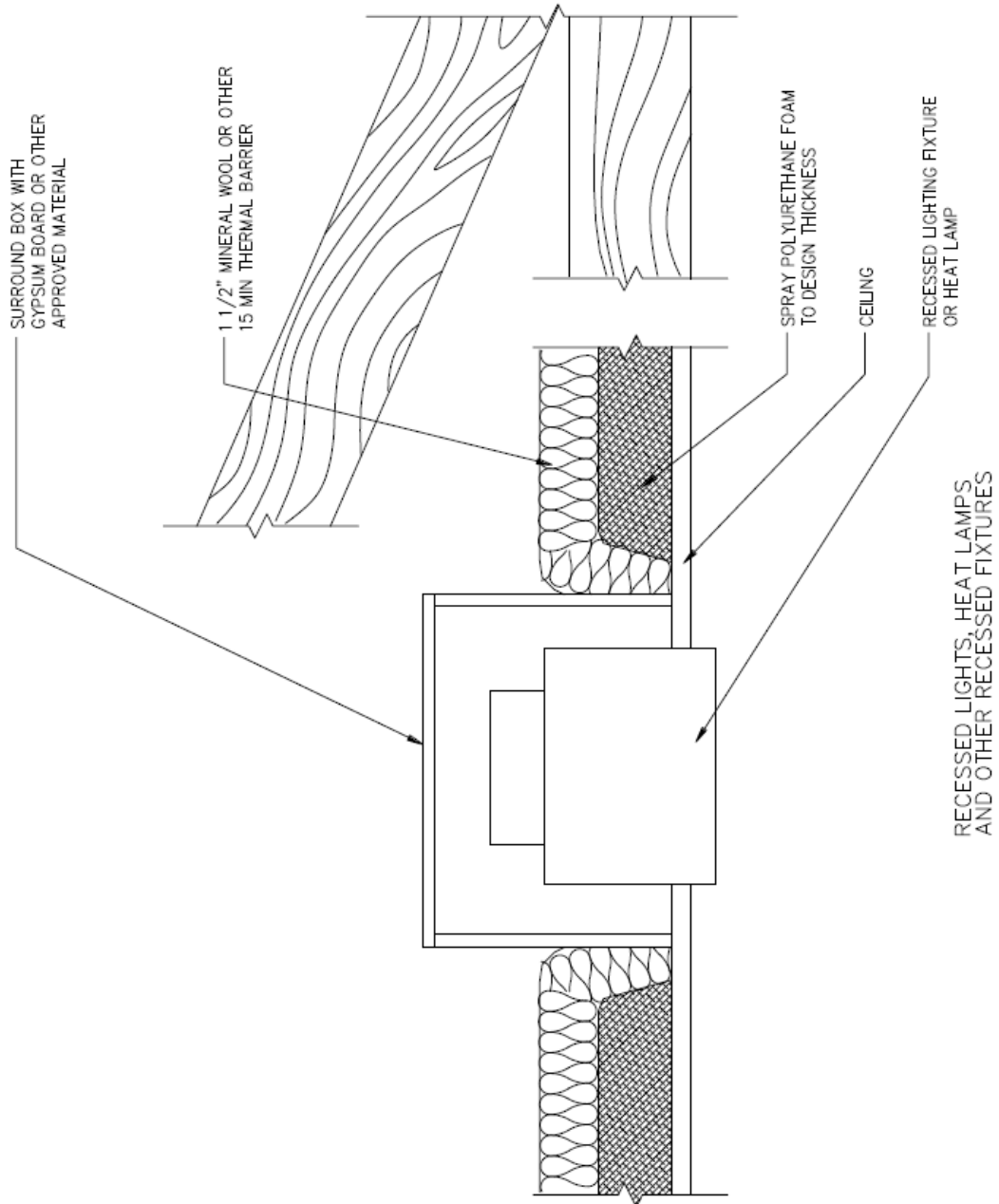
The interior surface of the SPF must be covered with a 15-minute rated thermal barrier. The thermal barrier must be applied in accordance with manufacturer guidelines.

