PRODUCT

STEWARDSHIP

MANUAL

February 2018 version

145 Newborn Road • Rutledge, GA 30663
866.644.3626 • www.PROFOAM.com

PRODUCT STEWARDSHIP MANUAL

COMPANY NAME: _____ A/C# _____
OFFICE USE

ADDRESS: _____
STREET, P.O. BOX

_____
CITY, STATE, ZIP

_____
Email Address

1) Best Practices for Installation of Spray Polyurethane Foam
2) Ventilation Guidelines for Spray Polyurethane Foam Installation
3) Health and Safety Workbook
4) Model Respiratory Program in Compliance with OSHA's Program
5) Polyol Resin Blends Safety and Handling Guidelines
6) Working with MDI and Polymeric MDI: What You Should Know
7) Guidelines for the Responsible Disposal of Wastes and Containers from Polyurethane Processing
8) Fire Safety Guidance: Working with Polyurethane Foam During New Construction, Retrofit & Repair
9) SPFA: Thermal Barriers for the Spray Polyurethane Foam Industry
10) Applicator / Special Bulletins
    a) Health and Safety Bulletin
    b) Jobsite Safety and Ventilation
    c) Recommended Procedures for Applying NCFI SPF to Exterior Roof Surfaces
11) Estimating Guide for PROFOAM Spray-in-Place Polyurethane Foam Systems
12) Product SDS (GHS Compliant)
    PROFOAM-CC-2000W – PROSEAL
    PROFOAM-OC-500 – PROFILL
    PROFOAM-ROOF - PROZONE
13) Product Data Sheets
    PROFOAM-CC-2000W – PROSEAL
    PROFOAM-OC-500 – PROFILL
    PROFOAM-ROOF – PROZONE
14) Recommendations for Switching Between Closed-Cell and Open-Cell SPF
15) PROSEAL Spray-In-Place Closed Cell Insulation Specification
    a) Guidelines for New and Retrofit Applications
    b) Detailed drawings

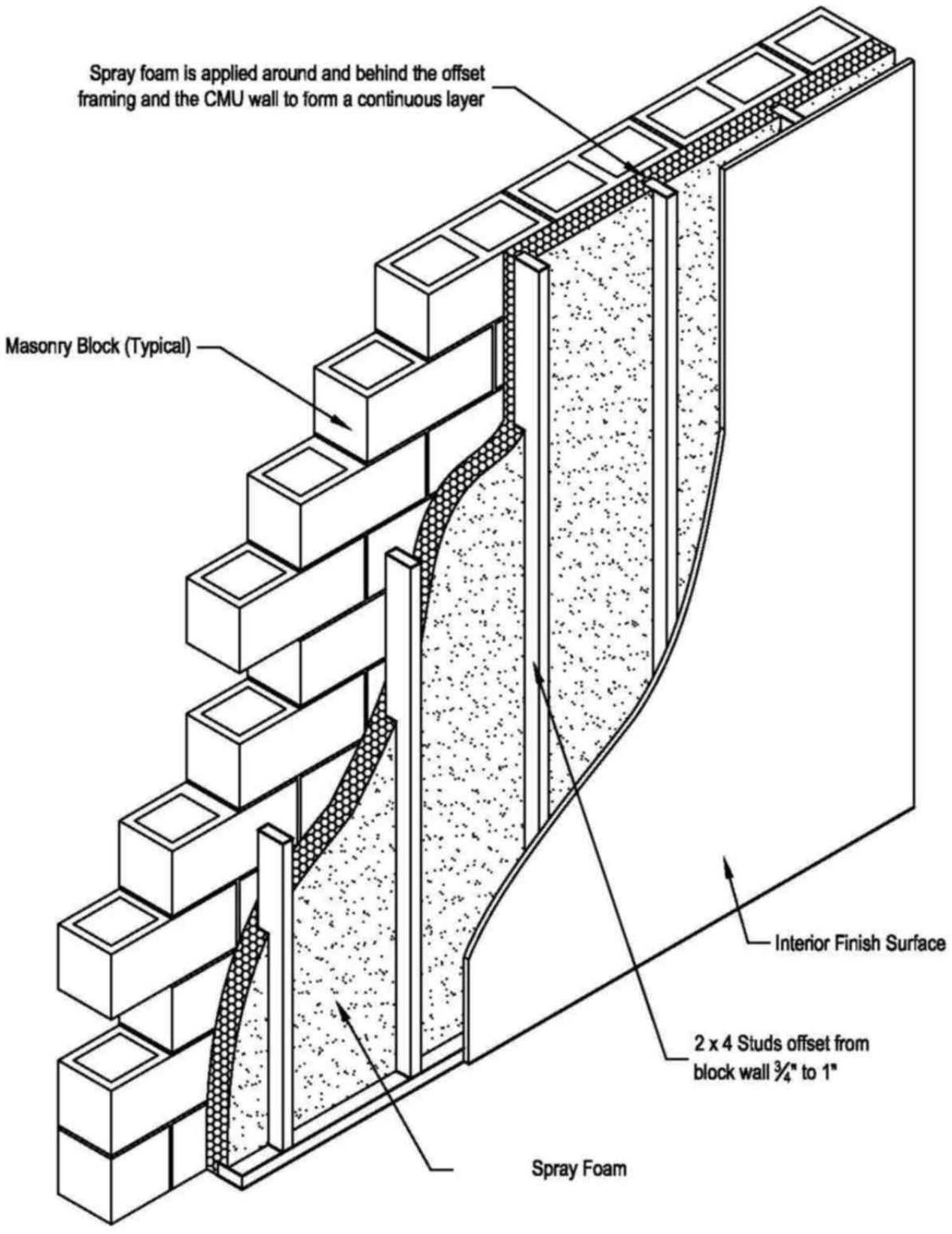
By signing this return sheet, I acknowledge receiving and completely reviewing the contents of this manual.
Manual is located on Profoam jump drive.

Signature: _____ **Date** _____

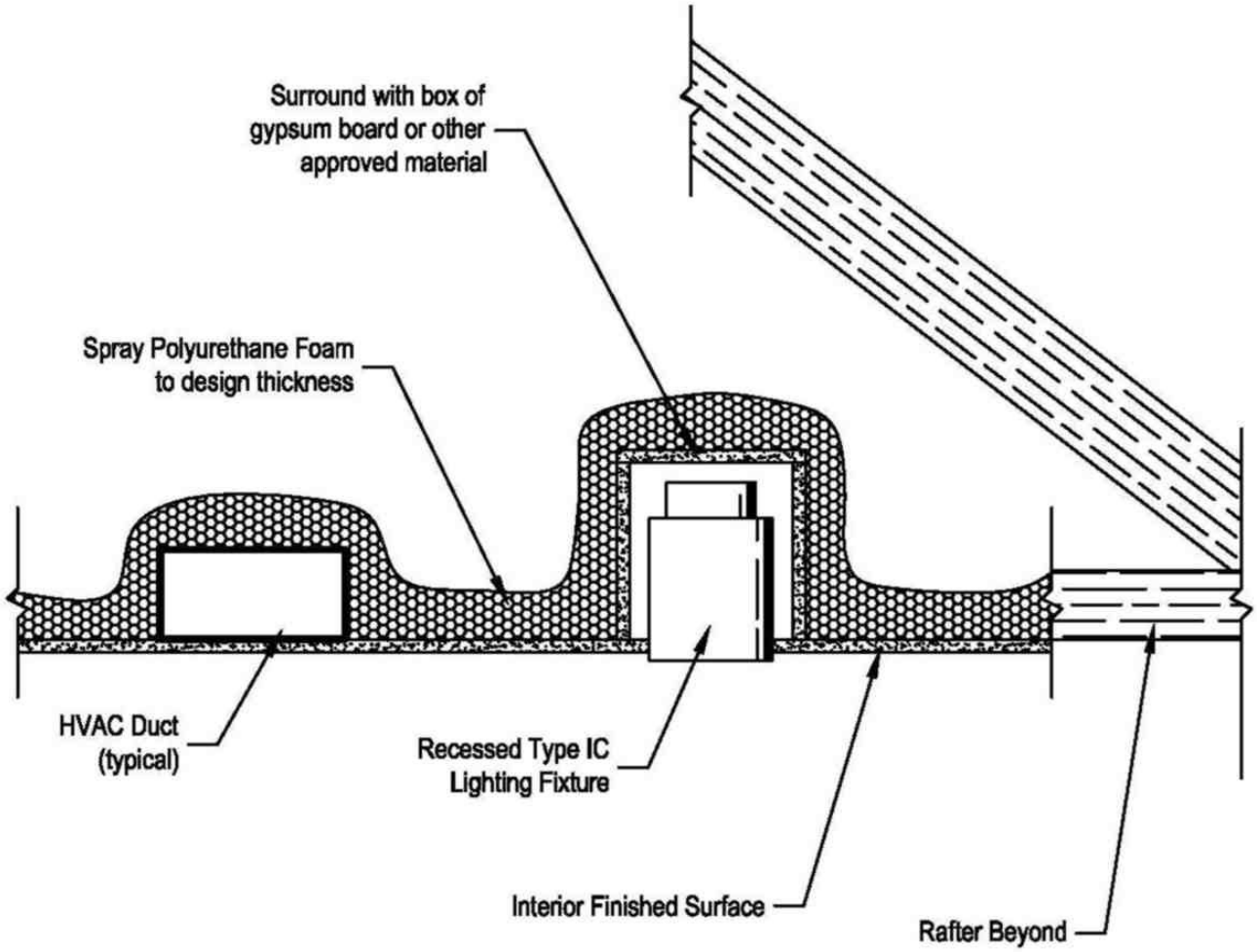
Print Name: _____

PLEASE CHECK YOUR MOST RECENT PRODUCT SHIPMENT FOR MOST RECENT DATA SHEETS & SDS

February 2018 version



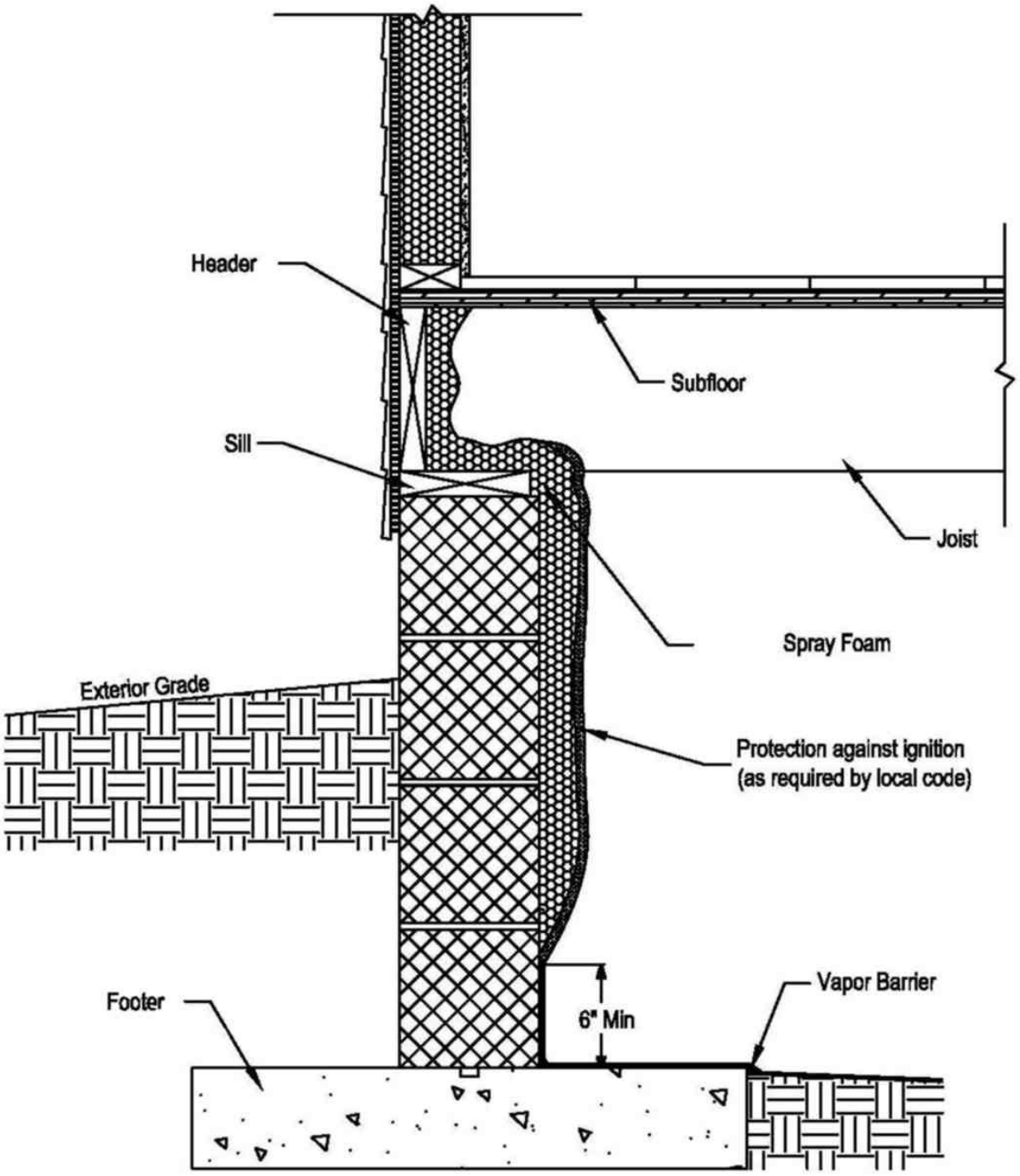
Profoam Basement Insulation	Finished Basement Wall with Offset Studs	Dwg. # 11
	These details are intended for use by design professional and users of Profoam systems to assist in developing project specific details. They should be modified where necessary to accommodate specific project conditions. Final details and specification must be approved by a licensed professional.	1-26-13



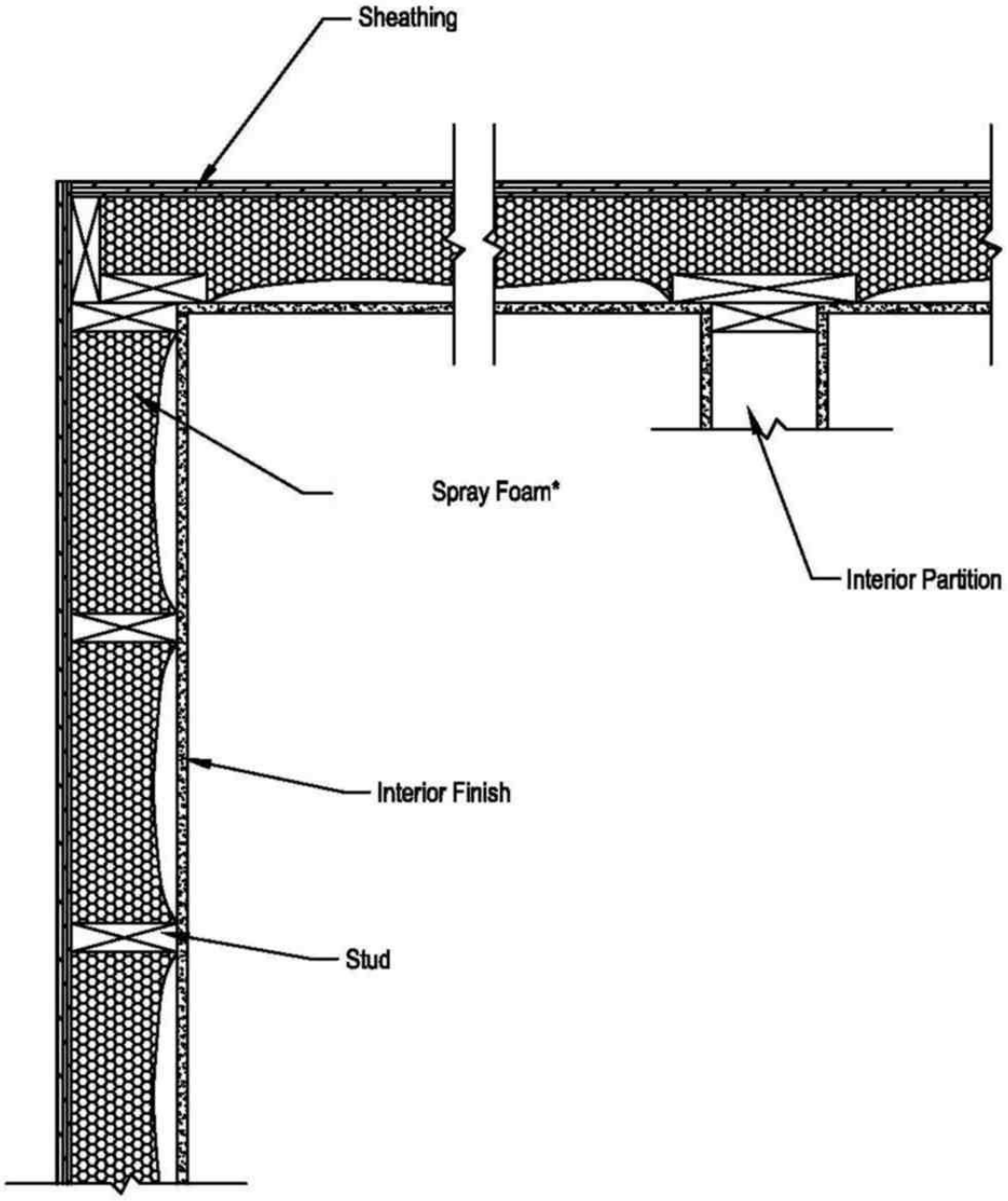
Recessed Lights and Fixtures

Avoid applying spray foam directly to recessed light fixtures or other fixtures that could generate heat. Typically, these fixtures are first "boxed in" with ½" gypsum board (a thermal barrier). The spray foam is terminated at the barrier box. See the typical detail at right.

Profoam Attic Insulation	HVAC Duct & Recessed Lighting Fixture	Dwg. # 10
	These details are intended for use by design professional and users of Profoam systems to assist in developing project specific details. They should be modified where necessary to accommodate specific project conditions. Final details and specification must be approved by a licensed professional.	1-19-13

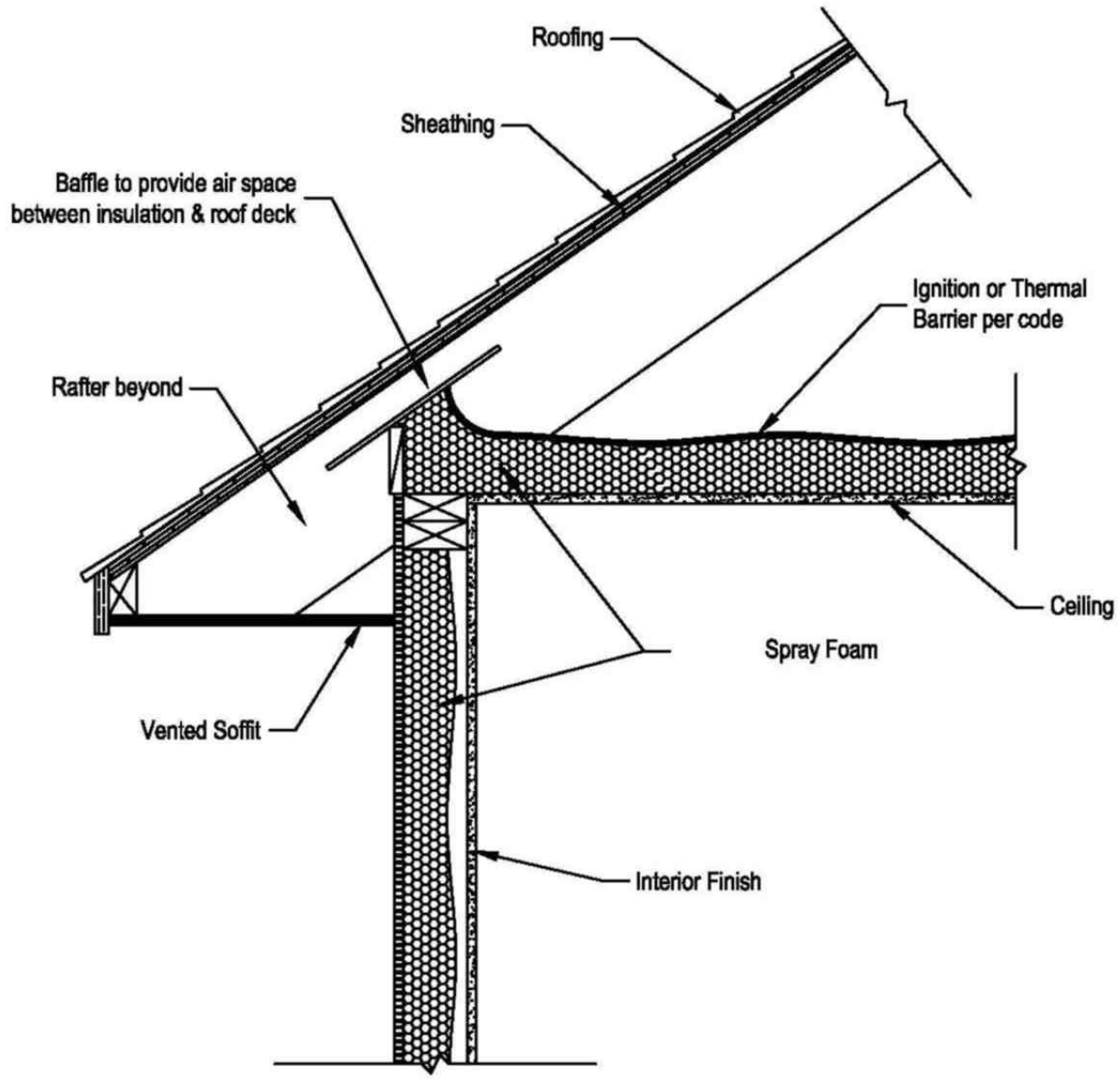


Profoam Crawl Space	Insulated Unvented Crawl Space Wall	Dwg. # 6
	These details are intended for use by design professional and users of Profoam systems to assist in developing project specific details. They should be modified where necessary to accommodate specific project conditions. Final details and specification must be approved by a licensed professional.	12-22-12

