



**Spray Polyurethane Foam
For Residential
Building Envelope Insulation
and
Air Seal**

RECOMMENDED
DESIGN CONSIDERATIONS
AND GUIDE SPECIFICATIONS

Spray Polyurethane Foam Alliance.
Copyright 1994

To order copies of this publication, call 800-523-6154 and request SPI Stock Number AY 112

MISSION STATEMENT

The mission of the Technical Committee is to provide a wide range of technical service to the 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.

TECHNICAL COMMITTEE:

Roger Morrison, Chairman
North Carolina Foam Industries

David Lewis
Coast Coatings Inc.

Larry Smiley
Poly-Tek

Mary Bodgen
Honeywell

Roger Lock
Mactec Engineering & Consulting

Robert Smith
Inista

Bob Braun
Dow Chemical

Jack Moore
West Roofing Systmes, Inc

John Stahl
.Preferred Solutions, Inc.

John Courier
Equipment & Coatings Technology

Bruce Schenke
BASF

Jay Zhang
Convenience Products

John Hatfield
Penta Engineering Group, Inc.

Irene Schwechler
Gaco Western, Inc.

AD HOC MEMBERS:

Dan Hensley
Hensley Coating Inc.

Chuck Skalski
Gaco Western, Inc.

Laverne Dalgleish
CUFCA

Tim Leonard
ERSystems

Scott Brown
BaySystems North America LLC

This brochure was developed to aid specifiers 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.

TABLE OF CONTENTS

DESIGN CONSIDERATIONS

General Considerations.....	4
Surface Preparation.....	4
Selection of Primer	4
Selection of Vapor Retarder	4
Selection of Spray Polyurethane Foam System	5
Selection of Thermal Barrier	5

RECOMMENDED GUIDE SPECIFICATION FOR BUILDING ENVELOPE INSULATION

PART 1 - GENERAL

1.01	Scope of Work	6
1.02	Related Work Specified Elsewhere	6
1.03	Quality Assurance.....	6
1.04	Submittals	6
1.05	Materials, Delivery and Storage	6
1.06	Environmental Conditions	7
1.07	Sequencing and Scheduling.....	7
1.08	Safety Requirements	7

PART 2 - PRODUCTS

2.01	Spray Polyurethane Foam	7
2.02	Related Products.....	8

PART 3 - EXECUTION

3.01	Application of Products	9
3.02	Substrate Consideration and Preparation	9
3.03	Primer Application	10
3.04	Spray Polyurethane Foam Application.....	10
3.05	Vapor Retarder Application.....	10
3.06	Thermal Barrier Application	10

ILLUSTRATIONS

Detail 1	Commercial Buildings, Perimeter Wall Insulation.....	11
Detail 2	Commercial Buildings, Underside of Roof Decks	12
Detail 3	Frame Construction, Side Walls and Footing.....	13
Detail 4	Frame Construction, Cathedral Ceiling	14

OTHER PROGRAMS AND SERVICES OFFERED BY SPFA

Professional Training	15
-----------------------------	----

TABLE OF CONTENTS

Technical Documents15
Association Newsletter15
SPFA Website.....15
Hot Line 800 Number15

DESIGN CONSIDERATIONS

GENERAL CONSIDERATIONS

The performance of a spray applied polyurethane foam 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, 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.

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

DETERMINING ISULATION 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 interior surface is lower than the dew point of the inside air. 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, which meets a specified return on investment from energy cost savings.

The best method to determine insulation thickness would be to determine the minimums for each of the situations described above and choosing the method, which 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 spray polyurethane foam, the surface must be cured, dry, 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, hand power broom, chemical solvents, sandblasting, manual scraping, etc.

SELECTION OF PRIMER

If a primer is required, it should be considered in accordance to 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, it's 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.

DESIGN CONSIDERATIONS

SELECTION OF THE SPRAY POLYURETHANE FOAM SYSTEM

The contractor, in the case of spray polyurethane foam applications, fabricates the product on site in accordance with manufacturer instructions.

A wide range of spray polyurethane foam 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 run on laboratory produced samples. The thickness of polyurethane foam sprayed, number of passes, temperature of substrate, ambient temperatures, etc., have a pronounced effect on all properties.