## Detail Drawings

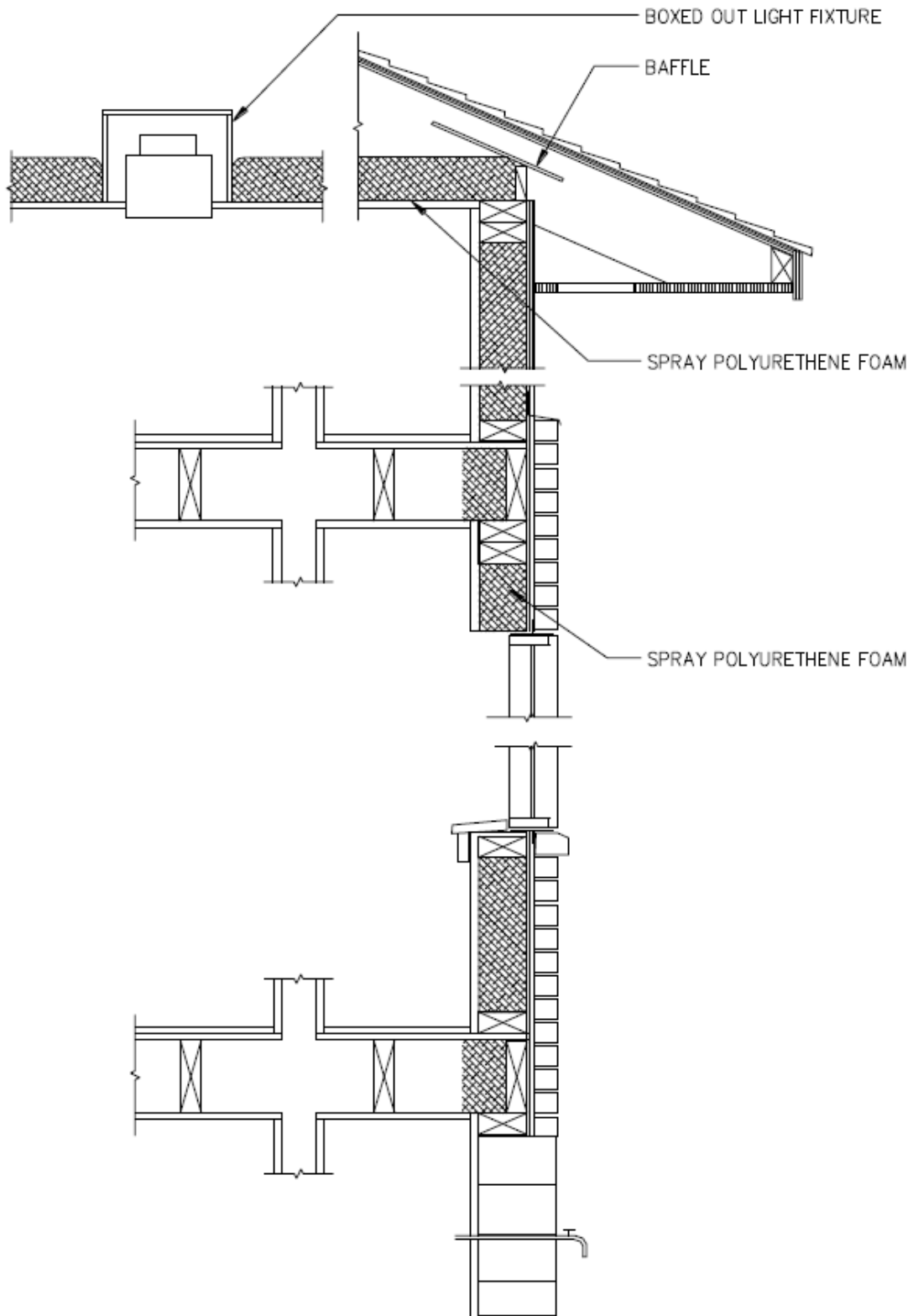
### DETAIL DRAWING 1: COMMERCIAL BUILDINGS, PERIMETER WALL INSULATION



**DETAIL DRAWING 2: COMMERCIAL BUILDINGS, UNDERSIDE OF ROOF DECKS**

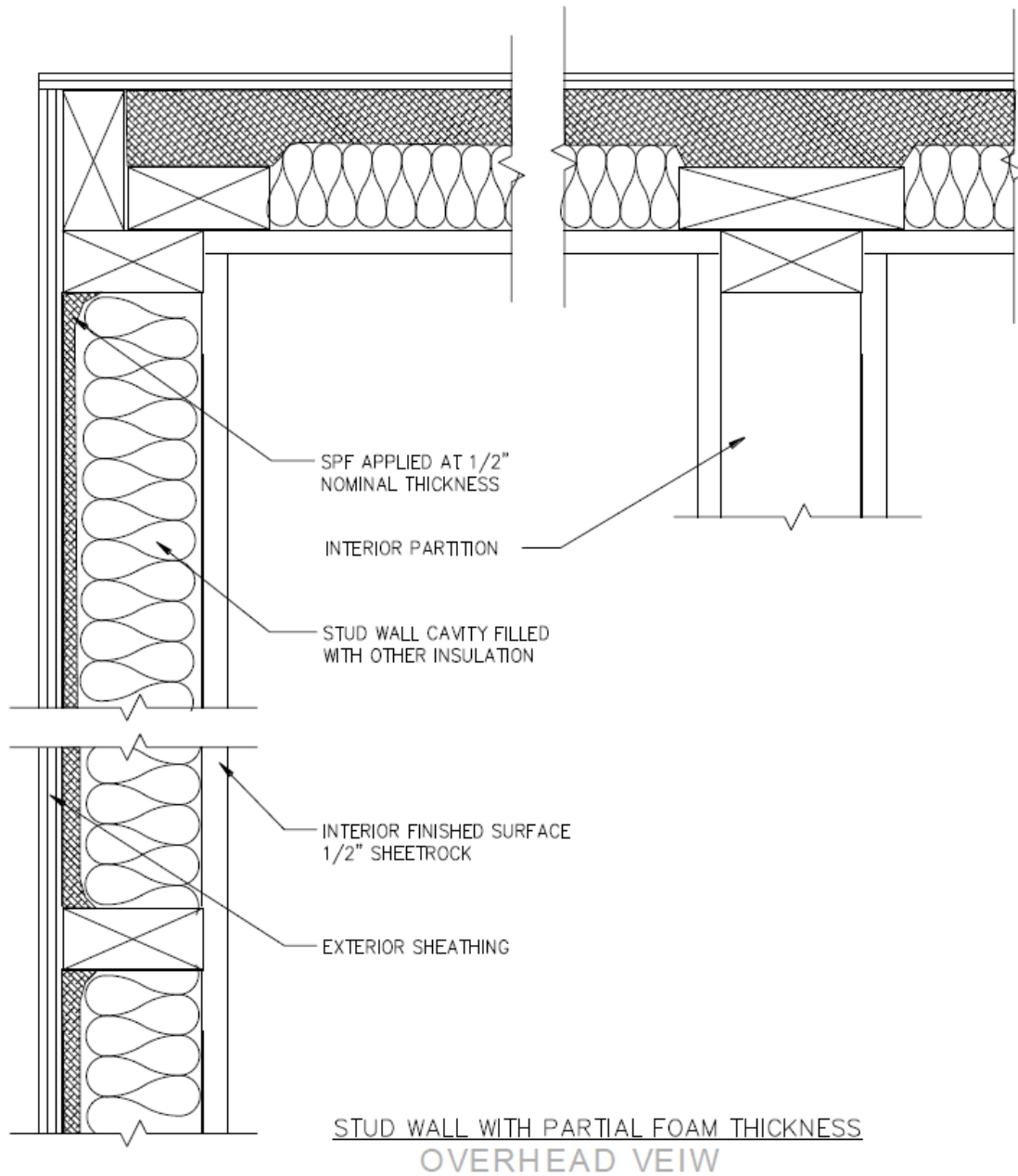


**DETAIL DRAWING 3: FRAME CONSTRUCTION, SIDE WALLS AND FOOTING**





**DETAIL DRAWING 4: FRAME CONSTRUCTION, CATHEDRAL CEILING**



## 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.

### TECHNICAL DOCUMENTS

SPFA-102	A Guide for Selection of Protective Coatings over Spray Polyurethane Foam Roofing Systems
SPFA-103	Spray Polyurethane Foam Insulation Systems for Metal Service Vessels Operating Between -30°F and 200°F
SPFA-104	Spray Polyurethane Foam Systems for New and Remedial Roofing
SPFA-107	Spray Polyurethane Foam Blisters – Their Causes, Types, Prevention and Repair
SPFA-110	Spray Polyurethane Foam Aggregate Systems for New and Remedial Roofing
SPFA-111	Spray Polyurethane Foam Systems for Cold Storage Facilities Operating Between -40°F and 50°F
SPFA-112	Spray Polyurethane Foam for Building Envelope Insulation and Air Seal
SPFA-113	Contractor/Applicator Handbook
SPFA-116	Spray-Applied Polyurethane Foam and Elastomeric Coating Systems (10 min. VHS Video)
SPFA-117	Spray-Applied Polyurethane Foam and Aggregate Roof Systems (10 min. VHS Video)
SPFA-118	Moisture Vapor Transmission