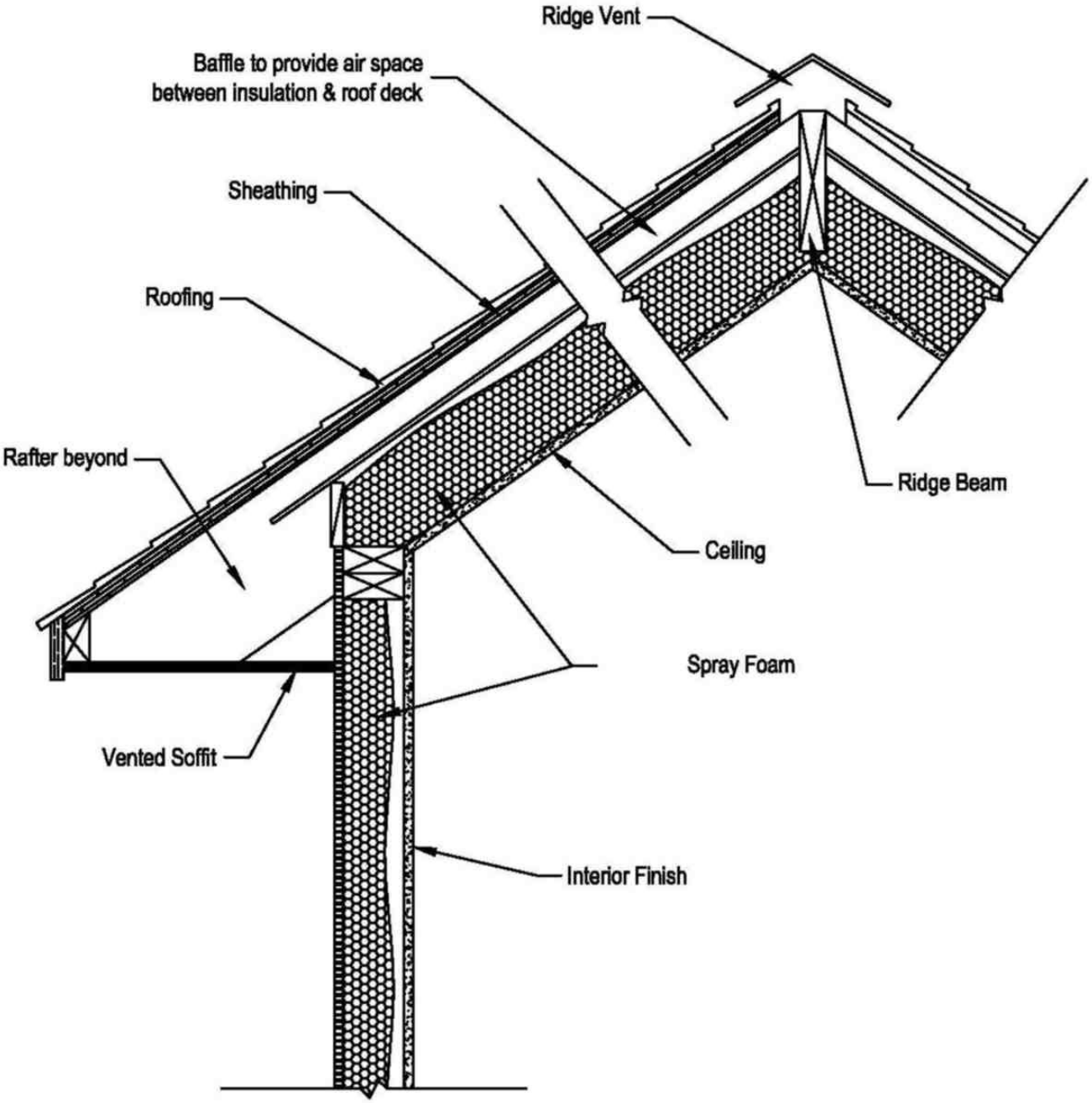


*Spray Foam thickness determined by design R-value

Profoam Wall Application	Stud Wall Insulation	Dwg. # 4
	These details are intended for use by design professional and users of Profoam systems to assist in developing project specific details. They should be modified where necessary to accommodate specific project conditions. Final details and specification must be approved by a licensed professional.	11-26-12

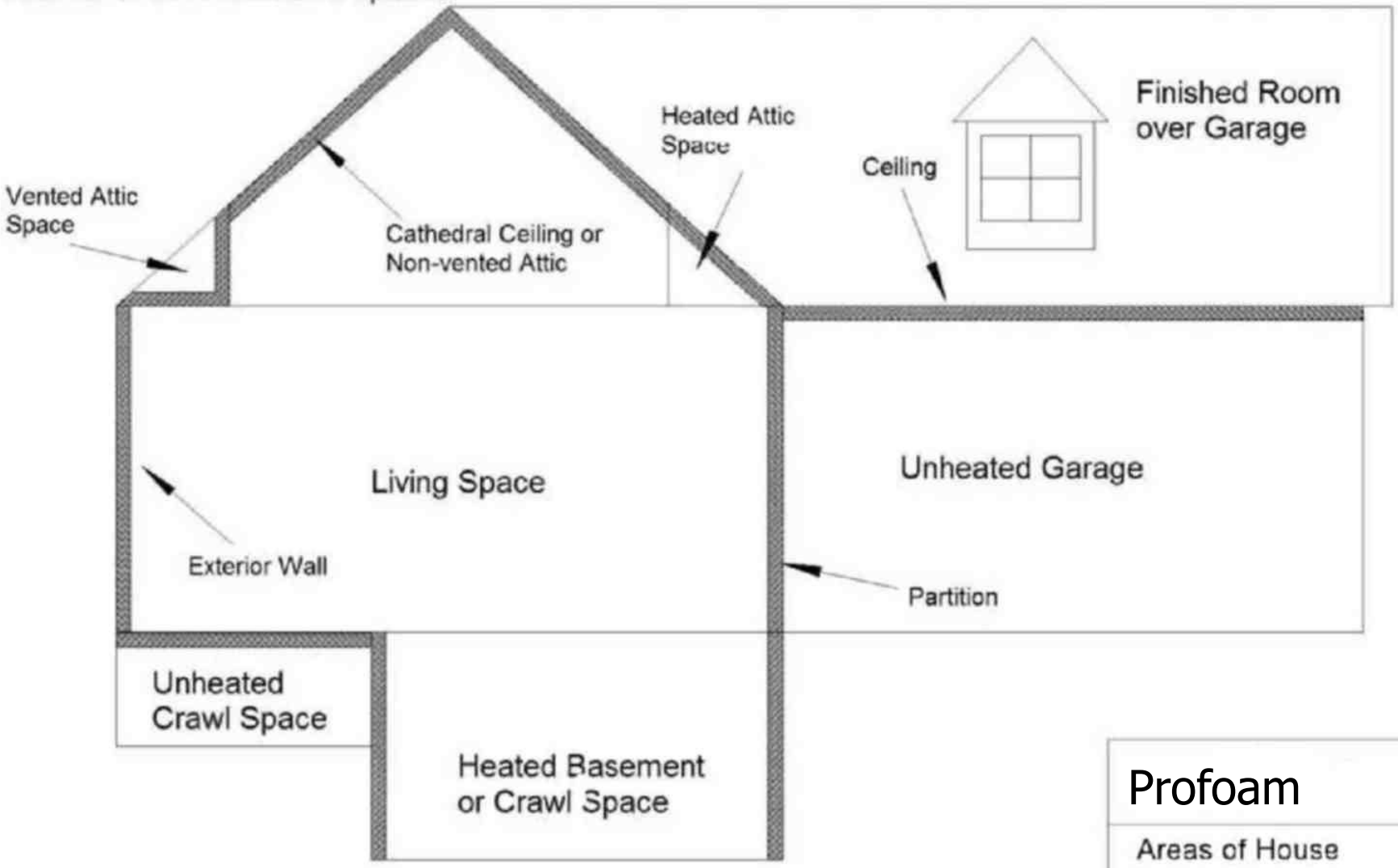


Profoam Soffit Application	Vented Soffit with Attic Floor Insulation	Dwg. # 3
	These details are intended for use by design professional and users of Profoam systems to assist in developing project specific details. They should be modified where necessary to accommodate specific project conditions. Final details and specification must be approved by a licensed professional.	11-26-12



Profoam Ceiling Application	Vented Cathedral Ceiling	Dwg. # 2
	These details are intended for use by design professional and users of Profoam systems to assist in developing project specific details. They should be modified where necessary to accommodate specific project conditions. Final details and specification must be approved by a licensed professional.	11-26-12

Note: Insulate walls, ceilings, and floors that separate interior areas from the exterior or from unheated spaces.



Profoam

Areas of House to Insulate

1 | | 102403

145 Newborn Road, Rutledge, GA 30663
706-557-1400

RECOMMENDATIONS FOR SWITCHING BETWEEN CLOSED AND OPEN CELL FOAMS

Special care must be taken to ensure that Profoam 500 series open cell (Resin) is not contaminated with closed cell Resin material. A few ounces of closed cell Resin can contaminate an entire drum of open cell Resin and render unacceptable foam upon processing. Cross contamination is avoidable with proper handling by the operator when processing open and closed cell foam through the same equipment. These guidelines should be strictly followed when processing open cell and closed cell systems through the same equipment:

1. Separate, dedicated drum pumps must be used for processing Profoam open and closed cell Resins. There is enough closed cell Resin clinging to a drum pump being taken from a drum of closed cell resin and inserted in a drum of open cell to contaminate the entire drum of material.

2. DO NOT bleed or recirculate material out of the spray lines into drums that are to be reused. When changing over either to or from closed cell and open cell Resin, spray out the material onto cardboard or plastic film under pressure to evacuate the supply hose, proportioner, and spray hoses to minimize wasted time and material. Remember to limit the thickness of passes to minimize exotherm. Cut open and examine the cell structure to make certain that good quality foam is being made before job is commenced "Changeover" product should be cut open to check for signs of heat build up and stored outside, away from vehicles, buildings or dumpsters for 24 hours before disposal.

Expect to waste some material when changing between systems. For each additional section of spray hose, more material will be required to completely purge the system.

PROZONE™
Polyurethane Spray Foam Roofing System

PROFOAM

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145 Newborn Road • Rutledge, GA 30663
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DATA SHEET

PF-ROOF

DESCRIPTION:

PF-ROOF is a two component, HFC-245fa blown, all PMDI based spray polyurethane foam system designed for use as a self-adhering, seamless, high insulating, spray applied rigid polyurethane foam roofing system. PF-ROOF will be available in multiple speeds for use in varying temperature conditions. PF-ROOF has been formulated to spray at 2.8 pcf depending on lift thickness, and may be used in applications with EnduraTech® coatings.

DISTINGUISHING CHARACTERISTICS:

- Excellent Cure and Overlap Adhesion
- High Yields
- High Closed Cell Content
- Good Dimensional Stability

TYPICAL PHYSICAL PROPERTIES:

Core Density	2.8 pcf
Compressive Strength	54 psi
Tensile Strength	60 psi
Moisture Vapor Transmission	0.92 perm·in
Closed Cell Content	>93%
R Value	6.3 @ 1" 9.8 @ 1.5" 13.4 @ 2" 27.4 @ 4"
Maximum Service Temperature	180°F
Flammability, ASTM E-84	2 inch Flame Spread <75

Note: The above values are average values obtained from a laboratory and should serve only as a guide.

APPROVALS:

For proper use of this PROFOAM roofing material refer to the PROFOAM Application Information and any of the following codes or guides:

- International Building Code (IBC) Section 2603
- API Bulletin AX 151: *Guidelines for the Responsible disposal of Waste and Containers from Polyurethane Processing*
- API Bulletin AX 205: *Working with MDI and Polymeric MDI: What You Should Know*
- API Bulletin AX 236: *Six Steps for Fire Safety During Construction*

PF-ROOF APPLICATION INFORMATION

EQUIPMENT AND COMPONENT RATIOS:

It is preferred that this system be processed with Graco Polyurethane Spray Equipment. B-PF-ROOF is connected to the resin pumps with A-PF-ROOF being connected to the isocyanate pumps. The proportioning pump ratio is 1 to 1. Dispensing temperature should be set at 130°F for automatically controlled machinery to give a good pattern. For additional assistance contact PROFOAM.

PROPER TEMPERATURE AND OPTIMUM FOAM REACTIVITY:

Below are the recommended air temperatures with the proper version of PF-ROOF for roof work.

50°F to 60°F	60°F & above	75°F & above
F (Fast)	R (Regular)	S (Slow)

Care in selecting the proper reactivity version of PF-ROOF is needed for the combination of adequate curing on the overlap edges and reasonable texture of the foam surface. For temperatures below 50°F contact PROFOAM for specific recommendations.

STORAGE AND USE OF CHEMICALS:

Keep temperature of chemicals above 70°F for several days before use. Cold chemicals can cause poor mixing, pump cavitation or other process problems due to higher viscosity at lower temperatures. Storage temperature should not exceed 90°F. Do not store in direct sunlight. Keep drums tightly closed when not in use. The B side drum must be kept under dry air or nitrogen pressure of 2-3 psi after opening and during use. The shelf life of PF-ROOF is six months.

SAFE HANDLING OF LIQUID COMPONENTS:

Use caution in removing bungs from the container. Loosen the small bung first and let any built up gas escape before completely removing. Avoid prolonged breathing of vapors. In case of chemical contact with eyes, flush with water for at least 15 minutes and get medical attention. For further information refer to “MDI-Based Polyurethane Foam Systems: Guidelines for Safe Handling and Disposal” publication AX-119 published by Alliance For The Polyurethanes Industry 1300 Wilson Blvd, Suite 800, Arlington, VA 22209.

PREPARATION OF SURFACE TO BE SPRAYED:

All surfaces to be sprayed should be clean, dry, and free of dew or frost. All metal to which foam is to be applied must be free of oil, grease, etc. Primers should be used where necessary. Please refer to PROFOAM's "Special Bulletin on Recommended Procedures for Applying PROFOAM Spray Foam Systems on Exterior Roof Surfaces."

PROPER TEMPERATURE FOR OPTIMUM ADHESION:

When the surface temperature will have a service temperature between 120°F and 180°F (#6 oil and resin tanks), the surface to be sprayed should be 120°F or above at the time of spraying. For temperatures over 180°F please contact PROFOAM for specific recommendations.

WEATHER PROTECTION OF FINISHED FOAM:

The finished surface of sprayed polyurethane foam should be protected from adverse effects of ultraviolet rays of direct sunlight, which can cause dusting and discoloration. Protective coatings designed for use with polyurethane foam are available.

VAPOR BARRIER PROTECTION ON COLD STORAGE WORK:

When sprayed polyurethane foam is used on exterior roofs of freezer or cooler buildings, the exterior coating on the foam should be a vapor barrier. This is because of severe vapor drive from hot roof to cold interior.

PREDICTION OF FIRE HAZARD IN CONSTRUCTION:

PF-ROOF is designed for use as an exterior roof membrane. PF-ROOF is not designed for interior use. PROFOAM has many other systems designed for interior use; however, where any foam is sprayed in building interiors its exposed surface should be protected from fire hazard by ½" Portland cement plaster or ½" gypsum board or equivalent per applicable building code.

FOR ANY QUESTIONS REGARDING THE ABOVE RECOMMENDATIONS CONTACT PROFOAM

SECTION 07211

FOAMED-IN-PLACE CLOSED CELL POLYURETHANE BUILDING INSULATION

Display hidden notes to specifier. (Don't know how? Click Here)

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Spray Polyurethane Foam (SPF).

1.2 RELATED SECTIONS

A. Section 04800 - Unit Masonry assemblies: Cavity wall assemblies.

B. Section 06100 - Rough Carpentry: Wood framing.

C. Section 07210 - Fiberglass Building Insulation: Supplemental blanket, batt and roll insulation.

D. Section 07260 - Vapor Retarders: Vapor retarder materials to adjacent insulation.

E. Section 07270 - Air Barriers: Air seal materials to adjacent insulation.

F. Section 07620 - Sheet Metal Flashing and Trim: Requirements for flashings.

G. Section 07900 - Joint Sealers: Rod and sealant at control and expansion joints.

H. Section 07810 - Fire and Smoke Protection: Insulation installed in conjunction with fire stopping or smoke containment systems.

I. Section 09200 - Plaster and Gypsum Board: Insulation installed in conjunction with interior wall and ceiling finish systems.

1.3 REFERENCES

A. ASTM C 518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.

B. ASTM E 84 - Standard Test Method for Surface Burning Characteristics of Building Materials.

C. ASTM E 96 - Standard Test Methods for Water Vapor Transmission of Materials.

D. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials

E. ASTM E 283 - Standard Test Method for Determining Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen

F. ASTM E 2178 – Standard Test Method for Air Permeance of Building Materials

G. ASTM D 1621 - Standard Test Method for Compressive Properties of Rigid Cellular Plastics.

H. ASTM D 1622 - Standard Test Method for Apparent Density of Rigid Cellular Plastics.

I. ASTM D 6226 - Standard Test Method for Open-Cell Content of Rigid Cellular Plastics.

J. ASTM E 331 Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference.

K. AATCC 127 - Water Resistance: Hydrostatic Pressure Test.

L. NFPA 285 – Standard Method of Test for the Evaluation of Flammability Characteristics of Exterior Non-Load-Bearing Wall Assemblies Containing Combustible Components Using the Intermediate-Scale, Multistory Test Apparatus

M. UL 263 - Fire Tests of Building Construction and Materials

1.4 PERFORMANCE REQUIREMENTS

A. Conform to applicable code for flame and smoke, concealment, and over coat requirements.

B. Fire Resistive Wall assembly (as required by Type construction) per NFPA 285, UL 263 or ASTM E119 as appropriate per the wall design.

1.5 SUBMITTALS

A. Submit under provisions of Section 01300.

B. Product Data: Manufacturer's data sheets on each product to be used, including:
1. Preparation instructions and recommendations.
2. Storage and handling requirements and recommendations.
3. Installation methods.
4. Appropriate Fire Resistance Assembly approval per Type Building Construction and Wall design. (NFPA 285, ASTM E119, UL 263)

C. Manufacturer's Certificates: Certify products meet or exceed specified requirements.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing polyurethane foam products and systems of this section with minimum ten years documented experience.

B. Installer Qualifications: Company specializing in performing Work of this section with minimum three years documented experience.
1. Installer must be an Profoam certified insulation contractor or have manufacturer's certification for the application.
2. Installer shall provide the equipment required by the manufacturer for proper installation including high pressure plural component proportioning pump, heated hoses of suitable length, spray gun, drum pumps or other material feeding system, and other ancillary equipment required for the Work.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Store products under cover in manufacturer's unopened and labeled packaging until ready for installation.

B. Storage temperatures should not exceed 90 degrees F (32.22 degrees C). Do not store in direct sunlight.

C. Keep the temperature of the chemicals above 70 degrees F (21.66 degrees C) for several days prior to use. Cold chemicals can cause pump cavitation and incorrect metering. Keep drums tightly closed when not in use and under dry gas pressure of 2-3 psi after they have been opened.

D. Store and dispose of solvent-based materials, and materials used with solvent-based materials, in accordance with requirements of local authorities having jurisdiction.

1.8 PRE-INSTALLATION MEETINGS

A. Convene pre-installation meeting a minimum of two weeks prior to commencing work of this section.

B. Attendance: Architect, Contractor, framer, wall finish applicator and SPF applicator.

C. Agenda: Review installation sequence, safety requirements and scheduling.

1.9 COORDINATION

A. Ensure that the installation of products of this section is coordinated with affected trades to prevent interruption of construction progress.

1.10 PROJECT CONDITIONS

A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.

B. Do not install spray polyurethane foam during precipitation or when precipitation is imminent. Do not install when the ambient temperature is less than 50 degrees F (10 degrees C) without specific authorization of the manufacturer. Do not install when the ambient humidity exceeds the manufacturer's limits.

C. Cordon off area for spray foam application and post warning signs as necessary to prevent entry to the area by other persons not wearing appropriate Personal Protective Equipment (PPE).

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Material: Proseal CC-2000W, from Profoam, Rutledge GA Toll Free Tel: 866-644-3626; Email: request info (ted@profoam.com); Web: www.profoam.com

B. Substitutions: Not permitted.

C. Requests for substitutions will be considered in accordance with provisions of Section 01600.

2.2 MATERIALS

A. Spray Polyurethane Foam (SPF): Profoam Proseal CC-2000W high-performance, closed cell spray polyurethane foam (SPF) insulation:
   1. Physical Properties:
      a. Core Density: 1.8 to 2.0 lbs/ft3 when tested in accordance with ASTM D 1622.
      b. Compressive Strength: 20 psi minimum when tested in accordance with ASTM D 1621.
      c. Water Vapor Transmission: Less then or equal to 1.8 perms at 1 inch thick when tested in accordance with ASTM E 96.
      d. Closed Cell content: Greater than 90 percent when tested in accordance with ASTM D 6226.
      e. Maximum Service Temperature: 180 degrees F (82 degrees C).
      f. Air Leakage: Infiltration/exfiltration, 0.004 CF/min/SF at 1.57 psf when tested in accordance with ASTM E 283 or ASTM 2178.
      g. Water Resistance: No Failure when tested in accordance with AATCC 127 and ASTM E 331.
      h. Flame Spread: Less than 25 when tested in accordance with ASTM E 84 for 4 inch (102 mm) thickness.
      i. Smoke Developed: Less than 450 when tested in accordance with ASTM E 84 at 4 inch (102 mm) thickness.
   2. R-Value: R-Value when tested in accordance with ASTM C 518.
      a. R-Value: 6.8. Average Thickness 1 inch (25 mm).
      b. R-Value: 13. Average Thickness 2 inches (51 mm).
      c. R-Value: 19. Average Thickness 3 inches (76 mm).
      d. R-Value: 22. Average Thickness 3-1/2 inches (89 mm).

2.3 MISCELLANEOUS MATERIALS

A. Joint Filler Foam: Hilti CF 124 Filler Foam or equivalent.

B. Sealant: Sikaflex 1a: Single component polyurethane or equivalent.

C. Foam Repair Kit: Handi-Foam two part kits from Fomo Products, or Touchn'Seal 2 component systems from Convenience Products, or other equivalent kits.

D. Moisture Detection Paper (MDP) Strips: MDP Strips manufactured by NCFI Polyurethanes, Mount Airy, NC.

E. Butyl Seam Tape by NCFI Polyurethanes, Mount Airy, NC

F. Blueskin TWF by Henry.

G. R-Guard FastFlash liquid-applied flashing membrane by Prosoco.

PART 3 EXECUTION

3.1 EXAMINATION

A. Do not begin installation until substrates have been properly prepared.

B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.2 PREPARATION

A. Clean surfaces thoroughly prior to installation.

B. Prepare surfaces using the methods recommended by the manufacturer for

achieving the best result for the substrate under the project conditions.

C. Proceed with spray polyurethane foam application only after substrate construction, substrate penetration work, and related electrical and plumbing work has been completed.

D. Remove sawdust and other debris from areas to be sprayed by blowing with compressed air or vacuuming with a shop vacuum.

E. All metal to which foam is to be applied must be free of oil, grease, rust, etc. Primers should be used where necessary. Test for proper spray foam adhesion or check with spray foam manufacturer for additional application guidance.

F. Verify that substrate is dry by checking surface for moisture with Moisture Detection Paper (MDP) strips.

G. At junctions of dissimilar materials tape over the junction seam with butyl seam tape or R-Guard FlashFlash or Blueskin TWF.

H. Fill voids between masonry and structural steel greater than 2 inches (51 mm), with mineral wool or a backer gypsum board cut to fit in the void, and then spray over the backer material.

I. For exterior sheathing boards attached to metal studs, at openings such as windows and doors, wrap the corners with seam tape prior to the spray foam application.