From a fire safety standpoint, spray polyurethane foam 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 spray polyurethane foam.
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 sprayed in place polyurethane foam for use as a building envelope insulation system. Your contractor, selected systems 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 foam building envelope insulation system, including accessory items, subject to the general provisions of the contract.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- | | |
|----------------------|---------------|
| A. Rough Carpentry | Section 06100 |
| B. Insulation, Other | Section 07200 |
| C. Thermal Barrier | Section 07220 |
| D. Vapor Retarder | Section 06100 |
| E. Mechanical | Division 15 |
| F. Electrical | Division 16 |

1.03 QUALITY ASSURANCE

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

1.04 SUBMITTALS

- A. Manufacturers to provide published data sheets or letter of certification that their products comply with the materials specified. This is to include primers (if required), spray polyurethane foam, thermal barriers, and vapor retarder (if required).
- B. Shop drawings on sheet metal, accessories, or other fabricated items, if required.
- C. Manufacturer's application or installation instructions.
- D. Contractor/applicator certification from spray polyurethane foam supplier and/or thermal barrier manufacturers and experience. SEE SECTION 1.03
- E. Approval and information guides for applicable local or national building codes.
- F. Safety and handling instructions for storage, handling and use of the materials to include Materials Safety Data Sheets (MSDS).
- G. Field Quality Control Procedures to be utilized by the contractor/applicator to insure proper preparation and installation of spray polyurethane foam and thermal barriers, detail work and follow-up inspection.

1.05 MATERIALS, DELIVERY AND STORAGE

- A. Materials shall be delivered in the manufacturer's original, tightly sealed containers or unopened package, all clearly labelled with the manufacturer's name, product identification, safety information and hatch 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.
- B. Containers shall be stored out of the weather and direct sun, where the temperatures are within the limits specified by the manufacturer.
- C. All materials shall be stored in compliance with local fire and safety requirements.

RECOMMENDED GUIDE SPECIFICATION FOR RESIDENTIAL BUILDING ENVELOPE INSULATION

1.06 ENVIRONMENTAL CONDITIONS

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

1.07 SEQUENCE AND SCHEDULING

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

1.08 SAFETY REQUIREMENTS

- A. API Bulletin AX-119, "*MDI-Based Polyurethane Foam Systems: Guidelines for Safe Handling and Disposal.*"
- B. Refer to appropriate Material Safety Data Sheets (MSDS) for additional safety information.
- C. 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.
- D. 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.
- E. For protection against exposure to higher levels of MDI (greater than 1ppm) or for entry into confined spaces, workers must wear either a self-contained breathing apparatus, with full facepiece, operated in a pressure-demand or other positive-pressure mode, or a combination respirator, including a Type C air-supplied respirator, with full facepiece, 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 "*MDI based Polyurethane Foam Systems: Guidelines for Safe Handling and Disposal*", Stock Number AX-119.
- F. Personal protective clothing should be worn. This includes the wearing of 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

- A. 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:

RECOMMENDED GUIDE SPECIFICATION FOR RESIDENTIAL BUILDING ENVELOPE INSULATION

INTERIOR POLYURETHANE FOAM: CLOSED CELL TYPE

<u>PROPERTIES</u>	<u>ASTM TEST</u>	<u>SI UNITS</u>	<u>US UNITS</u>
Density (sprayed-in-place)	D-1622	24-48kg/m ³	1.5-3.0 lbs/ft ³
Compressive Strength	D-1621	100 kPa (min.)	15 lb/in ² (Min.)
R-Value per inch	C-177, C-236, C-518	1.1 K·m ² /W average aged value	6.2 °F·ft ² ·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

<u>PROPERTIES</u>	<u>ASTM TEST</u>	<u>SI UNITS</u>	<u>US UNITS</u>
Density (sprayed-in-place)	D-1622	6-10 kg/m ³	0.4 - 0.6 lbs/ft ³
R-Value per inch	C-177, C-236, C-518	.60 K·m ² /W average aged value	3.4 °F·ft ² ·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 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 over material under actual fire conditions**

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

RECOMMENDED GUIDE SPECIFICATION FOR RESIDENTIAL BUILDING ENVELOPE INSULATION

2.02 RELATED PRODUCTS

A. ONE COMPONENT POLYURETHANE FOAM SEALANT, SPRAYED-IN-PLACE

<u>PROPERTIES</u>	<u>ASTM TEST</u>	<u>SI UNITS</u>	<u>US UNITS</u>
Density (sprayed-in-place)	D-1622	16-33 kg/m ³	1.0-2.0 lbs/ft ³
R-Value per inch	C-177, C-236, C-518	0.60 K·m ² /W average aged value	3.4 °F·ft ² ·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 inch bead. This standard is used solely to measure and describe 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.**