SPFA-119	Glossary of Terms Common to the Spray Polyurethane Foam Industry
SPFA-121	Spray Polyurethane Foam Estimating Reference Guide
SPFA-122	The Renewal of Spray Polyurethane Foam and Coating Roof Systems
SPFA-124	Wind Uplift Brochure
SPFA-125	P-Rating Brochure
SPFA-126	Thermal Barriers for the Spray Polyurethane Foam Industry
SPFA-127	Maintenance Manual for Spray Polyurethane Foam Roof Systems
SPFA-129	SPF Roofing “Seamless Roofing and Insulation” (8-page Color Brochure)
SPFA-130	SPF Roofing “Sustainable Roofing” (4-page Color Brochure)
SPFA-131	Whole Wall Rating/Label for Metal Stud Wall Systems with SPF; Steady State Thermal Analysis
SPFA-132	The SPF Roofing Systems (11.5 min. informative video offering a comprehensive pictorial review of this most extraordinary roofing concept)
SPFA-133	Maintenance Manual for Spray Polyurethane Foam Roof Systems (Spanish Version)
SPFA-134	Guideline for Insulating Metal Buildings with Spray Polyurethane Foam
AX-171	Course 101-R Chapter 1: Health, Safety and Environmental Aspects of Spray Polyurethane Foam and Coverings (Video and Text)

- The **SPFA website** is a direct communication to all member suppliers and contractors with web access. Up-to-date information is offered, and, as a member, you may link into the website: [www.sprayfoam.org](http://www.sprayfoam.org).
- 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.