J. Mask off all areas not to receive spray foam with masking tape and plastic sheeting. Apply release agent to stud facing to facilitate removal of foam.

K. Review Profoam Product Stewardship Manual for ventilation and Personal Protective Equipment requirements and ensure unauthorized workers are not in the area during the spray foam application.

L. At the start of work, spray-apply SPF to an area of approximately 100 ft^2 (9.29 m^2) at the specified thickness. Proceed with work only after ensuring proper foam thickness and full adhesion to the substrate.

3.3 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. All surfaces to be sprayed with SPF must be free of all moisture and ice.

C. Do not apply SPF during inclement weather or when ambient temperature and humidity are outside the ranges prescribed by the manufacturer.

D. Apply the SPF to an average thickness indicated on the Drawings or specified in the schedule at the end of this section.

E. Apply SPF into stud wall cavities using a "picture framing" technique: apply a cant of foam between the exterior sheathing and the inner stud surface. Then spray apply the required thickness of foam against the sheathing. For a nominal thickness of 1/2 inch (12.5 mm), apply in one pass. For partial filling the stud wall cavity, apply the foam in 1-1/2 inches or less for each pass, using multiple passes to achieve the desired thickness.

F. Do not apply SPF to fill voids around doors and windows. Use non-expanding foam for those applications.

G. Apply SPF to fill voids around accessible service and equipment penetrations.

H. Apply SPF to seal voids at truss ends to prevent wind scouring of ceiling insulation.

I. Seal plumbing stacks, electrical wiring and other penetrations into attic to control air leakage.

J. Remove overspray from adjacent surfaces.

K. Where damage occurs which violates the spray foam's air seal and moisture seal, repair as needed using the specified spray polyurethane material or the specified foam repair kit material.

3.4 ACCESSORY APPLICATION

A. Joint Filler Foam and Caulk: Use joint filler foam and/or caulk to seal around windows, doors, chimneys, electrical raceways, sill plates, multiple studs, etc. Note that the expansion of joint filler foam in a confined space can tighten window frames and door jambs to the point that they will not open or close properly. Care must be used in these areas to avoid distortion of these members.

B. Supplemental Insulation: If the stud wall cavity is not completely filled with spray polyurethane foam, supplemental insulation may be installed to achieve desired R-values. Supplemental insulation is specified in Section 07210.

C. Vapor retarders are specified in Section 07260.

D. Air barriers are specified in Section 07270.

3.5 PROTECTION

A. Protect installed products until completion of project.

B. Touch-up, repair or replace damaged products before Substantial Completion.

3.6 CLEANING

A. Remove excess SPF.

B. Replace defective SPF.

C. Clean soiled surfaces with cleaning solution.

3.7 SCHEDULES

A. For the following locations, apply the average cured SPF thickness indicated.:
   1. Interior surface of exterior basement walls: _____ inches.
   2. Garage ceiling between joists and over air ducts: _____ inches.
   3. Cathedral ceilings: _____ inches.
   4. Unvented roof spaces: _____ inches.
   5. Voids in overhangs such as bay windows and cantilevered floors: _____ inches.
   6. Exterior above grade walls: _____ inches.
   7. Floor headers: _____ inches.

END OF SECTION

PROSEAL™ Closed-Cell Polyurethane

TECHNICAL DATA SHEET

PROFOAM
145 Newborn Road • Rutledge, GA 30663
866.644.3626 • www.PROFOAM.com

PF-CC-2000W

DESCRIPTION:

PF-CC-2000W is a two component, self-adhering, seamless, closed cell, spray applied polyurethane foam system. This PROFOAM system has been formulated with highly insulating HFC-245fa as the blowing agent and contains an anti-microbial ingredient to inhibit the growth of molds. The PF-CC-2000W insulation system is suitable for application on the exterior or interior side of Class I, II, III, IV, & V buildings as well as other insulation applications. It complies with AC 377 and ASTM C1029. ProSEAL is certified for application in ABAA projects.

DISTINGUISHING CHARACTERISTICS:

- High R-Value
- Zero ODP
- Moisture Vapor Retarder - Class II @ 1.3”
- High Yields
- High Closed Cell Content
- Air Barrier, ABAA Certified @1”
- Good Dimensional Stability
- Meets ASTM E-84, FS ≤25, SD ≤450 @ 4”
- FEMA Flood Resistance - Class 5
- Water Resistive Barrier (AC71) @1”
- Passed NFPA 285
- Approved in multiple UL Fire Resistive Assemblies

For proper use of this PROFOAM insulating material refer to the PROFOAM Application Information and any of the following codes or guides:

- 2012 International Building Code Chapter 26
- 2012 International Residential Code Section R316 and R806
- ICC-ES Evaluation Report 1615
- API Fire Safety Guidelines for Use of Rigid Polyurethane and Polyisocyanurate Foam Insulation in Building Construction (AX230)

TYPICAL PHYSICAL PROPERTIES*[1]:

Free Rise Core Density*[2] ASTM D 1622	2.0 pcf
Compressive Strength ASTM D 1621	27 psi
Moisture Vapor Transmission - ASTM E 96	1.3 perm·in
Closed Cell Content ASTM D 6226	>90%
R-value @ 1” - ASTM C 518	6.8
Air Permeance @1” Infiltration ASTM E 283 & 2178 Exfiltration	0.000 cfm/ft^2 @ 1.57 psf 0.000 cfm/ft^2 @ 1.57 psf
Bacterial & Fungal Growth ASTM G 21 & E 1428	Negligible*[3]
STC - ASTM E 90 OITC - ASTM E 90	31*[4] 24*[4]
Flammability ASTM E-84 @ 4 inches	Flame Spread ≤25 Smoke Dev ≤450
Potential Heat—NFPA 259	1989 Btu/ft^2/in
Max Service Temperature	180ºF

*[1]The above values are average values obtained from laboratory experiments and should serve only as guide lines.

*[2]Free rise core density should not be confused with overall density. Overall densities are always higher than free rise core densities and take into account skin formation, thickness of application, environmental conditions, etc.

*[3]See page 4 for details.

*[4]As measured in a 2” x 4” studwall assembly.

PF-CC-2000W Insulation Fact Sheet

R-Values*			
Thickness (inches)	R-Value (°F·hr·ft^2 / Btu)	Moisture Vapor Perm	Installation Limitations Limits based on NFPA 286
1”	6.8	1.3	Maximum Thickness in walls is 8” Maximum Thickness in Roof Decks or Ceilings is 12”
2”	13	0.65	
3”	19	0.43	
3.5”	22	0.37	
8”	51	0.16	
12”	77	0.1	
*Note: As with all insulating materials, the R-value will vary with age and use conditions.			

Property	**Test Method**	**Test Condition**	**Result**
Air Barrier Certification	ASTM E 283	Infiltration @ 1.57 psf	1 inch thickness 0.0000 cfm/ft^2
	ASTM E 2178	Exfiltration @ 1.57 psf	1 inch thickness 0.0000 cfm/ft^2
Water Resistance	AATCC 127-1998	@ 56.5 ft	1 inch thickness No failure
	ASTM E 331	6.24 psf	1 inch thickness No Penetration

Florida Product Approval #9975 for increased wind resistance when installed to the roof deck between the rafters/truss top chords.

Plywood decks rated to 190 psf OSB decks rated to 200 psf.

PF-CC-2000W provides the Secondary Water Resistive Barrier

PF-CC-2000W closed cell spray foam system is an approved Air Barrier material per the Air Barrier Association of America (ABAA) and is certified per AC 71 as a Water Resistive Material when installed on the exterior side of walls. Exterior wall coverings of this spray foam system may be restricted. Contact PROFOAM for the current approvals.

Read This Before You Buy

What you should know about R values

The chart shows R value of this insulation. R value means resistance to heat flow. The higher the R value, the greater the insulating power. Compare insulation R values before you buy. There are other factors to consider. The amount of insulation you need depends mainly on the climate you live in. Also, your fuel savings from insulation will depend upon the climate, the type and size of your house, the amount of insulation already in your house, and your fuel use patterns and family size. If you buy too much insulation, it will cost you more than what you’ll save on fuel. To get the marked R-value, it is essential that this insulation be installed properly.

PF-CC-2000W Application Information

STORAGE AND USE OF CHEMICALS:
The PF-CC-2000W chemicals should be between 65°F and 80°F for proper processing through the spray equipment. Chemicals shipped during winter or summer months may need extra time in moderate temperature storage to stabilize back in the proper application range. Cold chemicals can cause poor mixing, pump cavitation or other process problems due to higher viscosity at lower temperatures. Storing chemicals above 90°F should be avoided as much as possible. Excessively warm chemicals should be cooled prior to opening the drums. Do not store in direct sunlight. Keep drums tightly closed when not in use and under dry air or nitrogen pressure of 2-3 psi after they have been opened. The shelf life of PF-CC-2000W is six months

SAFE HANDLING OF LIQUID COMPONENTS:
Use caution in removing bungs from the container. Loosen the small bung first to allow any built-up vapor pressure to stabilize before completely removing. **R component will froth at elevated temperatures.** Avoid prolonged breathing of vapors. In case of chemical contact with eyes, flush with water for at least 15 minutes and get medical attention. For further information refer to www.spraypolyurethane.org, Resources box, "Health and Safety Product Stewardship Workbook for High-Pressure Application of SPF".

APPLICATION GUIDELINES:
PF-CC-2000W is suitable for application to most construction materials including wood, masonry, concrete, and metal. Application can be to the exterior or interior side of wall surfaces. PF-CC-2000W can be applied to surfaces that will be in contact with soil and intermittent contact with water, such as below grade exterior foundation and basement walls or under concrete slab floors. To ensure proper adhesion, all substrate surfaces should be dry, clean of dust or flaking surface rust, ice or frost. All metal surfaces must be free of oil, grease, etc. Uncoated metals may require a primer coat.

No flammable chemicals, such as wasp and hornet sprays, should be sprayed in the area of the foam application 24 hours before the application. No such chemical can be sprayed after the foam application until the foam has cooled to room temperature.

APPLICATION AROUND PLASTIC PIPES:
Based on a series of extensive studies, the PF-CC-2000W system can be applied in contact with PVC, CPVC, ABS, PP-R and PEX plastic pipes. The pipes must not be pressurized during the foam application. Each foam pass shall not exceed 2" thick, and a 10 minute cooling/curing time must be allowed between each subsequent pass. The total foam thickness is limited to that thickness permitted in that area of the building assembly.

APPLICATION AROUND ELECTRICAL WIRES:
Based on PROFOAM testing, the PF-CC-2000W system can be applied in contact with electrical wires. Spray foam applicators must spray the foam in such a manner that the expanding foam does not stretch and distort the wires. Light gauge wires which will be encapsulated in the foam layer should have the foam installed behind the wires and allowed to cool prior to applying a top layer to cover the wire. Use a shallow lift of 3/4" of foam to cover the wire. Wait the required 10 minutes between passes when adding more foam thickness to achieve the desired R-value.

APPLICATION PASS THICKNESS:
Spraying foam will generate heat. Foam which is applied too thick in single passes can build temperatures which will degrade cell structure and not produce foam with optimum properties. In the most extreme case, PF-CC-2000W could reach dangerously high temperatures inside the finished foam which could lead to splitting, charring, or even spontaneous combustion. The maximum pass thickness for PF-CC-2000W is 2 inches, and a 10 minute cooling time is required before adding additional foam passes. Multiple layers can be applied to reach the desired R-value.

VENTILATION OF SPRAY AREA:
Spraying foam will generate a mist and fumes with a distinct odor. For interior applications the building area must be vented with fresh air to dissipate the odor. The amount of air flow and time for venting will vary based on each situation. A closed attic area may require fans to force air into and out of the space. An open building that does not have the doors and windows installed may have sufficient air flow to vent the odor fairly quickly. Reentry time for closed-in areas being vented with fans is typically about 24 hours. Other workers should remain out of the immediate area during this venting time period.

PF-CC-2000W Application Information

EQUIPMENT AND COMPONENT RATIOS:
It is preferred that this system be processed with Graco Polyurethane Spray Equipment. R-PF-CC-2000W is connected to the resin pumps with A-PF-CC-2000W being connected to the isocyanate pumps. The proportioning pump ratio is 1 to 1 by volume. **Graco preheater and hose temperature should be set at 130°F to give a good pattern. Due to equipment variations, the application temperature settings may be adjusted to achieve a good spray pattern**. For higher-pressure settings above 1,000 psi, temperature settings can be slightly lower.

OPTIMUM ADHESION TEMPERATURE OF SURFACE TO BE SPRAYED:
The surface should be between 10°F and 120°F. In this range the warmer the surface, the better the adhesion. PROFOAM has three grades of PF-CC-2000W foam for this application range: G-series designed for temperatures no lower than 50°F, M-series designed for temperatures as low as 20°F and the X-series, when processing must be conducted down to temperatures as low as 10°F. For best results, when surfaces to be sprayed are cooler than 60°F, a flash coat should be applied with the second coat following as soon as the original coat is no longer tacky to the touch.

BACTERIA AND FUNGUS RESISTANCE:
PF-CC-2000W is formulated with an anti-microbial ingredient to inhibit the growth of bacteria and fungus (mold). The anti-microbial properties do not protect occupants of spaces insulated with PF-CC-2000W from potential deleterious effects of molds, mold spores, or disease organisms that may be present in the environment.

VAPOR BARRIER PROTECTION ON COLD STORAGE APPLICATIONS:
When PF-CC-2000W is used in structures subject to continuous cold temperatures, such as coolers and freezers, a Class I moisture vapor barrier (0.1 perm or less) is normally required on the "warm" side of the foam insulation. Contact PROFOAM for specific recommendations.

WEATHER PROTECTION OF FINISHED FOAM ON EXTERIOR APPLICATIONS:
The finished surface of sprayed polyurethane foam should be protected from adverse effects of ultraviolet rays of direct sunlight which can cause dusting and discoloration. Protective coatings designed for use with polyurethane foam are available. On exterior applications where a masonry veneer or mechanically attached covering is to be installed, the PF-CC-2000W foam surface may be exposed to UV light up to 6 months.

CODE-COMPLIANT FIRE RESISTANCE:
Where foam is sprayed over large areas of building interiors, building codes require the installation of an approved thermal barrier between the foam plastic insulation and the interior of the building. ½" gypsum board or other tested and approved material may be installed as a thermal barrier. Refer to specific building codes for details. When Fire Resistive Wall Assemblies are required, contact PROFOAM for specific alternate approvals for PF-CC-2000W.

OTHER APPLICATION AND SAFETY CONSIDERATIONS:
Before PF-CC-2000W is to be applied, there are many safety and application situations to consider. All spray foam applicators must evaluate the job prior to beginning the spray foam application. It is impossible to anticipate every issue and provide explicit guidance in this product data sheet. If there is a question regarding some aspect of the planned application, consult with PROFOAM for more guidance. The PROFOAM Product Stewardship Manual contains additional information and should be reviewed often enough by all spray foam applicators to remain familiar with the contents. The American Chemistry Council (ACC), the Center for Polyurethanes Industry (CPI) and the Spray Polyurethane Foam Alliance (SPFA) also publish information regarding the safe handling and application of spray foam chemicals.
If there are any questions regarding the application of the PF-CC-2000W system, contact an PROFOAM representative.

PROSEAL™ Closed-Cell Polyurethane

TECHNICAL DATA SHEET

PROFOAM
145 Newborn Road • Rutledge, GA 30663
866.644.3626 • www.PROFOAM.com

PF-CC-2000

DESCRIPTION:

PF-CC-2000 is a two component, self-adhering, seamless, closed cell, spray applied polyurethane foam system. This PROFOAM system has been formulated with highly insulating HFC-245fa as the blowing agent and contains an anti-microbial ingredient to inhibit the growth of molds. The PF-CC-2000 insulation system is suitable for application on the exterior or interior side of Class I, II, III, IV, & V buildings as well as other insulation applications. It complies with AC 377 and ASTM C1029.

DISTINGUISHING CHARACTERISTICS:

- High R-Value
- Zero ODP
- Moisture Vapor Retarder - Class II @ 1.3"
- High Yields
- High Closed Cell Content
- Good Dimensional Stability
- Meets ASTM E-84, FS ≤25, SD ≤450 @ 4"
- FEMA Flood Resistance - Class 5
- Water Resistive Barrier (AC71) @1"
- Passed NFPA 285
-

For proper use of this PROFOAM insulating material refer to the PROFOAM Application Information and any of the following codes or guides:

- 2012 International Building Code Chapter 26
- 2012 International Residential Code Section R316 and R806
- API Fire Safety Guidelines for Use of Rigid Polyurethane and Polyisocyanurate Foam Insulation in Building Construction (AX230)

TYPICAL PHYSICAL PROPERTIES*[1]:

Free Rise Core Density*[2] ASTM D 1622	2.0 pcf	
Compressive Strength ASTM D 1621	27 psi	
Moisture Vapor Transmission - ASTM E 96	1.3 perm·in	
Closed Cell Content ASTM D 6226	>90%	
R-value @ 1" - ASTM C 518	6.8	
Air Permeance @1" Infiltration ASTM E 283 & 2178 Exfiltration	0.000 cfm/ft² @ 1.57 psf 0.000 cfm/ft² @ 1.57 psf	
Bacterial & Fungal Growth ASTM G 21 & E 1428	Negligible*[3]	
STC - ASTM E 90 OITC - ASTM E 90	31*[4] 24*[4]	
Flammability ASTM E-84 @ 4 inches	Flame Spread Smoke Dev	≤25 ≤450
Potential Heat—NFPA 259	1989 Btu/ft²/in	
Max Service Temperature	180ºF	

*[1]The above values are average values obtained from laboratory experiments and should serve only as guide lines.

*[2]Free rise core density should not be confused with overall density. Overall densities are always higher than free rise core densities and take into account skin formation, thickness of application, environmental conditions, etc.

*[3]See page 4 for details.

*[4]As measured in a 2" x 4" studwall assembly.

PF-CC-2000 Insulation Fact Sheet

R-Values*			
Thickness (inches)	R-Value (°F·hr·ft² / Btu)	Moisture Vapor Perm	Installation Limitations Limits based on NFPA 286
1"	6.8	1.3	Maximum Thickness in walls is 8"
2"	13	0.65	
3"	19	0.43	
3.5"	22	0.37	
8"	51	0.16	Maximum Thickness in Roof Decks or Ceilings is 12"
12"	77	0.1	
*Note: As with all insulating materials, the R-value will vary with age and use conditions.			

Property	**Test Method**	**Test Condition**	**Result**
Air Barrier	ASTM E 283	Infiltration @ 1.57 psf	1 inch thickness 0.0000 cfm/ft²
	ASTM E 2178	Exfiltration @ 1.57 psf	1 inch thickness 0.0000 cfm/ft²
Water Resistance	AATCC 127-1998	@ 56.5 ft	1 inch thickness No failure
	ASTM E 331	6.24 psf	1 inch thickness No Penetration

Tested for increased wind resistance when installed to the roof deck between the rafters/ truss top chords.

Plywood decks rated to 190 psf OSB decks rated to 200 psf.

PF-CC-2000 provides the Secondary Water Resistive Barrier

PF-CC-2000 closed cell spray foam system is tested per AC 71 as a Water Resistive Material when installed on the exterior side of walls. Exterior wall coverings of this spray foam system may be restricted. Contact PROFOAM for the current approvals.

Read This Before You Buy

What you should know about R values

The chart shows R value of this insulation. R value means resistance to heat flow. The higher the R value, the greater the insulating power. Compare insulation R values before you buy. There are other factors to consider. The amount of insulation you need depends mainly on the climate you live in. Also, your fuel savings from insulation will depend upon the climate, the type and size of your house, the amount of insulation already in your house, and your fuel use patterns and family size. If you buy too much insulation, it will cost you more than what you'll save on fuel. To get the marked R-value, it is essential that this insulation be installed properly.

PF-CC-2000 Application Information

STORAGE AND USE OF CHEMICALS:
The PF-CC-2000 chemicals should be between 65°F and 80°F for proper processing through the spray equipment. Chemicals shipped during winter or summer months may need extra time in moderate temperature storage to stabilize back in the proper application range. Cold chemicals can cause poor mixing, pump cavitation or other process problems due to higher viscosity at lower temperatures. Storing chemicals above 90°F should be avoided as much as possible. Excessively warm chemicals should be cooled prior to opening the drums. Do not store in direct sunlight. Keep drums tightly closed when not in use and under dry air or nitrogen pressure of 2-3 psi after they have been opened. The shelf life of PF-CC-2000 is six months

SAFE HANDLING OF LIQUID COMPONENTS:
Use caution in removing bungs from the container. Loosen the small bung first to allow any built-up vapor pressure to stabilize before completely removing. **B component will froth at elevated temperatures.** Avoid prolonged breathing of vapors. In case of chemical contact with eyes, flush with water for at least 15 minutes and get medical attention. For further information refer to www.spraypolyurethane.org, Resources box, "Health and Safety Product Stewardship Workbook for High-Pressure Application of SPF".

APPLICATION GUIDELINES:
PF-CC-2000 is suitable for application to most construction materials including wood, masonry, concrete, and metal. Application can be to the exterior or interior side of wall surfaces. PF-CC-2000 can be applied to surfaces that will be in contact with soil and intermittent contact with water, such as below grade exterior foundation and basement walls or under concrete slab floors. To ensure proper adhesion, all substrate surfaces should be dry, clean of dust or flaking surface rust, ice or frost. All metal surfaces must be free of oil, grease, etc. Uncoated metals may require a primer coat.

No flammable chemicals, such as wasp and hornet sprays, should be sprayed in the area of the foam application 24 hours before the application. No such chemical can be sprayed after the foam application until the foam has cooled to room temperature.

APPLICATION AROUND PLASTIC PIPES:
Based on a series of extensive studies, the PF-CC-2000 system can be applied in contact with PVC, CPVC, ABS, PP-R and PEX plastic pipes. The pipes must not be pressurized during the foam application. Each foam pass shall not exceed 2" thick, and a 10 minute cooling/curing time must be allowed between each subsequent pass. The total foam thickness is limited to that thickness permitted in that area of the building assembly.

APPLICATION AROUND ELECTRICAL WIRES:
Based on product testing, the PF-CC-2000 system can be applied in contact with electrical wires. Spray foam applicators must spray the foam in such a manner that the expanding foam does not stretch and distort the wires. Light gauge wires which will be encapsulated in the foam layer should have the foam installed behind the wires and allowed to cool prior to applying a top layer to cover the wire. Use a shallow lift of 3/4" of foam to cover the wire. Wait the required 10 minutes between passes when adding more foam thickness to achieve the desired R-value.

APPLICATION PASS THICKNESS:
Spraying foam will generate heat. Foam which is applied too thick in single passes can build temperatures which will degrade cell structure and not produce foam with optimum properties. In the most extreme case, PF-CC-2000 could reach dangerously high temperatures inside the finished foam which could lead to splitting, charring, or even spontaneous combustion. The maximum pass thickness for PF-CC-2000 is 2 inches, and a 10 minute cooling time is required before adding additional foam passes. Multiple layers can be applied to reach the desired R-value.