B. 15-Minute Rated Thermal Barriers.

1. Sprayed-in-place cementitious.
2. Sprayed-in-place fiber.
3. Minimum 1/2-inch gypsum board.
4. Other.

C. VAPOR RETARDER (if required)

1. Asphaltic.
2. Butyl.
3. Chloro-sulfonated polyethylene.
4. Polyethylene film.
5. Other.

D. 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 spray polyurethane foam.

1. Wood: chlorinated rubber, modified alkyds, others.
2. Steel: modified alkyds, epoxy, acrylics, others.
3. Galvanized: vinyl copolymer, “wash primer”, modified alkyds, others.
4. Concrete/masonry: chlorinated rubber, vinyl copolymer acrylic, asphaltic, other.

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, they must be sequenced so as to take into consideration substrate preparation, proper cure times, and inter-coat adhesion.

3.02 SUBSTRATE CONSIDERATION AND PREPARATION

Surface preparation for those substrates that are to be insulated and statements regarding the selection of materials

RECOMMENDED GUIDE SPECIFICATION FOR RESIDENTIAL BUILDING ENVELOPE INSULATION

related to the successful performance of the spray polyurethane foam insulation are outlined below.

A. WOOD

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

B. STEEL.

1. Primed: If the primed metal surface is free of loose scale, rust, 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.
2. 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.
3. Galvanized: When required, clean galvanized steel as recommended by the primer manufacturer.
4. Unpainted Steel: Clean as recommended by primer manufacturer in order to prepare the steel surface for the primer.

C. CONCRETE AND MASONRY.

Must be cured, and loose dirt and any other contaminants removed.

D. SHEATHING BOARD.

Most sheathing boards need not be primed prior to the application of sprayed-in-place polyurethane foam.

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 application of spray polyurethane foam or other products.

3.04 SPRAY POLYURETHANE FOAM APPLICATION

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

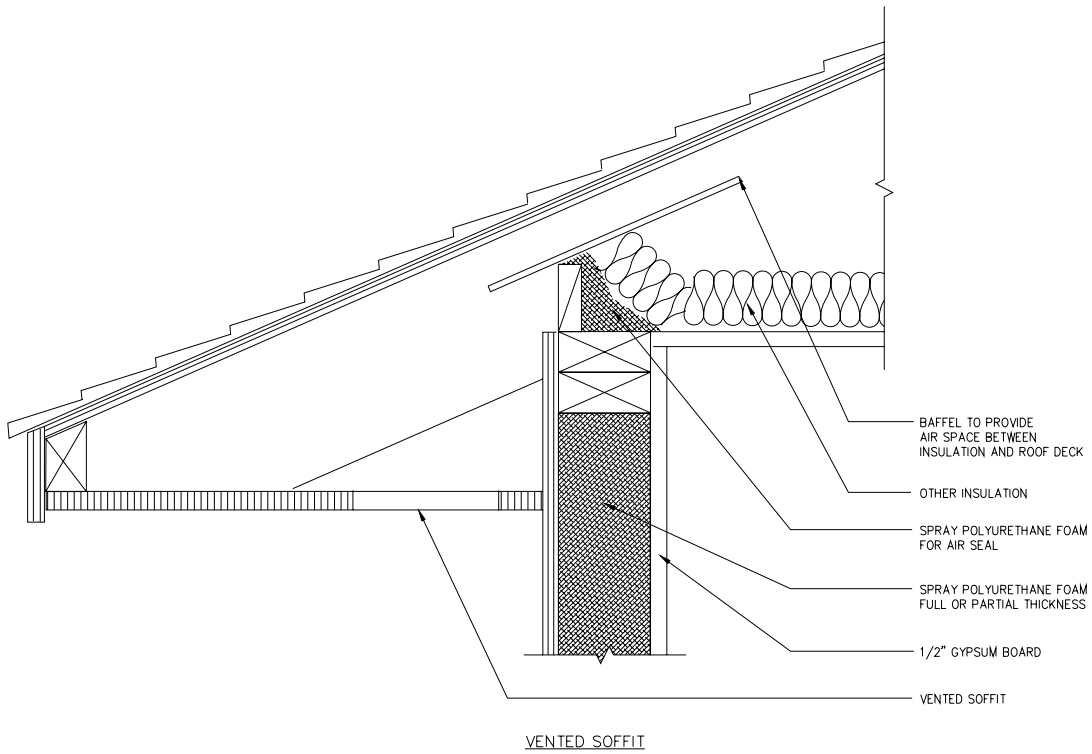
3.05 VAPOR RETARDER APPLICATION

- A. When required, a vapor retarder shall be applied to the substrate to be insulated or to the finished spray polyurethane foam insulation. The predominant direction of the vapor drive determines the location of the vapor retarder relative to the spray polyurethane foam. (Refer to Details 1 and 9 in the master pages file.)
- B. The vapor retarder shall be applied in accordance with manufacturer's specifications so as to achieve the desired perm rating per ASTM E-96, Method E.