VENTILATION OF SPRAY AREA:
Spraying foam will generate a mist and fumes with a distinct odor. For interior applications the building area must be vented with fresh air to dissipate the odor. The amount of air flow and time for venting will vary based on each situation. A closed attic area may require fans to force air into and out of the space. An open building that does not have the doors and windows installed may have sufficient air flow to vent the odor fairly quickly. Reentry time for closed-in areas being vented with fans is typically about 24 hours. Other workers should remain out of the immediate area during this venting time period.

PF-CC-2000 Application Information

EQUIPMENT AND COMPONENT RATIOS:
It is preferred that this system be processed with Graco , PMC or equal plural component proportioner. B-PF-CC-2000 is connected to the resin pumps with A-PF-CC-2000 being connected to the isocyanate pumps. The proportioning pump ratio is 1 to 1 by volume. **Preheater and hose temperature should be set at 130°F to give a good pattern. Due to equipment variations, the application temperature settings may be adjusted to achieve a good spray pattern**. For higher-pressure settings above 1,000 psi, temperature settings can be slightly lower.

OPTIMUM ADHESION TEMPERATURE OF SURFACE TO BE SPRAYED:
The surface should be between 10°F and 120°F. In this range the warmer the surface, the better the adhesion. PROFOAM has three grades of PF-CC-2000 foam for this application range: S-series designed for temperatures no lower than 50°F, M-series designed for temperatures as low as 20°F, and the W-series, when processing must be conducted down to temperatures as low as 10°F. . For best results, when surfaces to be sprayed are cooler than 60°F, a flash coat should be applied with the second coat following as soon as the original coat is no longer tacky to the touch.

BACTERIA AND FUNGUS RESISTANCE:
PF-CC-2000 is formulated with an anti-microbial ingredient to inhibit the growth of bacteria and fungus (mold). The anti-microbial properties do not protect occupants of spaces insulated with PF-CC-2000 from potential deleterious effects of molds, mold spores, or disease organisms that may be present in the environment.

VAPOR BARRIER PROTECTION ON COLD STORAGE APPLICATIONS:
When PF-CC-2000 is used in structures subject to continuous cold temperatures, such as coolers and freezers, a Class I moisture vapor barrier (0.1 perm or less) is normally required on the "warm" side of the foam insulation. Contact PROFOAM for specific recommendations.

WEATHER PROTECTION OF FINISHED FOAM ON EXTERIOR APPLICATIONS:
The finished surface of sprayed polyurethane foam should be protected from adverse effects of ultraviolet rays of direct sunlight which can cause dusting and discoloration. Protective coatings designed for use with polyurethane foam are available. On exterior applications where a masonry veneer or mechanically attached covering is to be installed, the PF-CC-2000 foam surface may be exposed to UV light up to 6 months.

CODE-COMPLIANT FIRE RESISTANCE:
Where foam is sprayed over large areas of building interiors, building codes require the installation of an approved thermal barrier between the foam plastic insulation and the interior of the building. ½" gypsum board or other tested and approved material may be installed as a thermal barrier. Refer to specific building codes for details. When Fire Resistive Wall Assemblies are required, contact PROFOAM for specific alternate approvals for PF-CC-2000.

OTHER APPLICATION AND SAFETY CONSIDERATIONS:
Before PF-CC-2000 is to be applied, there are many safety and application situations to consider. All spray foam applicators must evaluate the job prior to beginning the spray foam application. It is impossible to anticipate every issue and provide explicit guidance in this product data sheet. If there is a question regarding some aspect of the planned application, consult with PROFOAM for more guidance. The PROFOAM Product Stewardship Manual contains additional information and should be reviewed often enough by all spray foam applicators to remain familiar with the contents. The American Chemistry Council (ACC), the Center for Polyurethanes Industry (CPI) and the Spray Polyurethane Foam Alliance (SPFA) also publish information regarding the safe handling and application of spray foam chemicals.
If there are any questions regarding the application of the PF-CC-2000 system, contact an PROFOAM representative.

145 Newborn Road • Rutledge, GA 30663
866.644.3626 • www.PROFOAM.com

Section 1: Identification

Product Identifier

Trade Name: B-PF-ROOF
Chemical Name: Polyurethane Resin
Recommended Use: Component for the manufacture of Polyurethanes
Restrictions on Use:

Chemical Manufacturer Information

Name: PROFOAM
Address: 145 Newborn Road, Rutledge, GA 3066
Website: www.PROFOAM.com
Phone: (866) 644-3426
Fax: (706) 557-1405
Emergency Phone: CHEMTREC: 800-424-9300

Section 2: Hazard Identification

Classification of the substance or mixture:

GHS Classification:	
• Skin irritation, Category 3	• Eye irritation, Category 2

GHS Labeling:

Warning

Hazard Statements:	
• May cause skin irritation	• May cause eye irritation
• May cause respiratory irritation	•

Precautionary Statements:	
• Do not breathe fume/gas/mist/vapors/spray	• Wear protective gloves/eye protection/face protection
• IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.	• IF INHALED: Remove victim to fresh air and keep at rest in a position comfortable for breathing
• IF ON SKIN: Wash with plenty of soap and water	

Other Hazards:

Section 3: Composition

Hazardous Components

Type of product: Mixture

CAS#	Weight %	Name
460-73-1	<9	1,1,1,3,3-Pentafluoropropane ($CF_3CH_2CHF_2$ or HFC-245fa)
Proprietary	<4	Tertiary amine catalysts
156-60-5	<3	Trans-1,2-Dichloroethylene

Section 4: First Aid Measures

Inhalation:	Move to fresh air if symptoms develop. If breathing is difficult, give oxygen and call physician**.**
Eye Contact:	Flush with water for at least 15 minutes. See a physician if irritation develops.
Ingestion:	Do not induce vomiting unless told to do so by a medical professional.
Most Important symptoms and effects, acute and delayed:	May cause skin or eye irritation upon contact. Avoid breathing vapors. The dense vapors can displace and reduce breathing air in confined or unventilated spaces causing asphyxiation. Overexposure may cause tremors, confusion, irritation, and may result in cardiac sensitization.
Indication of immediate medical attention and special treatment, if applicable:	N/A
Skin Contact:	Wash with soap and water at first opportunity.

Section 5: Fire-Fighting Measures

Suitable extinguishing media:	Water, dry chemicals, CO_2
Unsuitable extinguishing media:	None
Special hazards arising from the chemical:	Overheated containers may rupture due to pressure produced by $CF_3CH_2CHF_2$. $CF_3CH_2CHF_2$ burns to form acids and noxious gases.
Precautions for fire-fighters:	A self-contained breathing apparatus should be worn to protect against toxic and irritating vapors.

Section 6: Accidental Release Measures

Personal precautions, protective equipment, and emergency procedures:	Clear area. Ensure adequate ventilation. Wear suitable personal protective clothing and equipment.
Environmental precautions:	Do not discharge into drains/surface waters/groundwater
Methods and material for containment and cleanup:	Absorb with sawdust, etc., and shovel into container. Waste material should be disposed of under conditions which meet federal, state, and local environmental regulations.

Section 7: Handling and Storage

Precautions for safe handling:	Store between 65°F and 85°F out of sunlight. Relieve pressure slowly when opening container. Under no circumstances should empty drums be burned or cut open with an electric or gas torch.
Conditions for safe storage, including any incompatibilities:	Keep tightly sealed.

Section 8: Exposure Controls and PPE

Exposure Limits

Component:	**Type**	**Value**
1,1,1,3,3-Pentafluoropropane ($CF_3CH_2CHF_2$ or HFC-245fa)	TWA	300ppm recommended
Tertiary Amine Catalysts[1]	TWA	None established
Trans-1,2-Dichloroethylene	TWA	200ppm

[1]Not listed as a carcinogen (NTA, IARC, OSHA)

Exposure Controls

Respiratory Protection:	The specific respirator selected must be based on contamination levels of this material found in the workplace and the working limits of the respirator. A supplied air, full-face mask, positive pressure or continuous flow respirator or a supplied air hood is required when airborne concentrations are unknown or exceed threshold limit values. A positive pressure, self-contained breathing apparatus can be used in emergencies or other unusual situations. Full-face air purifying respirators equipped with organic vapor cartridges can be used in certain situations***, see OSHA standard 29CFR 1910.134***. All equipment must be NIOSH approved and maintained.
Hand, eye, skin, body protection:	Wear goggles or chemical safety glasses and chemically resistant rubber or plastic gloves. Avoid eye and skin contact. Eye wash system and showers should be available.

Section 9: Physical and Chemical Properties

Basic chemical and physical properties

Appearance:	Liquid	**Flammability:**	N/A
Color:	Amber	**Upper/lower flammability or explosive limits:**	N/A
Odor:	Ethereal odor	**Vapor pressure:**	N/A
Odor threshold:	N/A	**Vapor density:**	N/A
pH:	N/A	**Relative density:**	1.2g/mL
Melting pt/freezing pt:	<32°F	**Solubility(ies):**	Slightly soluble in water
Boiling pt/boiling range:	60°F	**Partition coefficient (n-octanol/water):**	N/A
Flash point:	>200°F	**Auto-ignition temperature:**	>500°F
Evaporation rate:	Slower than ether	**Decomposition temperature:**	>500°*F*

Section 10: Stability and Reactivity

Chemical stability:	Stable
Possibility of hazardous reactions:	N/A
Conditions to avoid:	Temperatures over 85°F
Incompatible materials:	Isocyanates and other chemicals that react with hydroxyl groups.
Hazardous decomposition products:	When burned, CO, CO_2, NO_x aliphatic fragments, halogens, halogen acids, and possibly carbonyl halides.

Section 11: Toxicological Information

Acute toxicity:	May cause skin irritation
Chronic toxicity:	Not available
Likely routes of exposure:	Skin
Symptoms related to physical, chemical and toxicological characteristics:	May cause skin irritation
Delayed and immediate effects and chronic effects from short and long-term exposure:	May cause skin irritation; avoid contact with eyes
Numerical toxicity measures:	Not available

Section 12: Ecological Information

Ecotoxicity:	Not a marine pollutant
Persistance and degradability:	No known significant effects
Bioaccumulative potential:	Does not bioaccumulate
Mobility in soil:	

Section 13: Disposal

Waste disposal:	B component drums can be sent to drum reconditioners or disposed of as ordinary industrial waste in compliance with pertinent regulations

Section 14: Transport

UN number:	Not regulated
UN Proper shipping name:	Not regulated
Transport Hazard class(es):	Not regulated
Packing group, if applicable:	Not regulated
Marine pollutant (YorN):	N
Special precautions:	None

Section 15: Regulatory

Relevant safety, health, and environmental regulations

Inventory Status:	All components TSCA listed
US Regulations:	No ingredients listed
US Superfund Amendments and Reauthorization Act (SARA) Title III Section 313 information:	No ingredients listed

Section 16: Other

SDS Preparation Date:	03/15/2015
Revision Date:	01/09/2018

IMPORTANT NOTICES
This notification is a part of the Safety Data Sheet document and must not be detached. Any copying and redistribution of the Safety Data Sheet shall include copying of this notice and attaching the copy to the redistributed Material Safety Data Sheet copies.

This information is furnished without warranty, expressed, or implied, except that it is accurate to the best knowledge of PROFOAM. The data on this sheet relates only to the specific material designated herein. PROFOAM assumes no legal responsibility for use or reliance upon these data.

Section 1: Identification

Product Identifier

Trade Name: A2-000
Chemical Name: Diphenylmethane Diisocyanate (MDI)
Recommended Use: Component for production of polyurethanes
Restrictions on Use:

Chemical Manufacturer Information

Name: PROFOAM
Address: 145 Newborn Road, Rutledge, GA 30663
Website: www.PROFOAM.com
Phone: (866) 644-3626
Fax: (704) 557-1405
Emergency Phone: CHEMTREC: 800-424-9300

Section 2: Hazard Identification

Classification of the substance or mixture

GHS Classification:	
• Skin irritation, Category 2	• Acute toxicity, Inhalative, Category 4
• Sensitization of respiratory airways, Category 1	• Eye irritation, Category 2
• Carcinogenicity, Category 2	• Sensitization of the skin, Category 1
• Specific target organ toxicity (repeated exposure), Category 2	• Specific target organ toxicity (single exposure), Category 3

GHS Labeling:

Danger

Hazard Statements:	
• May cause an allergic skin reaction	• Causes skin irritation
• Harmful if inhaled	• Causes serious eye irritation
• May cause respiratory irritation	• May cause allergy or asthma symptoms or breathing difficulties if inhaled
• May cause damage to organs through prolonged or repeated exposure	• Suspected of causing cancer

Precautionary Statements:	
• Do not breathe dust/fume/gas/mist/vapors/spray	• IF INHALED: Remove victim to fresh air and keep at rest in a position comfortable for breathing
• Wear protective gloves/eye protection/face protection	• IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.
• IF ON SKIN: Wash with plenty of soap and water	

Other Hazards: Persons with respiratory conditions should avoid handling this product.

Section 3: Composition

Hazardous Components

Type of product: substance

CAS#	Weight %	Name
101-68-8	38.0%	Diphenylmethane-4,4'-diisocyanate (MDI)
26447-40-5	< 10.0%	MDI Mixed Isomers
9016-87-9	< 55.0%	P-MDI

Section 4: First Aid Measures

General:	Remove contaminated clothing
Inhalation:	Remove affected individual to fresh air and keep person calm. Assist in breathing if necessary. Immediate medical attention required.
Skin Contact:	Wash affected areas with soap and water. Seek medical attention for irritation.
Eye Contact:	Rinse for at least 15 minutes with water. Immediate medical attention required.
Ingestion:	Rinse mouth and drink plenty of water. Do not induce vomiting. Immediate medical attention required.

Section 5: Fire-Fighting Measures

Suitable extinguishing media:	Carbon dioxide, foam, dry powder, water spray
Unsuitable extinguishing media:	High volume water jet
Special hazards arising from the chemical:	Burning releases CO, CO2, oxides of nitrogen, isocyanate vapors and traces of hydrogen cyanide.
Precautions for firefighters:	Firefighters should be equipped with self-contained breathing apparatus and turn-out gear.

Section 6: Accidental Release Measures

Personal precautions, protective equipment, and emergency procedures:	Clear area. Ensure adequate ventilation. Wear suitable personal protective clothing and equipment.
Environmental precautions:	Do not discharge into drains/surface waters/groundwater
Methods/material for containment and cleanup:	Remove mechanically; cover remainder with wet, absorbent material **(e.**g. sawdust, chemical binder based on calcium silicate hydrate, sand). After approx. one hour transfer to waste container and do not seal (evolution of CO2?). Keep damp in a safe ventilated area for several days.

Spill area can be decontaminated with the following recommended decontamination solution:

Decontamination Solution #1: 8-10% sodium carbonate and 2% liquid soap in water

Decontamination Solution #2: Liquid/yellow soap (potassium soap with ~15% anionic surfactant): 20 ml; Water: 700 ml; Polyethylene glycol (PEG 400): 350 ml

Section 7: Handling and Storage

Precautions for safe handling:	Provide sufficient air exchange and/or exhaust in work rooms. Occupational exposure limits should not be exceeded (refer to Section 8). Contact with skin and eyes and inhalation of vapors must be avoided. Keep away from foodstuffs, drinks, and tobacco. Wash hands before breaks and at end of work.
Conditions for safe storage, including any incompatibilities:	Keep container tightly closed and protect against moisture. Segregate from bases. Store from 32°F – 110°F.

Section 8: Exposure Controls and PPE

Exposure Limits

Component	Type	Value
P-MDI	OSHA PEL	CLV 0.02 ppm 0.2 mg/m3
Diphenylmethane-4,4'-diisocyanate (MDI)	OSHA PEL	CLV 0.02 ppm 0.2 mg/m3

Exposure Controls

Respiratory Protection:	Respiratory protection required in insufficiently ventilated working areas and during spraying. An air-fed mask, or for short periods of work, a combination of charcoal filter and particulate filter is recommended.
Hand, eye, skin, body protection:	Chemical resistant protective gloves should be worn to prevent all skin contact. Wear eye/face protection. Wear suitable protective clothing

Section 9: Physical and Chemical Properties

Basic chemical and physical properties

Appearance:	liquid	**Flammability**	not applicable
Color	dark amber	**Upper/lower flammability or explosive limits**	
Odor	earthy, musty	**Vapor pressure**	0.00016 mmHg
Odor threshold	not established	**Vapor density**	not established
pH	not established	**Relative density**	1.24
Melting pt/freezing pt	3°C	**Solubility(ies)**	Reacts with water
Boiling pt/boiling range	> 300°C	**Partition coefficient (n-octanol/water)**	not established
Flash point	> 250°C	**Auto-ignition temperature**	not applicable
Evaporation rate	not established	**Decomposition temperature**	not established

Section 10: Stability and Reactivity

Chemical stability:	Polymerizes at about 200°C with evolution of CO2
Possibility of hazardous reactions:	Exothermic reaction with amines and alcohols; reacts with water forming CO2; in closed containers, risk of bursting owing to increase of pressure
Conditions to avoid:	Avoid moisture
Incompatible materials:	water, alcohols, strong bases

Hazardous decomposition products:	carbon monoxide, hydrogen cyanide, nitrogen oxides, aromatic isocyanates, gases/vapors

Section 11: Toxicological Information

Acute toxicity (inhalation):	LC50: 490mg/kg , vapor, 4hr rat
Chronic toxicity:	2 years, inhalation; NOAEL: 0.2mg/m3, (rat, Male/Female, 6hrs/day 5 days/week)
Likely routes of exposure:	Skin, inhalation
Symptoms related to physical, chemical and toxicological characteristics:	Minor skin irritation; asthma-like symptoms
Delayed and immediate effects and chronic effects from short and long-term exposure:	Possible sensitization
Numerical toxicity measures:	

Section 12: Ecological Information

Ecotoxicity:	LC0: >1,000mg/l (Zebra fish 96 hrs) LC0: >3,000mg.l (Killifish 96hrs)
Persistance and degradability:	0%
Bioaccumulative potential:	Does not bioaccumulate
Mobility in soil:	

Section 13: Disposal

Waste disposal:	Incinerate or dispose of in a licensed facility. Do not discharge substance/product into sewer system. Do not burn empty drums or cut open with gas or an electric torch as toxic decomposition products may be liberated. Do not reuse empty containers.

Section 14: Transport

Land transport

USDOT	Not classified as dangerous good
China	Not classified as dangerous good

Sea transport

IMDG	Not classified as dangerous good

Air transport

IATA/ICAO	Not classified as dangerous good

Further information
DOT: This product is regulated if the amount in a single receptacle exceeds the Reportable Quantity (RQ). Refer to Section 15 for the RQ of this product.

Section 15: Regulatory

Relevant safety, health, and environmental regulations:	
Inventory Status:	TSCA listed
US Regulations:	Not regulated
US Superfund Amendments and Reauthorization Act (SARA) Title III Section 313 information:	Methylene Bis Phenylisocyanate 101-68-8 5000 lbs. (Same as Diphenylmethane diisocyanate (MDI) Polymeric Diphenylmethane diisocyanate 9016-87-9

Section 16: Other

SDS Preparation Date:	03/15/2015
Revision Date:	01/09/2018

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SAFETY DATA SHEET According to GHS

145 Newborn Road • Rutledge, GA 30663
866.644.3626 • www.PROFOAM.com

Section 1: Identification

Product Identifier

Trade Name: B-PF-OC-500
Chemical Name: Polyurethane Resin
Recommended Use: Component for the manufacture of Polyurethanes
Restrictions on Use:

Chemical Manufacturer Information

Name: PROFOAM
Address: 145 Newborn Road, Rutledge, GA 30663
Website: www.PROFOAM.com
Phone: (866) 644-3626
Fax: (706) 557-1405
Emergency Phone: CHEMTREC: 800-424-9300

Section 2: Hazard Identification

Classification of the substance or mixture:

GHS Classification:	
• Skin irritation, Category 3	• Eye irritation, Category 2

GHS Labeling:

Warning

Hazard Statements:	
• May cause skin irritation	• May cause eye irritation
• May cause respiratory irritation	•

Precautionary Statements:	
• Do not breathe fume/gas/mist/vapors/spray	• Wear protective gloves/eye protection/face protection
• IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.	• IF INHALED: Remove victim to fresh air and keep at rest in a position comfortable for breathing
• IF ON SKIN: Wash with plenty of soap and water	

Other Hazards:

Section 3: Composition

Hazardous Components

Type of product: Mixture

CAS#	Weight %	Name
Proprietary	<8	Tertiary amine catalysts

Section 4: First Aid Measures

Inhalation:	Move to fresh air if symptoms develop. If breathing is difficult, give oxygen and call physician**.**
Eye Contact:	Flush with water for at least 15 minutes. See a physician if irritation develops.
Ingestion:	Do not induce vomiting unless told to do so by a medical professional.
Most Important symptoms and effects, acute and delayed:	May cause skin or eye irritation upon contact. Avoid breathing vapors. The dense vapors can displace and reduce breathing air in confined or unventilated spaces causing asphyxiation. Overexposure may cause tremors, confusion, irritation, and may result in cardiac sensitization.
Indication of immediate medical attention and special treatment, if applicable:	N/A
Skin Contact:	Wash with soap and water at first opportunity.

Section 5: Fire-Fighting Measures

Suitable extinguishing media:	Water, dry chemicals, CO_2
Unsuitable extinguishing media:	None
Special hazards arising from the chemical:	None
Precautions for fire-fighters:	A self-contained breathing apparatus should be worn to protect against toxic and irritating vapors.

Section 6: Accidental Release Measures

Personal precautions, protective equipment, and emergency procedures:	Clear area. Ensure adequate ventilation. Wear suitable personal protective clothing and equipment.
Environmental precautions:	Do not discharge into drains/surface waters/groundwater
Methods and material for containment and cleanup:	Absorb with sawdust, etc., and shovel into container. Waste material should be disposed of under conditions which meet federal, state, and local environmental regulations.

Section 7: Handling and Storage

Precautions for safe handling:	Store between 65°F and 85°F out of sunlight. Relieve pressure slowly when opening container.
Conditions for safe storage, including any incompatibilities:	Keep tightly sealed.

Section 8: Exposure Controls and PPE

Exposure Limits

Component:	**Type**	**Value**
Tertiary Amine Catalysts[1]	TWA	None established

[1]Not listed as a carcinogen (NTA, IARC, OSHA)

Exposure Controls

Respiratory Protection:	The specific respirator selected must be based on contamination levels of this material found in the workplace and the working limits of the respirator. A supplied air, full-face mask, positive pressure or continuous flow respirator or a supplied air hood is required when airborne concentrations are unknown or exceed threshold limit values. A positive pressure, self-contained breathing apparatus can be used in emergencies or other unusual situations. Full-face air purifying respirators equipped with organic vapor cartridges can be used in certain situations***, see OSHA standard 29CFR 1910.134***. All equipment must be NIOSH approved and maintained.
Hand, eye, skin, body protection:	Wear goggles or chemical safety glasses and chemically resistant rubber or plastic gloves. Avoid eye and skin contact. Eye wash system and showers should be available.

Section 9: Physical and Chemical Properties

Basic chemical and physical properties

Appearance:	Liquid	**Flammability:**	N/A
Color:	Amber	**Upper/lower flammability or explosive limits:**	N/A
Odor:	Faint ammonia odor	**Vapor pressure:**	N/A
Odor threshold:	N/A	**Vapor density:**	N/A
pH:	N/A	**Relative density:**	1.154g/mL
Melting pt/freezing pt:	<32°F	**Solubility(ies):**	highly soluble in water
Boiling pt/boiling range:	>200°F	**Partition coefficient (n-octanol/water):**	N/A
Flash point:	>200°F	**Auto-ignition temperature:**	>500°F
Evaporation rate:	Slower than ether	**Decomposition temperature:**	>500°*F*

Section 10: Stability and Reactivity

Chemical stability:	Stable
Possibility of hazardous reactions:	N/A
Conditions to avoid:	N/A
Incompatible materials:	Isocyanates and other chemicals that react with hydroxyl groups.
Hazardous decomposition products:	When burned, CO, CO_2, NO_x aliphatic fragments, halogens, halogen acids, and possibly carbonyl halides.

Section 11: Toxicological Information

Acute toxicity:	May cause skin irritation
Chronic toxicity:	Not available
Likely routes of exposure:	Skin
Symptoms related to physical, chemical and toxicological characteristics:	May cause skin irritation
Delayed and immediate effects and chronic effects from short and long-term exposure:	May cause skin irritation; avoid contact with eyes
Numerical toxicity measures:	Not available

Section 12: Ecological Information

Ecotoxicity:	Not a marine pollutant
Persistance and degradability:	No known significant effects
Bioaccumulative potential:	Does not bioaccumulate
Mobility in soil:	

Section 13: Disposal

Waste disposal:	B component drums can be sent to drum reconditioners or disposed of as ordinary industrial waste in compliance with pertinent regulations

Section 14: Transport

UN number:	Not regulated
UN Proper shipping name:	Not regulated
Transport Hazard class(es):	Not regulated
Packing group, if applicable:	Not regulated
Marine pollutant (YorN):	N
Special precautions:	None

Section 15: Regulatory

Relevant safety, health, and environmental regulations

Inventory Status:	All components TSCA listed
US Regulations:	No ingredients listed
US Superfund Amendments and Reauthorization Act (SARA) Title III Section 313 information:	No ingredients listed

Section 16: Other

SDS Preparation Date:	03/15/2015
Revision Date:	01/09/2018

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Section 1: Identification

Product Identifier

Trade Name: A2-000
Chemical Name: Diphenylmethane Diisocyanate (MDI)
Recommended Use: Component for production of polyurethanes
Restrictions on Use:

Chemical Manufacturer Information

Name: PROFOAM Polyurethanes
Address: 145 Newborn Road, Rutledge, GA 30663
Website: www.PROFOAM.com
Phone: (866) 644-3626
Fax: (706) 557-1405
Emergency Phone: CHEMTREC: 800-424-9300

Section 2: Hazard Identification

Classification of the substance or mixture

GHS Classification:	
• Skin irritation, Category 2	• Acute toxicity, Inhalative, Category 4
• Sensitization of respiratory airways, Category 1	• Eye irritation, Category 2
• Carcinogenicity, Category 2	• Sensitization of the skin, Category 1
• Specific target organ toxicity (repeated exposure), Category 2	• Specific target organ toxicity (single exposure), Category 3

GHS Labeling:


Danger

Hazard Statements:	
• May cause an allergic skin reaction	• Causes skin irritation
• Harmful if inhaled	• Causes serious eye irritation
• May cause respiratory irritation	• May cause allergy or asthma symptoms or breathing difficulties if inhaled
• May cause damage to organs through prolonged or repeated exposure	• Suspected of causing cancer

Precautionary Statements:	
• Do not breathe dust/fume/gas/mist/vapors/spray	• IF INHALED: Remove victim to fresh air and keep at rest in a position comfortable for breathing
• Wear protective gloves/eye protection/face protection	• IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.
• IF ON SKIN: Wash with plenty of soap and water	

Other Hazards: Persons with respiratory conditions should avoid handling this product.

Section 3: Composition

Hazardous Components

Type of product: substance

CAS#	Weight %	Name
101-68-8	38.0%	Diphenylmethane-4,4'-diisocyanate (MDI)
26447-40-5	< 10.0%	MDI Mixed Isomers
9016-87-9	< 55.0%	P-MDI

Section 4: First Aid Measures

General:	Remove contaminated clothing
Inhalation:	Remove affected individual to fresh air and keep person calm. Assist in breathing if necessary. Immediate medical attention required.
Skin Contact:	Wash affected areas with soap and water. Seek medical attention for irritation.
Eye Contact:	Rinse for at least 15 minutes with water. Immediate medical attention required.
Ingestion:	Rinse mouth and drink plenty of water. Do not induce vomiting. Immediate medical attention required.

Section 5: Fire-Fighting Measures

Suitable extinguishing media:	Carbon dioxide, foam, dry powder, water spray
Unsuitable extinguishing media:	High volume water jet
Special hazards arising from the chemical:	Burning releases CO, CO2, oxides of nitrogen, isocyanate vapors and traces of hydrogen cyanide.
Precautions for firefighters:	Firefighters should be equipped with self-contained breathing apparatus and turn-out gear.

Section 6: Accidental Release Measures

Personal precautions, protective equipment, and emergency procedures:	Clear area. Ensure adequate ventilation. Wear suitable personal protective clothing and equipment.
Environmental precautions:	Do not discharge into drains/surface waters/groundwater
Methods/material for containment and cleanup:	Remove mechanically; cover remainder with wet, absorbent material **(e.**g. sawdust, chemical binder based on calcium silicate hydrate, sand). After approx. one hour transfer to waste container and do not seal (evolution of CO2?). Keep damp in a safe ventilated area for several days.

Spill area can be decontaminated with the following recommended decontamination solution:

Decontamination Solution #1: 8-10% sodium carbonate and 2% liquid soap in water

Decontamination Solution #2: Liquid/yellow soap (potassium soap with ~15% anionic surfactant): 20 ml; Water: 700 ml; Polyethylene glycol (PEG 400): 350 ml

Section 7: Handling and Storage

Precautions for safe handling:	Provide sufficient air exchange and/or exhaust in work rooms. Occupational exposure limits should not be exceeded (refer to Section 8). Contact with skin and eyes and inhalation of vapors must be avoided. Keep away from foodstuffs, drinks, and tobacco. Wash hands before breaks and at end of work.
Conditions for safe storage, including any incompatibilities:	Keep container tightly closed and protect against moisture. Segregate from bases. Store from 32°F – 110°F.

Section 8: Exposure Controls and PPE

Exposure Limits

Component	Type	Value
P-MDI	OSHA PEL	CLV 0.02 ppm 0.2 mg/m3
Diphenylmethane-4,4'-diisocyanate (MDI)	OSHA PEL	CLV 0.02 ppm 0.2 mg/m3

Exposure Controls

Respiratory Protection:	Respiratory protection required in insufficiently ventilated working areas and during spraying. An air-fed mask, or for short periods of work, a combination of charcoal filter and particulate filter is recommended.
Hand, eye, skin, body protection:	Chemical resistant protective gloves should be worn to prevent all skin contact. Wear eye/face protection. Wear suitable protective clothing

Section 9: Physical and Chemical Properties

Basic chemical and physical properties

Appearance:	liquid	**Flammability**	not applicable
Color	dark amber	**Upper/lower flammability or explosive limits**	
Odor	earthy, musty	**Vapor pressure**	0.00016 mmHg
Odor threshold	not established	**Vapor density**	not established
pH	not established	**Relative density**	1.24
Melting pt/freezing pt	3°C	**Solubility(ies)**	Reacts with water
Boiling pt/boiling range	> 300°C	**Partition coefficient (n-octanol/water)**	not established
Flash point	> 250°C	**Auto-ignition temperature**	not applicable
Evaporation rate	not established	**Decomposition temperature**	not established

Section 10: Stability and Reactivity

Chemical stability:	Polymerizes at about 200°C with evolution of CO2
Possibility of hazardous reactions:	Exothermic reaction with amines and alcohols; reacts with water forming CO2; in closed containers, risk of bursting owing to increase of pressure

Conditions to avoid:	Avoid moisture
Incompatible materials:	water, alcohols, strong bases
Hazardous decomposition products:	carbon monoxide, hydrogen cyanide, nitrogen oxides, aromatic isocyanates, gases/vapors

Section 11: Toxicological Information

Acute toxicity (inhalation):	LC50: 490mg/kg , vapor, 4hr rat
Chronic toxicity:	2 years, inhalation; NOAEL: 0.2mg/m3, (rat, Male/Female, 6hrs/day 5 days/week)
Likely routes of exposure:	Skin, inhalation
Symptoms related to physical, chemical and toxicological characteristics:	Minor skin irritation; asthma-like symptoms
Delayed and immediate effects and chronic effects from short and long-term exposure:	Possible sensitization
Numerical toxicity measures:	

Section 12: Ecological Information

Ecotoxicity:	LC0: >1,000mg/l (Zebra fish 96 hrs) LC0: >3,000mg.l (Killifish 96hrs)
Persistance and degradability:	0%
Bioaccumulative potential:	Does not bioaccumulate
Mobility in soil:	

Section 13: Disposal

Waste disposal:	Incinerate or dispose of in a licensed facility. Do not discharge substance/product into sewer system. Do not burn empty drums or cut open with gas or an electric torch as toxic decomposition products may be liberated. Do not reuse empty containers.

Section 14: Transport

Land transport

USDOT	Not classified as dangerous good
China	Not classified as dangerous good

Sea transport

IMDG	Not classified as dangerous good

Air transport

IATA/ICAO	Not classified as dangerous good

Further information
DOT: This product is regulated if the amount in a single receptacle exceeds the Reportable Quantity (RQ). Refer to Section 15 for the RQ of this product.

Section 15: Regulatory

Relevant safety, health, and environmental regulations:	
Inventory Status:	TSCA listed
US Regulations:	Not regulated
US Superfund Amendments and Reauthorization Act (SARA) Title III Section 313 information:	Methylene Bis Phenylisocyanate 101-68-8 5000 lbs. (Same as Diphenylmethane diisocyanate (MDI) Polymeric Diphenylmethane diisocyanate 9016-87-9

Section 16: Other

SDS Preparation Date:	03/15/2015
Revision Date:	01/09/2018

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SAFETY DATA SHEET According to GHS

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Section 1: Identification

Product Identifier

Trade Name: B-PF-CC-2000 Series
Chemical Name: Polyurethane Resin
Recommended Use: Component for the manufacture of Polyurethanes
Restrictions on Use:

Chemical Manufacturer Information

Name: PROFOAM
Address: 145 Newborn Road, Rutledge, GA 30663
Website: www.PROFOAM.com
Phone: (866) 644-3626
Fax: (706) 557-1405
Emergency Phone: CHEMTREC: 800-424-9300

Section 2: Hazard Identification

Classification of the substance or mixture:

GHS Classification:	
• Skin irritation, Category 3	• Eye irritation, Category 2

GHS Labeling:

Warning

Hazard Statements:	
• May cause skin irritation	• May cause eye irritation
• May cause respiratory irritation	•

Precautionary Statements:	
• Do not breathe fume/gas/mist/vapors/spray	• Wear protective gloves/eye protection/face protection
• IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.	• IF INHALED: Remove victim to fresh air and keep at rest in a position comfortable for breathing
• IF ON SKIN: Wash with plenty of soap and water	

Other Hazards:

Section 3: Composition

Hazardous Components

Type of product: Mixture

CAS#	Weight %	Name
460-73-1	12%	1,1,1,3,3-Pentafluoropropane ($CF_3CH_2CHF_2$ or HFC-245fa)
Proprietary	<4	Tertiary amine catalysts
156-60-5	<4	Trans-1,2-Dichloroethylene

Section 4: First Aid Measures

Inhalation:	Move to fresh air if symptoms develop. If breathing is difficult, give oxygen and call physician**.**
Eye Contact:	Flush with water for at least 15 minutes. See a physician if irritation develops.
Ingestion:	Do not induce vomiting unless told to do so by a medical professional.
Most Important symptoms and effects, acute and delayed:	May cause skin or eye irritation upon contact. Avoid breathing vapors. The dense vapors can displace and reduce breathing air in confined or unventilated spaces causing asphyxiation. Overexposure may cause tremors, confusion, irritation, and may result in cardiac sensitization.
Indication of immediate medical attention and special treatment, if applicable:	N/A
Skin Contact:	Wash with soap and water at first opportunity.

Section 5: Fire-Fighting Measures

Suitable extinguishing media:	Water, dry chemicals, CO_2
Unsuitable extinguishing media:	None
Special hazards arising from the chemical:	Overheated containers may rupture due to pressure produced by $CF_3CH_2CHF_2$. $CF_3CH_2CHF_2$ burns to form acids and noxious gases.
Precautions for fire-fighters:	A self-contained breathing apparatus should be worn to protect against toxic and irritating vapors.

Section 6: Accidental Release Measures

Personal precautions, protective equipment, and emergency procedures:	Clear area. Ensure adequate ventilation. Wear suitable personal protective clothing and equipment.
Environmental precautions:	Do not discharge into drains/surface waters/groundwater
Methods and material for containment and cleanup:	Absorb with sawdust, etc., and shovel into container. Waste material should be disposed of under conditions which meet federal, state, and local environmental regulations.

Section 7: Handling and Storage

Precautions for safe handling:	Store between 65°F and 85°F out of sunlight. Relieve pressure slowly when opening container. Under no circumstances should empty drums be burned or cut open with an electric or gas torch.
Conditions for safe storage, including any incompatibilities:	Keep tightly sealed.

Section 8: Exposure Controls and PPE

Exposure Limits

Component:	**Type**	**Value**
1,1,1,3,3-Pentafluoropropane ($CF_3CH_2CHF_2$ or HFC-245fa)	TWA	300ppm recommended
Tertiary Amine Catalysts[1]	TWA	None established
Trans-1,2-Dichloroethylene	TWA	200ppm

[1]Not listed as a carcinogen (NTA, IARC, OSHA)

Exposure Controls

Respiratory Protection:	The specific respirator selected must be based on contamination levels of this material found in the workplace and the working limits of the respirator. A supplied air, full-face mask, positive pressure or continuous flow respirator or a supplied air hood is required when airborne concentrations are unknown or exceed threshold limit values. A positive pressure, self-contained breathing apparatus can be used in emergencies or other unusual situations. Full-face air purifying respirators equipped with organic vapor cartridges can be used in certain situations***, see OSHA standard 29CFR 1910.134***. All equipment must be NIOSH approved and maintained.
Hand, eye, skin, body protection:	Wear goggles or chemical safety glasses and chemically resistant rubber or plastic gloves. Avoid eye and skin contact. Eye wash system and showers should be available.

Section 9: Physical and Chemical Properties

Basic chemical and physical properties

Appearance:	Liquid	**Flammability:**	N/A
Color:	Green	**Upper/lower flammability or explosive limits:**	N/A
Odor:	Ethereal odor	**Vapor pressure:**	N/A
Odor threshold:	N/A	**Vapor density:**	N/A
pH:	N/A	**Relative density:**	1.23g/mL
Melting pt/freezing pt:	<32°F	**Solubility(ies):**	Slightly soluble in water
Boiling pt/boiling range:	60°F	**Partition coefficient (n-octanol/water):**	N/A
Flash point:	>200°F	**Auto-ignition temperature:**	>500°F
Evaporation rate:	Slower than ether	**Decomposition temperature:**	>500°*F*

Section 10: Stability and Reactivity

Chemical stability:	Stable
Possibility of hazardous reactions:	N/A
Conditions to avoid:	Temperatures over 85°F
Incompatible materials:	Isocyanates and other chemicals that react with hydroxyl groups.
Hazardous decomposition products:	When burned, CO, CO_2, NO_x aliphatic fragments, halogens, halogen acids, and possibly carbonyl halides.

Section 11: Toxicological Information

Acute toxicity:	May cause skin irritation
Chronic toxicity:	Not available
Likely routes of exposure:	Skin
Symptoms related to physical, chemical and toxicological characteristics:	May cause skin irritation
Delayed and immediate effects and chronic effects from short and long-term exposure:	May cause skin irritation; avoid contact with eyes
Numerical toxicity measures:	Not available

Section 12: Ecological Information

Ecotoxicity:	Not a marine pollutant
Persistance and degradability:	No known significant effects
Bioaccumulative potential:	Does not bioaccumulate
Mobility in soil:	

Section 13: Disposal

Waste disposal:	B component drums can be sent to drum reconditioners or disposed of as ordinary industrial waste in compliance with pertinent regulations

Section 14: Transport

UN number:	Not regulated
UN Proper shipping name:	Not regulated
Transport Hazard class(es):	Not regulated
Packing group, if applicable:	Not regulated
Marine pollutant (YorN):	N
Special precautions:	None

Section 15: Regulatory

Relevant safety, health, and environmental regulations

Inventory Status:	All components TSCA listed
US Regulations:	No ingredients listed
US Superfund Amendments and Reauthorization Act (SARA) Title III Section 313 information:	No ingredients listed

Section 16: Other

SDS Preparation Date:	03/15/2015
Revision Date:	01/09/2018

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Section 1: Identification

Product Identifier

Trade Name: A-PF-CC-2000 Series
Chemical Name: Diphenylmethane Diisocyanate (MDI)
Recommended Use: Component for production of polyurethanes
Restrictions on Use:

Chemical Manufacturer Information

Name: PROFOAM Polyurethanes
Address: 145 Newborn Road, Rutledge, GA 30663
Website: www.PROFOAM.com
Phone: (866) 644-3626
Fax: (704) 557-1405
Emergency Phone: CHEMTREC: 800-424-9300

Section 2: Hazard Identification

Classification of the substance or mixture

GHS Classification:	
• Skin irritation, Category 2	• Acute toxicity, Inhalative, Category 4
• Sensitization of respiratory airways, Category 1	• Eye irritation, Category 2
• Carcinogenicity, Category 2	• Sensitization of the skin, Category 1
• Specific target organ toxicity (repeated exposure), Category 2	• Specific target organ toxicity (single exposure), Category 3

GHS Labeling:

Danger

Hazard Statements:	
• May cause an allergic skin reaction	• Causes skin irritation
• Harmful if inhaled	• Causes serious eye irritation
• May cause respiratory irritation	• May cause allergy or asthma symptoms or breathing difficulties if inhaled
• May cause damage to organs through prolonged or repeated exposure	• Suspected of causing cancer

Precautionary Statements:	
• Do not breathe dust/fume/gas/mist/vapors/spray	• IF INHALED: Remove victim to fresh air and keep at rest in a position comfortable for breathing
• Wear protective gloves/eye protection/face protection	• IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.
• IF ON SKIN: Wash with plenty of soap and water	

Other Hazards: Persons with respiratory conditions should avoid handling this product.

Section 3: Composition

Hazardous Components

Type of product: substance

CAS#	Weight %	Name
101-68-8	38.0%	Diphenylmethane-4,4'-diisocyanate (MDI)
26447-40-5	< 10.0%	MDI Mixed Isomers
9016-87-9	< 55.0%	P-MDI

Section 4: First Aid Measures

General:	Remove contaminated clothing
Inhalation:	Remove affected individual to fresh air and keep person calm. Assist in breathing if necessary. Immediate medical attention required.
Skin Contact:	Wash affected areas with soap and water. Seek medical attention for irritation.
Eye Contact:	Rinse for at least 15 minutes with water. Immediate medical attention required.
Ingestion:	Rinse mouth and drink plenty of water. Do not induce vomiting. Immediate medical attention required.

Section 5: Fire-Fighting Measures

Suitable extinguishing media:	Carbon dioxide, foam, dry powder, water spray
Unsuitable extinguishing media:	High volume water jet
Special hazards arising from the chemical:	Burning releases CO, CO2, oxides of nitrogen, isocyanate vapors and traces of hydrogen cyanide.
Precautions for firefighters:	Firefighters should be equipped with self-contained breathing apparatus and turn-out gear.

Section 6: Accidental Release Measures

Personal precautions, protective equipment, and emergency procedures:	Clear area. Ensure adequate ventilation. Wear suitable personal protective clothing and equipment.
Environmental precautions:	Do not discharge into drains/surface waters/groundwater
Methods/material for containment and cleanup:	Remove mechanically; cover remainder with wet, absorbent material **(e.**g. sawdust, chemical binder based on calcium silicate hydrate, sand). After approx. one hour transfer to waste container and do not seal (evolution of CO2?). Keep damp in a safe ventilated area for several days.

Spill area can be decontaminated with the following recommended decontamination solution:

Decontamination Solution #1: 8-10% sodium carbonate and 2% liquid soap in water

Decontamination Solution #2: Liquid/yellow soap (potassium soap with ~15% anionic surfactant): 20 ml; Water: 700 ml; Polyethylene glycol (PEG 400): 350 ml

Section 7: Handling and Storage

Precautions for safe handling:	Provide sufficient air exchange and/or exhaust in work rooms. Occupational exposure limits should not be exceeded (refer to Section 8). Contact with skin and eyes and inhalation of vapors must be avoided. Keep away from foodstuffs, drinks, and tobacco. Wash hands before breaks and at end of work.
Conditions for safe storage, including any incompatibilities:	Keep container tightly closed and protect against moisture. Segregate from bases. Store from 32°F – 110°F.

Section 8: Exposure Controls and PPE

Exposure Limits

Component	Type	Value
P-MDI	OSHA PEL	CLV 0.02 ppm 0.2 mg/m3
Diphenylmethane-4,4'-diisocyanate (MDI)	OSHA PEL	CLV 0.02 ppm 0.2 mg/m3

Exposure Controls

Respiratory Protection:	Respiratory protection required in insufficiently ventilated working areas and during spraying. An air-fed mask, or for short periods of work, a combination of charcoal filter and particulate filter is recommended.
Hand, eye, skin, body protection:	Chemical resistant protective gloves should be worn to prevent all skin contact. Wear eye/face protection. Wear suitable protective clothing

Section 9: Physical and Chemical Properties

Basic chemical and physical properties

Appearance:	liquid	**Flammability**	not applicable
Color	dark amber	**Upper/lower flammability or explosive limits**	
Odor	earthy, musty	**Vapor pressure**	0.00016 mmHg
Odor threshold	not established	**Vapor density**	not established
pH	not established	**Relative density**	1.24
Melting pt/freezing pt	3°C	**Solubility(ies)**	Reacts with water
Boiling pt/boiling range	> 300°C	**Partition coefficient (n-octanol/water)**	not established
Flash point	> 250°C	**Auto-ignition temperature**	not applicable
Evaporation rate	not established	**Decomposition temperature**	not established

Section 10: Stability and Reactivity

Chemical stability:	Polymerizes at about 200°C with evolution of CO_2
Possibility of hazardous reactions:	Exothermic reaction with amines and alcohols; reacts with water forming CO_2; in closed containers, risk of bursting owing to increase of pressure
Conditions to avoid:	Avoid moisture

Incompatible materials:	water, alcohols, strong bases
Hazardous decomposition products:	carbon monoxide, hydrogen cyanide, nitrogen oxides, aromatic isocyanates, gases/vapors

Section 11: Toxicological Information

Acute toxicity (inhalation):	LC50: 490mg/kg , vapor, 4hr rat
Chronic toxicity:	2 years, inhalation; NOAEL: 0.2mg/m3, (rat, Male/Female, 6hrs/day 5 days/week)
Likely routes of exposure:	Skin, inhalation
Symptoms related to physical, chemical and toxicological characteristics:	Minor skin irritation; asthma-like symptoms
Delayed and immediate effects and chronic effects from short and long-term exposure:	Possible sensitization
Numerical toxicity measures:	

Section 12: Ecological Information

Ecotoxicity:	LC0: >1,000mg/l (Zebra fish 96 hrs) LC0: >3,000mg.l (Killifish 96hrs)
Persistance and degradability:	0%
Bioaccumulative potential:	Does not bioaccumulate
Mobility in soil:	

Section 13: Disposal

Waste disposal:	Incinerate or dispose of in a licensed facility. Do not discharge substance/product into sewer system. Do not burn empty drums or cut open with gas or an electric torch as toxic decomposition products may be liberated. Do not reuse empty containers.