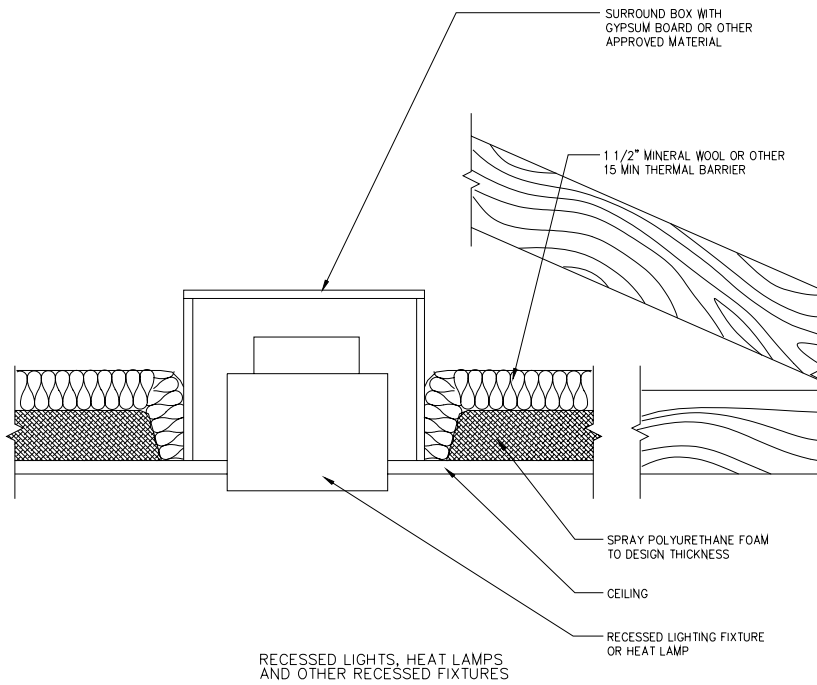
3.06 THERMAL BARRIER APPLICATION

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

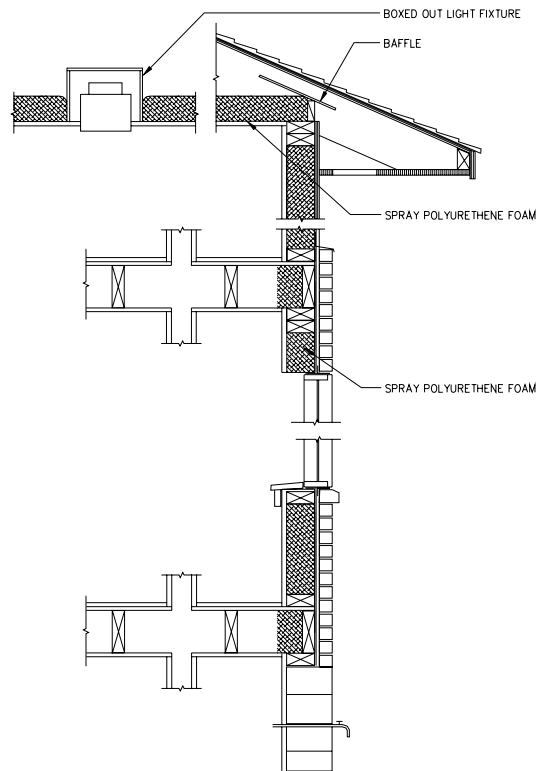
RECOMMENDED DETAILS FOR RESIDENTIAL BUILDING ENVELOPE INSULATION



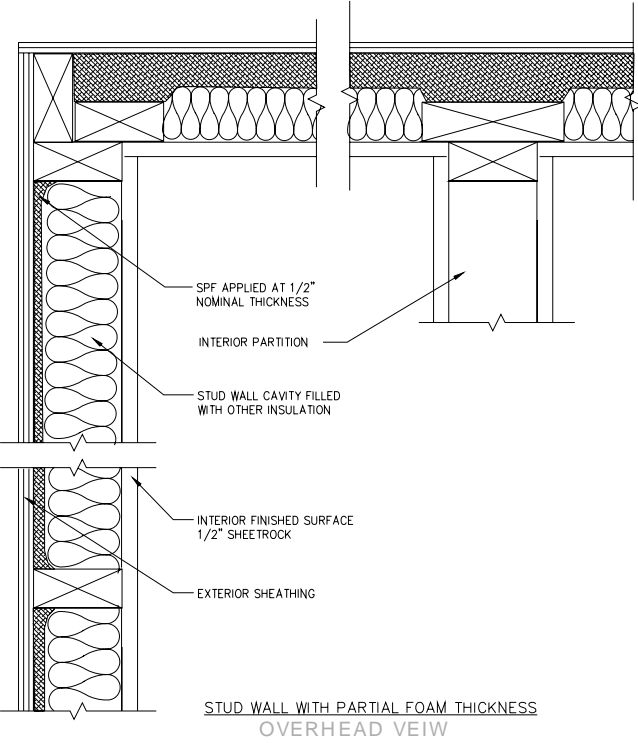
RECOMMENDED DETAILS FOR RESIDENTIAL BUILDING ENVELOPE INSULATION



RECOMMENDED DETAILS FOR RESIDENTIAL BUILDING ENVELOPE INSULATION



RECOMMENDED DETAILS FOR RESIDENTIAL BUILDING ENVELOPE INSULATION



OTHER PROGRAMS AND SERVICES OFFERED BY SPFA

Professional Training

The Accreditation Program offers individual 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** responsibility for the quality of their work through self-education.

Technical Documents

- AY-102 A Guide for Selection of Protective Coating Over Spray Polyurethane Foam Roofing Systems
- AY-103 Spray Polyurethane Foam Insulation Systems for Metal Service Vessels Operating Between -30°F and 200°F
- AY-104 Spray Polyurethane Foam Systems for New and Remedial Roofing
- AY-107 Spray Polyurethane Foam Blisters – Their Causes, Types, Prevention and Repair
- AY-110 Spray Polyurethane Foam Aggregate Systems for New and Remedial Roofing
- AY-111 Spray Polyurethane Foam Systems for Cold Storage Facilities Operating Between 040°F and 50°F
- AY-112 Spray Polyurethane Foam for Building Envelope Insulation and Air Seal
- AY-113 Contractor/Applicator Handbook
- AY-116 Spray Applied Polyurethane Foam and Elastomeric Coating Systems (10 min. VHS Video)
- AY-117 Spray Applied Polyurethane Foam and Aggregate Roof Systems (10 min. VHS Video)
- AY-118 Moisture Vapor Transmission
- AY-119 Glossary of Terms Common to the Spray Polyurethane Foam Industry
- AY-121 Spray Polyurethane Foam Estimating Reference Guide
- AY-122 The Renewal of Spray Polyurethane Foam and Coating Systems
- AY-124 Wind Uplift Brochure
- AY-125 P-Rating Brochure
- AY-126 Thermal Barriers for Spray Polyurethane Foam Industry
- AY-127 Maintenance Manual for Spray Polyurethane Foam Roof Systems
- AY-129 SPF Roofing “Seamless Roofing & Insulation” 8 Page Color Brochure
- AY-130 SPF Roofing “Sustainable Roofing” 4 Page Color Brochure
- AY-131 Whole Wall Rating/Label for Metal Stud Wall Systems with SPF; Steady State Thermal Analysis
- AY-132 The SPF Roofing Systems - 11.5 min. Informative Video offers a comprehensive pictorial review of this most extraordinary roofing concept.
- AY-133 Maintenance Manual for Spray Polyurethane Foam Roof Systems – **Spanish Version**
- AY-134 Guideline for Insulating Metal Buildings with Spray Polyurethane Foam
- AY-171 Course 101-R Chapter 1: Health, Safety and Environmental Aspects of Spray Polyurethane Foam and Covering. Video and Text

Association Newsletter published quarterly with a “Special Show Edition” for the annual conference offers articles, alerts, and technical information affecting the industry.

The SPFA Web Site 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 web site (www.sprayfoam.org)

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