Section 14: Transport

Land transport

USDOT	Not classified as dangerous good
China	Not classified as dangerous good

Sea transport

IMDG	Not classified as dangerous good

Air transport

IATA/ICAO	Not classified as dangerous good

Further information
DOT: This product is regulated if the amount in a single receptacle exceeds the Reportable Quantity (RQ). Refer to Section 15 for the RQ of this product.

Section 15: Regulatory

Relevant safety, health, and environmental regulations:	
Inventory Status:	TSCA listed
US Regulations:	Not regulated
US Superfund Amendments and Reauthorization Act (SARA) Title III Section 313 information:	Methylene Bis Phenylisocyanate 101-68-8 5000 lbs. (Same as Diphenylmethane diisocyanate (MDI) Polymeric Diphenylmethane diisocyanate 9016-87-9

Section 16: Other

SDS Preparation Date:	03/15/2015
Revision Date:	01/09/2018

IMPORTANT NOTICES
This notification is a part of the Safety Data Sheet document and must not be detached. Any copying and redistribution of the Safety Data Sheet shall include copying of this notice and attaching the copy to the redistributed Safety Data Sheet copies.

This information is furnished without warranty, expressed, or implied, except that it is accurate to the best knowledge of PROFOAM. The data on this sheet relates only to the specific material designated herein. PROFOAM assumes no legal responsibility for use or reliance upon these data.

Estimating Guide

Profoam Polyurethanes Spray-in-Place Systems

Profoam spray polyurethane systems are two different liquids in drums, sold as a set. The price of the drum set is based on the pounds of liquid in the drums. When sprayed, the liquids form a solid mass of polyurethane foam. The amount of finished foam that can be created from the drum set is the YIELD, which is measured in board feet (bd ft). One bd ft is one square foot (ft^2) of surface area that is one inch thick. When the foam is sprayed at a thickness greater than one inch, the number of square feet (ft^2) is multiplied by the inches of thickness. To calculate how much foam you require to complete a job, multiply the square feet of area by the thickness of the foam to be sprayed.
If the area is 1000 ft^2 and you want to spray the foam 2½" thick, then multiply 1000 ft^2 x 2½" which equals 2500 bf of foam required to spray the area.

**example	1000 ft^2	X	2½"	=	2500 bd ft
	Area to be sprayed		Thickness of foam		Amount of foam required
Figure your job here →		X		=	

The cost of a bd ft of foam is calculated by dividing the price of a drum set of chemicals by the estimated YIELD of the drum set.
If the set of chemicals cost $2000 and the estimated yield is 4000 board feet then:

** example	$2000	÷	4000	=	$0.50
	Cost of chemical set		Estimated Yield		Cost per board foot
Figure your job here →		÷		=	

To calculate the cost of chemicals for a job, multiply the cost per bf by the total number of boardfeet required for the job.

**example	$0.50	X	2500 bd ft	=	$1250.00
	Cost per board ft		Amount of foam required		Cost of chemicals for the job
Figure your job here →		X		=	

This calculation applies to any spray system; roofing or insulation.

**The numbers used in this example are not to be considered accurate for the cost or yield of a set of chemicals. Contact your Profoam Account Manager for current pricing.
See the back page for yield estimates.

Estimated Yield

If you know from experience what yield to expect from a given Profoam Spray System, use your own figures. The below yields are considered "typical" for job-site conditions. Many factors influence foam yield. Some of these factors which effect foam yield are listed under the table. Your own yield figures calculated from your own job experience will be the most accurate for you.

System	Density lb/ft^3	Pounds per set	Estimated Board Ft per set	Estimated Board ft/lb
Profoam Roof	2.8	1023	2700 - 3000	2.7 - 3.0
Profoam CC 2000	2.0	1035	3600 - 4000	3.4 - 3.9
Profoam OC 500	0.5	1006	14,000 -16,000	13.5 - 16

FACTORS WHICH REDUCE YIELD

Applying in multiple lifts
Applying to cold surfaces
Applying foam in cold ambient temperatures
Applying foam chemicals not hot enough
Applying foam to rough surfaces
Chemicals not on proper ratio
Applying foam overhead with more fallout
Applying foam in windy conditions
Varying Thickness
Applicator Skill
Loss of Blowing Agent
Inadequate chemical storage condition

FACTORS WHICH INCREASE YIELD

Applying foam at high altitude
Applying foam to hot surfaces
Spraying foam during hot ambient temperatures
Proper Equipment Set up
Use of Regulator Tree on Resin drum
Good applicator technique - minimize overspray
Spray foam systems designed for ambient temperature and location

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SPECIAL BULLETIN ON RECOMMENDED PROCEDURES FOR APPLYING PROFOAM POLYURETHANE SPRAY FOAM SYSTEMS AS INSULATION ON EXTERIOR ROOF SURFACES

1) The person applying foam must be fully qualified in handing and spraying urethane foam and thoroughly experienced in the use of urethane spray equipment, and must record daily all information on PROFOAM daily roofing spray foam checklist.
2) Primers should be used where necessary. Contact PROFOAM for primer applications on different surfaces. Time must be allowed for all solvents to dry from primer before applying foam.
3) Roofing surface to which foam will be applied must be thoroughly secured to deck as foam can pull loose felts, etc. due to contraction of foam as it cools or as it later may expand because of heat and moisture.
4) Roof vents are to be used in accordance with good roofing practice where necessary.
5) PROFOAM recommendation for storage of chemicals must be complied with. The feed tank or chemical drum temperature must be above 80°F. Storage temperature should not exceed 95°F.
6) Chemical feed into metering pumps must be at or above that pressure recommended by spray machine manufacturer.
7) Spray foam metering pumps must be operating at recommended pressures and preheater and hoses temperatures must be at recommended levels.
8) Purge air on spray foam guns must be free of moisture. PROFOAM moisture detection paper can be used to check this.
9) Surface to be sprayed with foam must be free of moisture. PROFOAM MDP is used to check this.
10) Air temperatures and substrate temperature should be above minimum set for version of spray foam system used. Wind speed must be below 15 mph.
    65°F minimum for REGULAR version
    80°F minimum for SLOW version
11) Relative humidity at time of application must be below limit set for given temperature per PROFOAM temperatures and humidity chart. Dry bulb and wet bulb readings should be taken at start and finish and every two hours during spraying.
12) The full specific thickness of foam is to be sprayed during the same day. For any foam thickness added on later must be wire brushed and checked for moisture with MDP strips prior to application of foam.
13) The minimum application thickness of each foam layer is to be ½“. A ¾” to 1” layer is the most desirable for good foam properties.
14) A full thickness foam sample is to be cut from the roof where foam was sprayed at start of each day’s application and at the end of each day’s application. Approximately half of this sample is to be filed with PROFOAM roofing spray foam checklist.
15) The finished sprayed foam is to be protected from UV aging in accordance with PROFOAM’s specifications or an elastomeric coating manufacturer’s recommendation.

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APPLICATOR BULLETIN

JOBSITE SAFETY & VENTILATION

1. ONLY TRAINED APPLICATOR PERSONNEL WEARING REQUIRED PERSONAL PROTECTIVE EQUIPMENT (PPE) SHOULD BE ALLOWED WITHIN 50 FEET OF THE SPRAY ZONE AND FOR 24 HOURS AFTER COMPLETION OF SPRAYING.

2. MARK THE AREA WITH WARNING TAPE AND SIGNAGE TO PREVENT UNPROTECTED PERSONS FROM ENTERING THE WORK ZONE. THIS INCLUDES THE AREA AT THE EXHAUST FAN OUTLET.

3. CREATE A VENTILATION PLAN FOR THE WORK ZONE. HOMEOWNERS SHOULD BE COMPLETELY EVACUATED DURING AND FOR 24 HOURS AFTER COMPLETION OF SPRAYING. LARGER STRUCTURES OR THOSE WITH MULTIPLE FLOORS CAN BE PARTITIONED AND ISOLATED WITH PLASTIC FILM SO THAT OTHER TRADES ON THE JOBSITE NOT WEARING PPE CAN CONTINUE TO WORK SAFELY.

4. MAKE SURE THAT IGNITION SOURCES AND HVAC SYSTEMS INCLUDING INLET VENTS ARE SHUT DOWN AND MASKED OFF TO PREVENT ACCIDENTAL USE DURING APPLICATION.

5. ACTIVE VENTILATION SHOULD BE USED WITH FAN(S) POSITIONED TO MAINTAIN A MINIMUM OF 30 ACH (AIR CHANGES/HOUR) TO EXHAUST VAPORS AND ODORS WHILE THE FOAM IS SAFELY CURED. VENTILATION PLANS WILL VARY ACCORDING TO SIZE OF THE SPACE, LAYOUT AND SCHEDULING.

6. FILTERS SHOULD BE USED OVER THE EXHAUST FAN INLET DURING SPRAYING TO PREVENT BUILDUP OF RESIDUE ON FAN BLADES WHICH WILL DECREASE AIR MOVEMENT SUBSTANTIALLY.

7. OPTIONAL INLET FANS CAN BE USED TO INCREASE AIR MOVEMENT, TAKING CARE THAT THE EXHAUST FAN IS MOVING AIR AT A GREATER RATE TO MAINTAIN NEGATIVE PRESSURE WITHIN THE SPRAY ZONE.

8. REFER TO PROFOAM'S PRODUCT STEWARDSHIP MANUAL, SFC GUIDANCE ON BEST PRACTICES FOR APPLICATION OF POLYURETHANE FOAM, www.sprayfoam.org AND EPA VENTILATION GUIDANCE www.epa.gov/dfe OR CALL PROFOAM AT 866.644.3626 FOR RECOMMENDATIONS BEFORE COMMENCING WORK.

5/5/2015

145 Newborn Road Rutledge GA 30663 706-557-1400 www.profoam.com

HEALTH & SAFETY

HOMEOWNERS

COMMITTED TO THE RESPONSIBLE USE OF SPRAY FOAM CHEMISTRY FOR OVER 20 YEARS

Profoam Corporation has distributed spray foam systems since 1995 and has a superb health and safety record in the millions of pounds sold and thousands of buildings with our products installed. Nonetheless, proper safe handling practices during and following application are required to eliminate the possibility of health effects due to isocyanate exposure. Asthma or other lung issues, as well as irritation of the nose and throat can result from the inhalation of isocyanates. Irritation can also be caused from direct skin or eye contact. Individuals will react differently to the same exposures since some people will be more sensitive than others.

Only trained application personnel wearing proper protective equipment can be present during spraying. All others must vacate the job site, staying completely out of the building and at least 50 feet away while spraying is in progress and remain away for at least 24 hours after completion. Active ventilation must be used for this entire period to remove any vapors or odors present during the spray process. No exceptions.

Years of experience and actual studies indicate with 24 hours of active ventilation after spraying is complete, Profoam spray foam insulation is safely cured.

THERMAL BARRIERS AND IGNITION BARRIERS FOR THE SPRAY POLYURETHANE FOAM INDUSTRY

SPRAY POLYURETHANE FOAM ALLIANCE

SPFA

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*SPFA would like to acknowledge the voluntary contributions of these individuals in the revision of this document.

NOTE: 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.

POLICY STATEMENT

It is the policy and recommendation of the Spray Polyurethane Foam Alliance that spray polyurethane foams installed within buildings be covered with a thermal or ignition barrier as soon as possible after the initial application, except as an assembly specifically approved by a building code authority based on fire tests specific to the application.

Why Do Codes Require Thermal or Ignition Barriers?

Spray polyurethane foam (SPF), like most other organic materials, is combustible. SPFs are formulated with flame retardants to decrease the flame spread as measured by ASTM E-84 (Test for Surface Burning Characteristics for Building Materials) and other tests. However, these flame spread indices are used solely to measure and describe properties of products in response to heat and flame under controlled laboratory conditions. The numerical flame spread indexes are not intended to reflect hazards presented by SPFs or any other material under actual fire conditions.

When exposed to fire sources, such as trash fires, welding arcs, cutting torches, or red-hot metal, unprotected SPF can ignite and may result in a flash fire. Although burning SPF will form a surface layer of less flammable char, the initial burning can produce combustible gases and black smoke. In confined interiors, these combustible gases can accumulate and ignite resulting in flashover, a dangerous fire situation. Under these conditions, additional foam and/or other combustibles can become involved in the fire creating additional combustible gases and feeding the fire.

For these reasons, and to allow sufficient time for occupants to escape during a fire, model building codes require SPF to be covered by thermal barriers, ignition barriers or have the SPF assemblies meet the acceptance criteria of large-scale fire tests as described in this document.

> **Note 1:** These fire scenarios depend on the accumulation of combustible gases. Exterior applications of SPF, such as roof systems, where combustible gases can dissipate, are less likely to become involved in flash fires and are subject to different requirements under the model building codes.

What Is A Thermal Barrier?

A thermal barrier is a material, applied between foam plastics (including spray polyurethane foam) and interior spaces designed to delay the temperature rise of the foam during a fire situation and to delay or prevent the foam's involvement in a fire. The *International Building Code*® (IBC) and the *International Residential Code*® (IRC) define an approved thermal barrier as one which is equal in fire resistance to 12.7 mm (1/2 inch) gypsum wallboard. In essence, the model building codes define ½-inch gypsum wallboard as a prescriptive thermal barrier; approved equivalents (non-prescriptive thermal barriers) must perform as well as or better than ½-inch gypsum wallboard in fire testing as described below.

Non-prescriptive thermal barriers (termed “equivalent thermal barriers”) must undergo a temperature transmission fire test wherein the temperature rise of the underlying polyurethane foam is limited to not more than 121ºC (250ºF) after 15 minutes of fire exposure complying with the standard time temperature curve of ASTM E 119 (Test Methods for Fire Tests of Building Construction Materials). Additionally, equivalent thermal barriers must undergo a fire integrity test to establish that they will sufficiently remain in place during a fire scenario by passing a large-scale, 15-minute fire test. Equivalent thermal barriers meeting this criterion are termed a “15-minute thermal barrier” or classified as having an “index of 15.”

In effect, equivalent thermal barriers (i.e., other than the prescriptive ½-inch thick gypsum wallboard) must undergo two fire tests:

(1) A temperature transmission test (such as a modified ASTM E 119, the actual thermal barrier test apparatus being smaller than the typical large-scale wall or roof/ ceiling test assemblies); and

(2) A fire integrity test (a large-scale fire test such as NFPA 286 [with a specific acceptance criteria defined within the IBC or IRC], UL 1040, UL 1715 or FM 4880).

Since alternative assemblies must undergo the same room corner fire test(s) as equivalent thermal barriers, many manufacturers have foregone the temperature transmission testing (e.g., ASTM E 119). Such materials are **not** classified as equivalent thermal barriers but may be used as an **alternative assembly** provided it has been approved by the code authority having jurisdiction.

NFPA 275 (Standard Method of Fire Tests for the Evaluation of Thermal Barriers Used over Foam Plastic Insulation) is an approved test standard per AC 377 for equivalent thermal barriers that incorporates both a temperature transmission fire test and a fire integrity test. Future editions of model building codes will likely include NFPA 275 as an acceptable test method.

AC 377 is the Acceptance Criteria for Spray-Applied Foam Plastic Insulation published by International Code Council Evaluation Service (ICC-ES) for the purpose of preparing evaluation reports. Copies are available at the ICC-ES website www.ICC-ES.org.

Under specific conditions, the temperature transmission test can be waived if approved by building code authorities on the basis of large-scale fire testing representing actual end uses. Many materials which are not "15-minute thermal barriers" per ASTM E 119 or NFPA 275, or classified as equivalent thermal barriers have earned various building code acceptances as an alternate to the use of thermal barriers over spray polyurethane foam (SPF) based on large -scale fire testing. The assembly, consisting of either the exposed foam plastic or the foam plastic with a fire-retardant coating is tested using one of the following procedures:

- NFPA 286 Standard Methods of Fire Tests for Evaluating Contribution of Wall and Ceiling Interior Finish to Room Fire Growth (Note: NFPA 286 does not include pass/fail criteria within it; the criteria is specifically defined within the IBC and IRC.)
- UL 1715 Fire Test of Interior Finish Material
- UL 1040 Insulated Wall Construction
- FM 4880 Building Corner Fire Test

What is an Ignition Barrier?

Model building codes allow an exception to the thermal barrier requirement in attics and crawlspaces where entry is made only for repairs or maintenance (IRC) or for the service of utilities (IBC) [see Note 3 below]. In these cases:

The foam plastic insulation is protected against ignition using one of the following ignition barrier materials:

- 1 ½-inch-thick (38 mm) mineral fiber insulation;
- 1/4-inch-thick (6.4 mm) wood structural panels;
- 3/8-inch (9.5 mm) particleboard (1/4-inch thick under the IBC)
- 1/4-inch (6.4 mm) hardboard;
- 3/8-inch (9.5 mm) gypsum board;
- Corrosion-resistant steel having a base metal thickness of 0.016 inch (0.406 mm); or
- 1 1/2 inch-thick cellulose insulation (per 2012 IRC)

[Paraphrased from 2009 IRC Sections R316.5.3 and R316.5.4. 2009 IBC Section 2306.4.1.6 contains equivalent language.]

The materials referenced above from the IRC and IBC are termed "prescriptive ignition barriers."

Ignition barriers do not afford as high a degree of protection from fire as thermal barriers but are considered

acceptable for attic and crawlspaces where entry is limited. Building code authorities may accept alternative ignition barrier materials and/or alternative assemblies based on large-scale tests such as outlined in ICC-ES Acceptance Criteria 377, Appendix X (On attic floors, ASTM E 970 [as outlined in AC 377] may be used to qualify alternate ignition barriers or qualify exposed SPF).

> **Note 2:** A thermal barrier is still required between attic and crawlspace areas and interior living spaces. The ignition barrier exception is only applicable to the SPF surfaces facing attic and crawlspace areas. Typically, ceiling treatments or floor treatments provide separation from interior living spaces and serve as the thermal barrier in these cases.

Where Is A Thermal Barrier Required?

All model building codes require that SPF, with some exceptions, be separated from interior living spaces by an "approved thermal barrier." Therefore, unless an exception applies, all interior SPF applications are required to be covered with a thermal barrier, covered with an equivalent thermal barrier or be part of a tested alternative assembly.

Exceptions to the thermal barrier requirement include:

- Exterior applications as part of certain tested and classified roof assemblies;
- Certain masonry or concrete constructions;
- Certain attics and crawlspaces (see discussion under "Where Is An Ignition Barrier Permitted?");
- Sill plates and headers (limited to certain SPFs in Type V construction); and
- Others as provided by the model building codes.

Review the specific code requirements on a case-by-case basis.

Where Is An Ignition Barrier Permitted?

The IBC and IRC permit the use of an ignition barrier as an alternative to installing a thermal barrier in attics and crawlspaces where entry is made only for repairs and maintenance (IRC) or for the service of utilities (IBC) [see Note 3 below]. Therefore, in such attics or crawlspaces, SPF surfaces need not be covered with a thermal barrier provided it is (1) covered with a prescriptive ignition barrier; or (2) part of an assembly tested in accordance with AC 377, Appendix X (or ASTM E 970 for attic floors only).

> **Note 3:** Model building codes allow an exception to the thermal barrier requirement in attics and crawlspaces where entry is made only for repairs or maintenance (IRC) or for the service of utilities (IBC). This language is often misunderstood and misinterpreted by designers, builders, SPF applicators and building officials alike.
>
> While the ultimate decision is left to the discretion of the local code authority, ICC Staff and ICC-ES engineers offer the following conditions that would determine if the space is entered only for repairs, maintenance or service of utilities:
>
> - Limited access (hatch, small door, etc)
> - Utilities within space including, but not limited to, HVAC equipment, ductwork, electrical lines, plumbing, wiring of any type (telephone, internet, cable, security, etc), radiant heating, etc
> - Possibility that any utility as described above may be installed in the future
>
> Based on this interpretation of the building code, the following criteria are often applied to determine appropriate fire protection for SPF surfaces in attics and crawlspaces:

- Thermal Barrier: Whenever the attic or crawlspace is used or could reasonably be used as an auxiliary living space or for storage. Criteria for such space may include: ease of entry, or fixed stairs, and presence of usable flooring (other than minimal pathways for equipment access). It should be noted that the

presence of any of the previous criteria does not automatically require thermal barrier protection, but rather offers guidance on what a code official might consider when determining the use of the space.

- Ignition Barrier: Whenever the attic or crawlspace is not or could not be used as an auxiliary living space or for storage. Criteria include difficulty of entry (for example a hatch or opening not easily accessible) and lack of flooring.
- Neither Barriers: Whenever no access exists to the space and the space is not connected and does not communicate with other spaces. (See Note 2 regarding ceiling and floor treatments).

Selection of Thermal Barriers

Generally, SPF installers have three choices:

(1) Prescriptive thermal barrier: The IBC and IRC specifically name ½-inch gypsum wallboard as an "approved" thermal barrier.

(2) Equivalent thermal barriers: Materials equivalent to ½-inch gypsum wallboard can be used as thermal barriers provided they have been tested in accordance with the IBC or IRC to limit temperature rise and remain in place for 15 minutes as described above in the "What is a Thermal Barrier" section. Typical equivalent thermal barriers include:

   a. Spray-applied cementitious materials
   b. Spray-applied cellulose materials
   c. Portland cement plaster
   d. Intumescent coatings
   e. Other various proprietary materials.

   Evaluation reports can assist code officials in determining the code compliance of equivalent thermal barriers. Local building code officials are permitted to allow the use of an equivalent thermal barrier which has not been issued an evaluation report provided that data satisfactory to the code official is submitted for approval.

> Equivalent thermal barriers and alternative assemblies are tested as part of assemblies which include specific formulations, materials, thicknesses and densities. Unless otherwise approved by the code authority having jurisdiction, the following rules apply:
>
> 1. SPF must be installed at thicknesses and density equal to or less than tested;
> 2. Protective materials must be installed at thicknesses equal to or greater than tested;
> 3. Formulations, materials and construction must conform to that which was tested.

(3) Alternative assemblies: SPF may be covered with other materials (such as intumescent or other coating systems) or left exposed provided the assembly has been specifically approved on the basis of large-scale fire testing representing the actual end-use configuration. Alternative assemblies may have a currently valid evaluation report. Local building code officials are permitted to allow the use of an alternate assembly which has not been issued an evaluation report provided that data satisfactory to the code official is submitted for approval. Generally accepted tests for alternative assemblies include:

- NFPA 286 Standard Methods of Fire Tests for Evaluating Contribution of Wall and Ceiling Interior Finish to Room Fire Growth (with specific acceptance criteria defined within the IBC or IRC)
- UL 1715 Fire Test of Interior Finish Material
- UL 1040 Insulated Wall Construction)
- FM 4880 Building Corner Fire Test)

Alternative assemblies tested under AC 377, Appendix X or ASTM E 970 are not appropriate alternative assemblies for meeting thermal barrier requirements.

Caution: Just because a material is advertised as a "thermal barrier" or an assembly is advertised as not requiring a thermal barrier does not mean that it has been approved by a code agency or a local code official. Ask for test data **and** code body approvals, listings, or other written indications of acceptability under the code to be sure that the

product selected offers the fire protection that the code requires.

Selection of Ignition Barriers

Generally, SPF installers have three choices:

(1) Prescriptive ignition barriers: These are specifically named in the IBC and IRC by type and thickness (for a list, see the "What is an Ignition Barrier" section above).

(2) Alternative materials: Alternate coatings or coverings may be approved by code authorities having jurisdiction. Proof of appropriate testing in accordance with AC 377, Appendix X supported by an evaluation report may be required (additional limitations are applicable, see Note 4).

(3) Alternative assemblies: Leaving SPF exposed in an attic or crawlspace may be permitted provided the SPF has been tested and passed in accordance with AC 377, Appendix X or ASTM E 970. An evaluation report maybe required by the code authority having jurisdiction before approving such an installation (additional limitations are applicable, see Note 4).

Alternative ignition barrier materials and alternative assemblies are tested as part of assemblies which include specific formulations, materials, thicknesses and densities. Unless otherwise approved by the code authority having jurisdiction, the following rules apply:

1. SPF must be installed at thicknesses and density equal to or less than tested;
2. Protective materials must be installed at thicknesses equal to or greater than tested;
3. Formulations, materials and construction must conform to that which was tested.

Note 4: AC 377, Appendix X limits alternative materials and assemblies in attic and crawlspaces as follows:

a. Entry to the attic or crawl space is only to service utilities, and no storage is permitted.
b. There are no interconnected attic or crawl space areas.
c. Air in the attic or crawl space is not circulated to other parts of the building.
d. Attic ventilation is provided when required by IBC Section 1203.2 or IRC Section R806, except when air-impermeable insulation is permitted in unvented attics in accordance with Section R806.4 of IRC, Under-floor (crawl space) ventilation is provided when required by IBC Section 1203.3 or IRC Section R408.1, as applicable.
e. The foam plastic insulation is limited to the maximum thickness and density tested.
f. Combustion air is provided in accordance with Sections 701 and 703 (2006 IMC) and Section 701 (2009 IMC).
g. The installed coverage rate or thickness of coatings, if part of the insulation system, shall be equal to or greater than that which was tested.

[Cited from AC 377, effective November 1, 2010]

Caution: Just because a material is advertised as an "ignition barrier" or an assembly is advertised as not requiring an ignition barrier does not mean that it has been approved by a code agency or a local code official. Ask for test data **and** code body approvals, listings, or other written indications of acceptability under the code to be sure that the product selected offers the fire protection that the code requires.

Fire Safety Guidance

Working with Polyurethane Foam Products

During New Construction, Retrofit and Repair

American Chemistry Council | Center for the Polyurethanes Industry

Fire Safety Guidance

Fire is a serious concern during construction, repair and retrofit projects because materials can be exposed to ignition sources. For example, there may be a potential for polyurethane/polyisocyanurate foam to be exposed to open flame from welding, cutting torches, and other ignition sources from allied trades during certain construction sequences. While fires involving polyurethane or polyisocyanurate foam during construction, retrofit or repair are rare, they do happen. The following safety precautions, limited here to a discussion of polyurethane and polyisocyanurate foam products that are present during "hot work," are suggested for the construction site to help prevent these accidents. However, if a fire does occur and cannot be extinguished immediately, evacuate the area at once. Any guidance or suggestions made in this document do not replace the instructions provided by the employer, the MSDS and the product instructions.

OSHA defines Hot Work as riveting, welding, flame cutting or any other fire or spark-producing operation (See 29 CFR § 1910.252a)

Trade Performing "Hot Work"

OSHA defines Hot Work as riveting, welding, flame cutting or any other fire or spark-producing operation (See 29 CFR § 1910.252a)

- OSHA states that "hot work" permits must be authorized by an individual designated by management and only after a "hot work" assessment has been completed. It also states that the person performing the "hot work" is not authorized to make such assessments or issue permits.
- Thoroughly educate other trades on the site about fire characteristics of polyurethane or polyisocyanurate foam. Refer to the foam manufacturer's literature for safety recommendations.
- If possible, perform "hot work" in a designated area free of combustibles.
- If "hot work" must be performed in an area where there are combustibles, move the combustibles, if possible, a distance of at least 35 feet from the "hot work," as required by OSHA. If the combustibles cannot be moved, shield the combustibles with a fire retardant cover.
- A fire watch is required by OSHA (see 29 CFR 1910.252(a) (2)(iii)) where:
  - » combustible building materials or contents are closer than 35 feet to the point of operation;
  - » wall or floor openings within a 35-foot radius expose combustible materials in adjacent areas, including concealed spaces in walls or floors;
  - » combustible materials are adjacent to the opposite side of partitions, walls, ceilings, or roofs and are likely to be ignited; or
  - » any other criteria are applicable as listed by OSHA under 29 CFR § 1910.252a (Fire Prevention and Protection).

If a fire occurs that cannot be extinguished immediately, evacuate the area at once

Contractor

- Conduct job safety meetings with all other trades in order to develop a safety plan before, during and after polyurethane or polyisocyanurate application. Review foam manufacturer's installation instructions for safety recommendations.
- For retrofit or repair projects, determine whether foam products are present before any hot work is performed. If so, follow the same fire prevention procedures as for new construction.
- If foam insulation is being installed near potential ignition sources, a fire watch may be required (see Trade Performing "Hot Work" Section for fire watch discussion).
- Provide warning signs and labels on the job site where the trades performing hot work are most likely to see them, as required by 29 CFR § 1910.145 and 29 CFR § 1910.252.
- Do not allow smoking on the job site.
- Schedule application of required thermal barrier as soon as practically possible.
- Keep other trades from working in the application area until a thermal barrier is applied over the foam. If another trade must work in the area before the thermal barrier is applied, they should determine if a fire watch is required (see Trade Performing "Hot Work" Section for fire watch discussion).

For Spray Polyurethane Foam Contractors

- Review the manufacturer's installations instructions concerning the thickness of the foam per pass, because the SPF may scorch or ignite when installed too quickly to achieve the desired thickness or installed in too thick a pass.

All Trades

If a fire occurs that cannot be extinguished immediately, evacuate the area at once.

- Have an adequate supply of suitable fire extinguishers in convenient locations. Personnel that use extinguishers must be trained in their use. (Note: Polyurethane and polyisocyanurate foam typically require carbon dioxide and dry chemical extinguishers)
- Avoid accumulating large amounts of combustible waste materials (for example, foam trim and paper). Observe good housekeeping practices, and dispose of waste properly.
- Do not smoke on the job site.

Additional Fire Safety Information:

Rigid polyurethane or polyisocyanurate foams will, if ignited, release various products of combustion such as smoke and gases that may be irritating, flammable and/or toxic. As with other organic materials, such as wood, the primary combustible gases are carbon dioxide and carbon monoxide.

- **Fire Safety Guidelines for Use of Rigid Polyurethane or Polyisocyanurate Foam Insulation in Building Construction**
  Center for the Polyurethanes Industry
  http://www.polyurethane.org/s_api/sec.asp?CID=1649&DID=11363
- **AY 126: Thermal Barriers for the Spray Polyurethane Foam Industry**
  Spray Polyurethane Foam Alliance
  http://www.sprayfoam.org/downloads/pdf/AY%20126.pdf
- **NFPA 51 B, Fire Prevention During Welding, Cutting and Other Hot Work**
  National Fire Prevention Association
  http://www.nfpa.org/aboutthecodes/AboutTheCodes.asp?DocNum=51B
- **OSHA Regulation 29 CFR § 1910.252 Welding, Cutting, and Brazing ttApplication Standard**
  http://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=STANDARDS&p_id=9853
- **Tech Tip Spray Polyurethane Foam – Exotherm vs. Thickness**
  Spray Polyurethane Foam Alliance
  http://www.sprayfoam.org/uploads/pages/4480/Tech%20Tip%20Exotherm.pdf

For more information on material presented in these Guidelines, please contact your supplier.

Fire Safety Guidance

Working with Polyurethane Foam Products During New Construction, Retrofit and Repair

1

MEET:
Conduct a safety meeting with other trades.

2

POST:
Put up warning signs at the site.

3 MOVE:

Move combustibles away from the "hot work" site.

4 SHIELD:

Shield combustibles with fire blanket or welder's blanket.

WATCH:

Provide fire watch if necessary. Have appropriate fire extinguisher and telephone nearby. Evacuate area if fire cannot be extinguished immediately.

PROTECT:

Protect installed foam with a required thermal barrier such as ½ in gypsum board as soon as possible.

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American Chemistry Council | Center for the Polyurethanes Industry

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ALLIANCE FOR THE POLYURETHANES INDUSTRY
A BUSINESS UNIT OF THE AMERICAN PLASTICS COUNCIL

technical bulletin

September 2002 AX151

Guidelines for the Responsible Disposal of Wastes and Containers from Polyurethane Processing

Introduction

This guide was developed to help processors of polyurethane chemicals manage waste chemicals and empty containers in a responsible manner that conforms to federal and state regulations. In particular, this guide focuses on those chemicals used in polyurethane processing operations that may be regulated as hazardous waste.

Regulations

Hazardous waste regulations are developed and implemented by the US Environmental Protection Agency (EPA) as directed by Congress in the Resource Conservation and Recovery Act of 1976 (RCRA) and subsequent amendments. EPA's hazardous waste management regulations are currently codified in 40 CFR Parts 260 to 270, and impose requirements upon hazardous waste generators concerning waste classification, waste accumulation, treatment and disposal, recordkeeping, and emergency preparedness. At the time of publication, EPA has delegated authority to implement and enforce hazardous waste management programs to 49 of the 50 states. State regulations may be more stringent or more extensive than the corresponding EPA regulations.

What is a Hazardous Waste?

EPA defines hazardous waste in 40 CFR Part 261. In order for a waste to be hazardous waste it must meet the EPA definition of "solid waste," since hazardous waste is considered a subset of solid waste.

contents

The term "solid waste" is used very broadly in RCRA and refers to both nonhazardous and hazardous waste, including not only solids, but also liquids, sludges, and compressed gases. Materials that are being disposed of, or are accumulated, stored, or treated before or instead of being disposed of, are solid waste. Also, spent materials that are accumulated, stored or treated before being recycled are usually solid waste. Generally, chemicals stored with no possibility of use or reclamation are solid waste.

EPA has determined that certain solid wastes are hazardous wastes if they may cause an increase in mortality or illness or pose substantial hazard to

human health or the environment when improperly managed. A waste is considered hazardous if it (1) is listed on one of the lists of hazardous wastes published by EPA in 40 CFR Part 261, Subpart D or (2) exhibits one or more of the four hazardous characteristics defined in 40 CFR Part 261, Subpart C. Listed and characteristic hazardous wastes are identified using EPA codes consisting of one letter followed by three digits. Some states may use additional codes for state-unique hazardous waste streams. For example, the hazardous waste code for used oil in Massachusetts is MA98. For listed wastes, the first letter in the code corresponds to the common list name (e.g., "F-List"). The first letter in the codes of characteristic wastes is D. Generators are required by law to identify their hazardous wastes with all applicable codes.

To determine if a waste is a regulated hazardous waste, the generator needs to first determine whether the waste fits within the definition of "solid waste" and, if so whether the waste is excluded from regulation under 40 CFR § 261.4. Next, the generator needs to examine whether the waste is listed as a hazardous waste in 40 CFR Part 261, Subpart D. Finally, the generator needs to consider whether the waste exhibits one or more of the hazardous characteristics identified in 40 CFR Part 261, Subpart C. In making these determinations, generators may use either analytical testing or their knowledge regarding the process that generates the waste. Wastes such as outdated raw materials may not require testing since knowledge of the chemicals' origins and characteristics may be applied in the determination. Often material safety data sheets (MSDSs) can be useful for this purpose.

Listed Wastes

There are four primary lists of hazardous wastes. To determine if a waste is listed, one must have knowledge of the waste's origin. The lists are described briefly below, but complete copies of the hazardous waste lists are included in 40 CFR Part 261.

- **F-List [40 CFR § 261.31]** — The F-list identifies spent solvents, electroplating wastes, wood-preserving wastes, certain landfill leachates, and more. Polyurethane processors may generate F-listed spent solvents (e.g., used methylene chloride, acetone, toluene, etc.). Spent solvents on the F-list are designated by the codes F001, F002, F003, F004 and F005.
- **K-List [40 CFR § 261.32]** — The K-list identifies wastes from specific industries (e.g., ink formulating, petroleum refineries and metal smelting). It is unlikely that polyurethane processors generate K-listed hazardous waste.
- **P-List [40 CFR § 261.33(e)]** — The P-list applies to unused discarded commercial chemical products with a sole-active ingredient on the P-list. Also, off-specification materials, container residues and spill residues of P-listed materials are P-listed wastes. P-listed wastes are "acutely hazardous wastes" and are subject to more stringent management standards than other hazardous wastes. It is unlikely that polyurethane processors will generate P-listed hazardous waste; however, processors should review the P-list to be sure. P-listed waste should be segregated from other hazardous waste.
- **U-List [40 CFR § 261.33(f)]** — The U-list is applied to wastes similar to application of the P-list. The U-list applies to unused discarded commercial chemical products with a sole-active ingredient on the U-list. Also, off-specification materials, container

residues and spill residues of U-listed materials are U-listed wastes. U-listed wastes are referred to as "toxic wastes." TDI (U223), MOCA (U158), DOP (U107), and methylene chloride (U080) are examples of chemicals used in the polyurethane industry that, upon disposal, may be U-listed hazardous wastes. Although discarded TDI is a U-listed waste, discarded TDI prepolymers are not. In a TDI prepolymer there may be some free TDI, but it is not the "sole active ingredient." On the other hand, if pure TDI were spilled, all of the spill cleanup material would be U223. Similarly, in a B-side formulation with polyol and MOCA, MOCA is not the "sole-active ingredient" and therefore the B-side waste would not be listed. However, cleanup of a pure MOCA spill would be U158.

Characteristic Wastes

EPA has identified four hazardous waste characteristics: ignitability, corrosivity, reactivity and toxicity. Generators may use testing or knowledge to determine if their wastes exhibit one or more of the characteristics.

- **Ignitability [40 § CFR 261.21]** — Ignitable wastes, denoted by the code D001, are generally liquids with flash points below 60˚C (140˚F).
- **Corrosivity [40 § CFR 261.22]** — Corrosive wastes, denoted by the code D002, are generally aqueous solutions with a pH ≤ 2 or ≥ 12.5.
- **Reactivity [40 § CFR 261.23]** — Reactive wastes, denoted by the code D003, are those wastes that are generally unstable, explosive, capable of detonation when heated under confinement, react violently with water or generate toxic gases, vapors, or fumes in dangerous quantities when mixed with water. Also, wastes are reactive if they generate toxic cyanide or sulfide fumes when subjected to pH between 2 and 12.5.
- **Toxicity [40 § CFR 261.24]** — Toxic wastes, denoted by the codes D004 through D043, are wastes containing certain regulated constituents. To determine if wastes exhibit the characteristic of toxicity, they are subjected to the toxicity characteristic leaching procedure (TCLP). TCLP identifies wastes that are likely to leach hazardous concentrations of regulated constituents above specified thresholds (mg/L) in simulated landfill conditions. Regulated constituents include various organic chemicals (e.g., chlorinated solvents, volatiles and semi-volatiles), pesticides (e.g., Lindane) and heavy metals (e.g., mercury, lead, cadmium).

Are Mixtures a Hazardous Waste?

Processors should beware of mixing hazardous waste with non-hazardous waste — especially when listed wastes are concerned. In most cases, if a non-hazardous or characteristic waste is mixed with a listed waste, the entire resulting mixture is considered listed hazardous waste and the original listed waste code applies to the mixture. It is advisable to segregate listed wastes from non-hazardous waste because mixing listed waste with non-hazardous waste results in the generation of increased volumes of listed hazardous waste. Under certain circumstances, wastes may be mixed to make a non-hazardous waste. This is particularly true in the polyurethane industry. However, generators need to use caution when mixing hazardous wastes in order to treat wastes. With a few exceptions, facilities treating hazardous waste must have RCRA permits. These exceptions are discussed below.

Are Empty Containers Hazardous Wastes?

Empty containers that once held hazardous chemicals are not regulated as hazardous waste if they meet the definition of "empty." A container is empty if all waste has been removed (e.g., by pouring or pumping) and less than one inch of residue remains on the bottom of the container. In general, there should be no free liquids in an "empty" container. Containers that held acutely hazardous waste (e.g., P-listed waste) are considered empty only after being triple rinsed with a solvent capable of removing the acutely hazardous waste residue. The solvent rinsate is then managed as acutely hazardous waste.

"Empty" containers may not be subject to RCRA but their disposal still may raise challenges. A few options for managing empty drums are outlined below:

- Arrange with the raw materials supplier to accept return drums.
- Reuse drums for outgoing product. Obviously this option poses compatibility and contamination issues. Also, this is not a viable option for packaging hazardous materials under transportation regulations.
- Ship empty drums to a drum reconditioner or a scrap recycler. In either case, the reputation of facilities handling empty drums must be carefully checked. (For more information on drum recycling facilities, see http://www.reusablepackaging.org)
- Disposal of drums into the local landfill is almost never an option since most landfills have an outright ban on accepting recognizable drums. In some cases, processors may be able to destroy the drums (e.g., using a drum crusher) and send them to a landfill. Still, sending empty drums to a landfill can pose long-term liability issues if the landfill is ever found to be contaminated.

Some processors have found that receiving raw materials in returnable shipping containers (e.g., totes) instead of drums is one of the better options. This requires a negotiated understanding with the supplier.

What Are My Responsibilities as a Hazardous Waste Generator?

EPA imposes numerous requirements upon hazardous waste generators, which govern all aspects of a waste management program including waste classification, storage, reporting and recordkeeping, training, and more. However, hazardous waste generators are subject to varying requirements depending on how much hazardous waste they generate monthly. Under EPA rules, there are three classes of generators: large quantity generators (LQGs), small quantity generators (SQGs), and conditionally-exempt small quantity generators (CESQGs). SQGs and LQGs are subject to more hazardous waste management requirements as depicted in the table below, while CESQGs are usually subject to very minimal regulation (in most states). Some states define generator status differently and set more stringent or different requirements upon SQGs and CESQGs. Because a facility's generator status is determined on a monthly basis, it is possible that a facility may be subject to different requirements throughout the year. For example, if a facility generates less than 100 kilograms of hazardous waste in January, it would be considered a CESQG and subject to the less onerous hazardous waste management requirements for that type of facility. If the same facility generates 500 kilograms of hazardous waste in February, its status would change to SQG and the facility would be subject to the hazardous waste management requirements applicable to that type of facility. For continued compliance, some facilities

Table 1—Basic Hazardous Waste Generator Requirements

Requirement (40 CFR § or Part)	CESQG	SQG	LQG
Waste Determination (262.11)	✔	✔	✔
Generation Rate (261.5 and 262.34)	≤ 100 kg/mo	100-1,000 kg/mo	No Limit
Accumulation Quantity (261.5 and 262.34)	≤ 1,000 kg; ≤ 1 kg acute	≤ 6,000 kg; ≤ 1 kg acute	No Limit
Accumulation Time (261.5 and 262.34)	No Limit	180 or 270 Days	90 Days
EPA ID Number (262.12)		✔	✔
Manifesting (262, Subpart B)		✔	✔
Mark Containers "Hazardous Waste" (262.34)		✔	✔
Mark Containers with Start Date (262.34)		✔	✔
Satellite Accumulation (262.34(c))		✔	✔
Personnel Training (262.34 and 265.16)		Minimal requirements in 262.34(d)(5)(iii)	✔
Preparedness and Prevention (265, Subpart C)		✔	✔
Contingency Planning (265, Subpart D)		Minimal requirements in 262.34(d)(5)	✔
Container Management (265, Subpart I)		✔ (except 265.176)	✔
Tank Management (265, Subpart J)		Only 265.201	✔
Recordkeeping and Reporting (262, Subpart D)		Only 262.44	✔
Land Disposal Restrictions (268.7)		✔	✔

choose to meet the more stringent requirements at all times if they know that their facility is likely to change generator status multiple times throughout the year.

Table 1 presents an overview of EPA hazardous waste management requirements that apply to processors depending upon their generator status.

How Do I Store Hazardous Waste?

Satellite Accumulation

When hazardous waste is accumulating at the point where it is initially generated and is under control of the process operator generating that waste, it is considered to be in a "satellite accumulation area" and is subject to minimal regulatory requirements (40 CFR § 262.34(c)). Specifically, hazardous waste containers must remain closed except when adding waste; containers must be marked with the words "Hazardous Waste" or other words that identify the containers' contents; containers must be in good condition and compatible with the wastes they contain; and no more than 55 gallons of hazardous waste or one quart of acutely hazardous waste may be stored at each satellite accumulation area.

Hazardous Waste in a Designated Accumulation Area

Once hazardous waste leaves the satellite accumulation area and enters a different location, referred to here as an accumulation area, it is subject to more

stringent management standards. When waste leaves the satellite accumulation area, "the clock starts," and from this date, the waste must be shipped off-site to a permitted hazardous waste treatment, storage or disposal facility (TSDF) within 90, 180 or 270 days, depending on the generator's status (e.g., CESQG, SQG, or LQG) and distance from the TSDF (40 CFR § 262.34).

In the accumulation area, all hazardous waste containers must be clearly marked with the date they entered the area. All containers must be clearly marked "Hazardous Waste." Emergency equipment must be maintained at the accumulation area and periodically tested to ensure it is in working order (e.g., communications device or alarm system, fire extinguishers, spill control equipment, etc.). Waste containers must be arranged in the accumulation area so that there is adequate aisle space to allow for the flow of emergency personnel and equipment. Incompatible wastes must be separated to the extent possible using distance, berms, or containment pans. The accumulation area must be inspected weekly for leaks and deterioration, and to ensure adequate spill response materials are on-hand.

How Do I Dispose of Hazardous Waste?

Most processors ship hazardous waste to permitted TSDFs. As specified in the EPA regulations, these shipments must comply with the US Department of Transportation (DOT) Hazardous Materials Regulations, 49 CFR Parts 171-180. Hazardous waste shipments must be accompanied by a hazardous waste manifest (shipping paper) and must be transported by an EPA-permitted transporter (40 CFR Part 262 Subpart B). Processors should ensure that their waste is shipped to a reputable, permitted TSDF in order to avoid potential future liabilities.

Prior to off-site disposal, careful waste segregation is important for both safety and economic reasons. For example, if methylene chloride waste is mixed with a B-side polyol blend, then more hazardous waste is generated and the cost of disposal will escalate because of the chlorine content, which decreases the opportunity for fuel blending the polyol or recycling the methylene chloride. Fuel blending and recycling generally are less expensive options and can be more responsible stewardship than conventional hazardous waste incineration.

Potential liability arises from the disposal of all chemical wastes, most particularly hazardous waste. Under the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA or "Superfund"), a person who arranges for the disposal or treatment, or transportation for disposal or treatment, of a hazardous substance can be held liable for any future remedial costs associated with those substances. Hazardous wastes qualify as hazardous substances under CERCLA, as do MDI, TDI, and other products used in the polyurethane industry. In order to limit potential liability, processors should ensure that all wastes are disposed, treated, and transported properly by licensed, reputable firms.

May I Treat or Dispose of My Hazardous Waste On-Site?

In limited circumstances, processors may treat hazardous waste on-site. However, before treating, hazardous waste processors should be sure that the treatment they are planning does not require a RCRA treatment permit. In fact, with few exceptions, on-site treatment requires a RCRA permit. RCRA permits are extremely costly and time consuming to obtain, but treating a hazardous waste without a permit when

one is required can subject processors to huge fines or criminal prosecution for noncompliance.

One widely applied type of hazardous waste treatment that EPA allows without a permit is elementary neutralization (adjusting the pH of an acidic or basic solution). EPA also allows generators to treat hazardous waste in accumulation containers without a permit, provided that the containers are managed in compliance with EPA's container management standards in 40 CFR Part 265, Subpart I. EPA states this exemption in its Federal Register notice dated March 24, 1986 (51 FR 10168) as well as in subsequent FR notices and interpretive memos. This allowance is quite broad in that it does not limit what type of treatment may take place (e.g., precipitation, oxidation/reduction, polymerization). Still, when treating a listed hazardous waste, generally the treatment residue carries the listing of the original hazardous waste. Therefore, the usefulness of this allowance is limited for listed wastes.

For example, excess, pure TDI waste reacted with a polyol would form an inert polyurethane that may be regulated as U223 hazardous waste. However, excess MDI waste reacted with polyol would not result in a regulated material because MDI is not a U-listed chemical. Although some treatment of hazardous wastes without a permit is allowed by most states, processors are cautioned to check with their state regulators before treating any hazardous waste.

Keep in mind that permits for treatment are only required for RCRA "hazardous wastes" and state-regulated waste streams. Processors may treat wastes that are not regulated as hazardous. In many cases, excess A-side (isocyanate) and B-side (polyol) formulations may be reacted to make non-hazardous solids that may be disposed with regular trash. Regardless, check with the waste transporter and disposal facility before mixing any non-hazardous waste streams together or with the regular plant trash.

Where Can I Get More Information?

1. **www.epa.gov**
   EPA's official web site.
2. **www.epa.gov/epaoswer/osw**
   Links to information concerning permits, storage, disposal, recycling, and identification of hazardous waste and EPA regulations.
3. **http://www.epa.gov/rcraonline**
   RCRA Online — enables you to search for questions/answers; guidance documents on all aspects of EPA's hazardous waste regulations.
4. **www.atsdr.cdc.gov**
   Agency for Toxic Substances and Disease Registry: health effects and minimum risk levels of hazardous chemicals.
5. **www.epa.gov/estpages/wasthazardouswaste.html**
   Contains links to hazardous waste and RCRA information within EPA.
6. **http://www.epa.gov/epaoswer/osw/regions.htm**
   Link to regional EPA and state hazardous waste offices.
7. **www.osha.gov/SLTC/hazardouswaste**
   Safety and health information for hazardous waste handlers (PPE, training, etc.).
8. **http://hazmat.dot.gov**
   DOT HazMat site: information regarding regulations governing the transportation of hazardous materials.

These Guidelines have been prepared by the Alliance for the Polyurethanes Industry (API), a business unit of the American Plastics Council (APC), as a service to its members and their customers. It is intended to assist in the general understanding of legal and regulatory obligations governing disposal of wastes and containers from polyurethane processing. The information herein is provided in good faith and is believed to be accurate when prepared, but is offered WITHOUT WARRANTY, EXPRESSED OR IMPLIED. API, its members and contributors disclaim all responsibility for any regulatory challenge, loss, or damage arising from reliance on these Guidelines by any party, and assume no responsibility for compliance with applicable laws and regulations by users of the Guidelines. Specific questions relating to disposal of hazardous wastes should be addressed to legal counsel or appropriate technical advisors.

api
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Guidance for Working with MDI and Polymeric MDI: Things You Should Know

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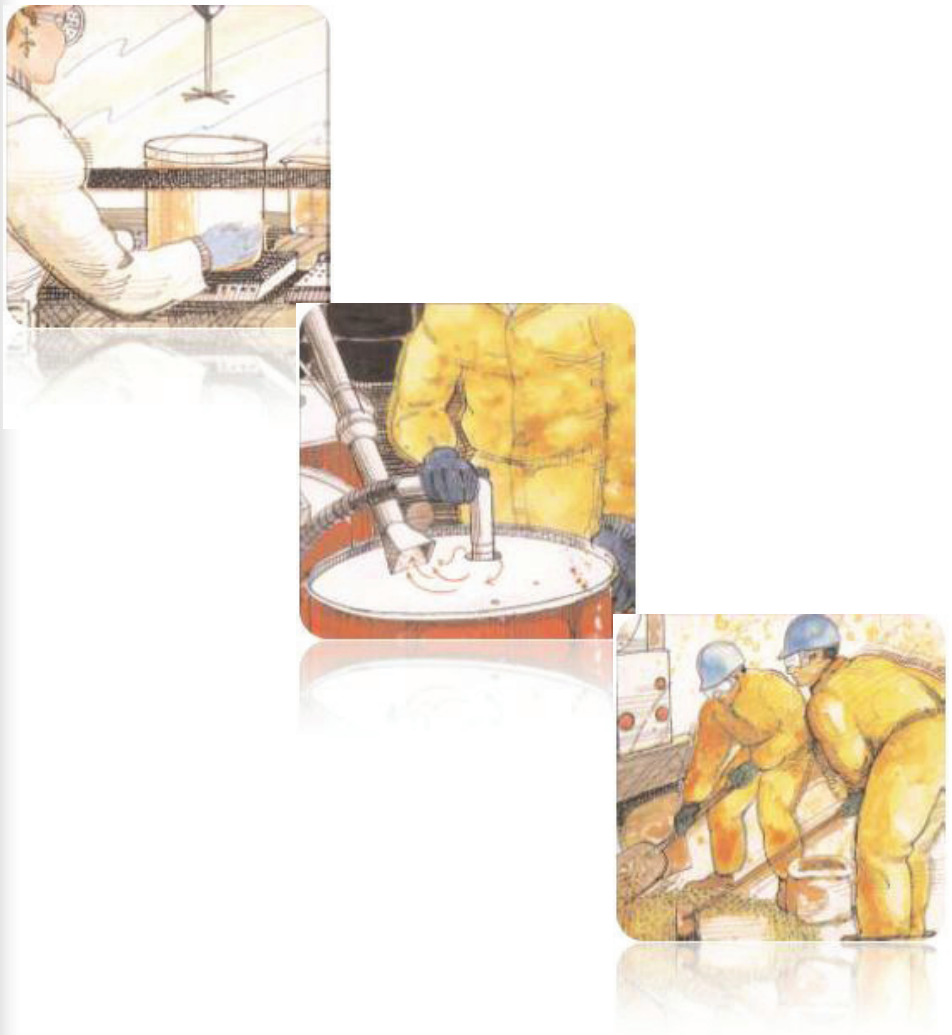
Purpose

The Center for the Polyurethanes Industry (CPI), prepared this guidance to provide information about important health and safety considerations when working with MDI or polymeric MDI. It supplements the comprehensive information contained in your supplier's Safety Data Sheets (SDSs), which are as the primary source of information for specific MDI or polymeric MDI distribution and handling issues. Throughout this document, the term MDI is used to adress both MDI and polymeric MDI.



American Chemistry Council | Center for the Polyurethanes Industry

Identifying MDI

Diphenylmethane diisocyanate, commonly referred to as MDI, is a white to yellowish solid at room temperature with no odor. Polymeric MDI, which is more commonly used, is a mixture of MDI and larger molecular weight oligomers of MDI, and is a brownish liquid at room temperature and may have a slight odor. Some typical values for other physical properties are:

	Pure MDI	**Polymeric MDI**
Physical State	Solid at ambient conditions	Liquid
Molecular Weight	250	varies
Boiling Point	> 300 °C	> 300 °C
Freezing/Melting Point	40 °C	5 °C
Specific Gravity	1.33 @ 68°F (20°C)	1.24 @ 68°F (20°C)
Density	9.8 lbs/gal (50°C)	--
Vapor Pressure	$4.65x10^{-6}$ mm Hg at 68°F (20°C)	$2.33x10^{-6}$ mm Hg at 68°F (20°C)
Viscosity	4.7 to 5.0 mPas @ 122°F (50°C)	100 to 250 mPas @ 77°F (25°C)
Solubility in Water	not soluble; reacts with the evolution of CO2	not soluble; reacts with the evolution of CO2
Flash Point	412°F (211°C)	406°F (208°C)

Source: MDI and TDI: Safety, Health and the Environment. A Source Book and Practical Guide. Dennis C. Allport, David S. Gilbert, Susan M. Outterside, 2003.

Recognizing Potential Health Hazards

Overexposure to MDI vapor, liquid or aerosol can be harmful to your health. There are four possible routes of exposure:

- breathing it in
- getting it in your eyes
- getting it on your skin
- swallowing it

Here are the potential effects of overexposure and some first-aid considerations:

Inhalation: If MDI is sprayed as a mist or heated, or handled where there is poor ventilation, there is a greater chance of overexposure. Even if you cannot smell MDI, you may be in danger of overexposure, because most people cannot smell MDI until concentrations are above applicable exposure limits. Exposure limits are set by regulatory

organizations like the Occupational Safety and Health Administration (OSHA) and other professional organizations such as the American Conference of Governmental Industrial Hygienists (ACGIH). Exposure limits typically define the maximum air concentration to which you can be exposed without the need for respiratory protection.

MDI can irritate your nose and lungs. You may feel tightness in your chest and have difficulty breathing. Overexposure may cause you to become sensitized or "allergic" to MDI which may cause you to have asthma-like attacks if you breathe MDI vapors again. If this happens, any further exposure must be avoided. Effects may occur immediately upon exposure, and/or be delayed for several hours after exposure ends.

If you suspect someone has become overexposed, remove the person to an area with fresh air, and try to keep them calm and warm — but not hot. Seek immediate medical attention. If they are having difficulty breathing, a qualified person may provide oxygen. If they stop breathing, a qualified person may give artificial resuscitation. Call a doctor at once.

Eye Contact: Getting MDI in your eyes can be painful and could cause tearing and irritation. Wear chemical goggles or safety glasses with side shields whenever you might be exposed to liquid or vapor MDI or MDI mist. If you get MDI in your eyes, wash them immediately with a continuous flow of low pressure water, preferably from an eyewash fountain, for at least 15 minutes. See a doctor at once.

Skin Contact: Getting MDI on your skin may play a role in the development of skin sensitization. In addition, animal tests have indicated that respiratory sensitization may occur from skin contact with MDI. Repeatedly getting MDI on your skin may also cause discoloration, redness, swelling, or itching. It is best to conduct your work to avoid skin contact, but if you get MDI on your skin, wash thoroughly with soap and flowing water (warm water if available), do not use solvents.

If your skin is irritated, seek medical attention. Properly dispose of any clothing contaminated with MDI, as well as contaminated items such as shoes, belts, and watchbands.

Ingestion: Swallowing MDI can cause irritation in your mouth, throat and stomach. If you swallow MDI, rinse the mouth with water; do not try to induce vomiting. See a physician immediately.

Protecting Yourself from MDI Overexposure

Overexposure to airborne MDI can occur in inadequately ventilated environments when MDI is sprayed, aerosolized, or heated. In addition, overexposure can occur when there is direct skin contact with liquid MDI.

Where there is a risk of exposure to airborne MDI above applicable exposure limits, consider using (at a minimum):

- An approved respirator, either air-supplied or air-purifying. Consult your company safety professional or the product SDS for guidance. The type of respiratory protection will depend upon the maximum exposure concentration.
- Elevated airborne concentrations may be irritating to the eyes; therefore eye protection may also be needed if not already provided by the respirator.

Where there is a risk of skin and eye contact with liquid MDI consider using at a minimum:

- MDI resistant gloves (see CPI document MDI User Guidelines for Protective Clothing Selection, AX-178).
- Chemical safety goggles.
- If there is potential for more extensive exposure, consider using the following:
    - MDI-resistant long-sleeve coveralls or full body suit.
    - MDI-resistant fitted boots.
    - Head protection, such as a close-fitting hood.

In spray applications, use respiratory protection, eye protection, and complete skin protection are necessary. Visit spraypolyurethane.org for additional health and safety information on spray polyurethane foam.

Understanding Potential Reactivity Hazards

MDI is a reactive chemical. Reactions with buildup of heat or pressure can result from improper mixing with:

- Acids, inorganic bases (such as sodium hydroxide or potassium hydroxide), ammonia, and amines;
- Magnesium, aluminum and their alloys
- Other metal salts, especially halides (such as tin, iron, aluminum and zinc chlorides)
- All strong oxidizing agents (such as bleach or chlorine)
- Polyols
- Water (typically a relatively slow reaction)

Caution: Resealing MDI containers contaminated with any of the above materials can cause a buildup of pressure in the container and cause it to explode. All forms of MDI can

also self-react in a fire or at very high temperatures, releasing carbon dioxide and causing the buildup of pressure in sealed containers sufficient to cause explosion.

Handling, Unloading and Storing MDI Considerations

To minimize hazards when handling, unloading, or storing MDI consider the following:

- Wear protective clothing
- Follow employers' established procedures for normal operations, maintenance, loading/ unloading sampling, special operations, and emergencies
- Use appropriate checklists provided by the employer for specific procedures
- Inspect equipment to ensure operating integrity following maintenance procedures
- Maintain good housekeeping
- Participate in relevant training programs

Handling drums consider the following:

- Wear protective clothing
- Follow all safety precautions for handling MDI until empty drums are decontaminated
- Handle and store drums in a well-ventilated area with containment
- Check drum shipments for leakage
- Do not use pressure to empty drums
- Do not store MDI in open-head drums
- Use plugs/caps on terminal valves or fittings and bleed valves
- Keep drum overpacks available
- Keep drums segregated from containers of material that are incompatible with MDI
- Provide secondary containment
- Do not cut empty MDI drums with a torch
- Do not use empty MDI drums from a worksite for personal use such as a barbecue pit, flower box, trash barrel, etc. Empty drums should be handled by a qualified drum reconditioner. Contact the Reusable Industrial Packaging Association (RIPA – www.reusablepackaging.org) to locate a drum reconditioner near you.

Responding to Emergencies

Fires, spills, bulging drums, and other emergencies involving MDI require immediate responses. If you are not a trained, designated emergency responder, leave the area immediately and notify the appropriate emergency response personnel.
If you need assistance with a spill or other emergency involving MDI, call CHEMTREC at 1-800-424-9300. CHEMTREC operators are available 24 hours a day, seven days a week.

American® Chemistry Council | Center for the Polyurethanes Industry

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Polyol Resin Blends Safety and Handling Guidelines

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Purpose

The Center for the Polyurethanes Industry (CPI) has prepared this guide to provide important health and safety considerations associated with working with polyol resin blends.

Polyurethane foams are often made using "systems," sometimes called "A-side" and "B-side," or "iso side" and "resin side." It is important to know which side of the system ("A-side" or "B-side") is the diisocyanate and which is the polyol resin blend. The hazards of the polyol resin are different from those of the diisocyanates, and different precautions should be taken when handling the individual components. This guide gives a brief summary of hazards that may be associated with the "resin side" of systems and addresses important issues to consider in the safe handling of these chemicals.

This guide does not provide information about handling the "iso side." Handling information is contained in other documents produced by CPI. (See "Additional Information" page 4). Similarly, this guide does not contain information on either the hazards associated with solvents used for equipment cleanup or the hazards associated with specific polyol formulations. For that information, refer to the product-specific Safety Data Sheet (SDS), or consult the supplier.

American Chemistry Council | Center for the Polyurethanes Industry

Chemical Composition of Polyol Resin Blends

To make a polyurethane, a polyol is reacted with a diisocyanate. A number of additional ingredients are required to achieve the desired properties in a polyurethane foam. These additional ingredients are typically blended with the polyol to form what we call a "polyol resin blend." These ingredients may include catalysts, surfactants, colorants (pigments or dyes), blowing agents, and flame retardants. Customers who purchase polyurethane foam systems receive a two-part package, consisting of a diisocyanate and a polyol resin blend. To make polyurethane foam, the user meters the "A-side" and "B-side" in the proper ratio, using a proportioning pump to a mix head or spray gun, where the ingredients are mixed and dispensed.

Acute Health Hazards and Handling Precautions

Acute health hazards associated with the typical ingredients in a polyol resin blend are summarized below and in Table 1. General recommendations to minimize exposure to these ingredients also are provided.

There are four general recommendations for handling polyol resin blends:

- As with any chemical, review the SDS from the manufacturer before use. There should be a specific SDS for the polyol resin blend. Follow all of the manufacturer's recommendations.
- Don't eat or smoke where chemicals are handled to prevent inadvertant ingestion of these chemicals.
- Avoid eye or skin contact.
- Clean up spills promptly to minimize the potential for falls. Polyol resin blends are slippery.

Polyols

The major ingredient in polyol resin blends is a polyol or a mixture of several polyols. Although polyols differ in molecular weight, and somewhat in chemical structure, all are very large alcohol-type molecules. Polyols typically make up at least 70% by weight of a polyol resin blend.

In addition to the polyol, polyol resin blends contain a number of additives that may be hazardous (see below), which is why users avoid skin and eye contact with the blend.

Note: A hazard associated with most polyols is that—spilled material can be very slippery.

Catalysts

Some amine catalysts and various metal catalysts (e.g., tin, potassium, bismuth) can be strongly basic. Catalysts may cause respiratory, eye and/or skin irritation. Some amine catalysts are potential skin sensitizers, causing persistent dermatitis and skin problems, and/or are corrosive to the skin. The vapors of some amine catalysts can cause vision to

become hazy and for halos to appear around bright lights; these effects are usually temporary in nature. Each catalyst package may vary depending upon the application and manufacturer. Users of "systems" do not handle the catalyst package separately. It is already incorporated into the polyol resin blend at typically less than 10% by weight, which can reduce the hazards associated with the catalyst package.

Surfactants

There are many commercial silicone surfactants whose structure and/or composition have been varied to obtain specific properties in the finished polyurethane foam. Surfactants, in general, are minimally irritating or non-irritating and of low order toxicity by all typical routes of administration. However, some surfactants may cause slight irritation to the eyes, skin, and respiratory system. Generally, surfactants are a minor constituent of the polyol resin blend formulation (0 to 2% by weight).

Some surfactants may be combustible or flammable; take appropriate fire safety precautions.

Colorants

The coloring of polyurethane foam is obtained with pigment pastes, dyes, or dispersions, collectively called "colorants." Their presence at low levels (typically less than 1% by weight) in the blended polyol resin can minimize the potential for significant exposure.

Blowing Agents

A blowing agent is the ingredient that forms the cells in polyurethane foam. Blowing agents that currently are used include hydrofluorocarbons (HFCs), hydrocarbons (pentanes), liquid carbon dioxide (CO_2), acetone, and water (reacts with diisocyanate to form CO_2).

Like CO_2, many blowing agents are heavier than air. In high concentrations, they can displace oxygen available for breathing. HFCs in high concentrations can cause irregular heartbeat and depression of the central nervous system. Use general and/or local ventilation as necessary to prevent overexposure. Some blowing agents also are irritants to the eyes and skin. Hydrocarbons and acetone are flammable; take appropriate fire safety precautions.

Do not expose containers of polyol resin blends that contain blowing agent to elevated temperatures. Elevated temperatures may result in an over-pressurized or bulging container. Such containers may rupture or explode forcefully. Follow the manufacturer's recommended storage temperatures.

Flame Retardants

Some of the polyol resin blends used to make polyurethane foam for building construction contain flame retardants. Because a variety of chemicals are used as flame retardants, it is difficult to offer more than general guidelines, so consult the SDS for more information on potential health effects. Flame retardants are incorporated into the polyol resin blend at concentrations of up to 40% by weight. Avoiding skin and eye contact with the resin blend minimizes exposure to these materials.

Table 1—Acute Health Hazards of Polyol Resin Blends

Component	Chemical Composition	Eye Irritant	Skin Irritant
Polyols	Polyhydric alcohols	Yes (some)	Yes (some)
Catalysts	Amines, Metallic salts	Yes	Yes
Surfactants	Silicones	Yes (some)	Yes (some)
Colorants	Carbon Black, Dyes, Metal complexes	Yes	Yes
Blowing Agents	HFCs, Hydrocarbons, CO_2, Acetone and Water	Yes (some)	Yes (some)
Flame Retardants	Brominated compounds, Antimony compounds, Chlorinated phosphorus compounds	Yes	Yes (some)

Handling Information

Personal Protective Equipment

Personal Protective Equipment (PPE) is used for protection from potential chemical exposure during activities such as material transfer, maintenance, and processing. Some examples of PPE recommended, depending on the activity, is listed below. See the manufacturer's SDS for more detailed information on recommended PPE.

- Safety glasses with side shields or chemical goggles. For some operations, a face-shield is required by OSHA.
- Steel-toed shoes when handling drums or other heavy containers.
- Chemical resistant gloves. Because most polyurethane workers handling polyol resin blends also are working with diisocyanates, using gloves approved for diisocyanates is typically recommended (see "Additional Information" page).
- Organic vapor respirator with a particulate prefilter may be worn if vapors are detected or irritating. Note that this type of respirator may not be effective for HCFCs and HFCs; instead a supplied air respirator may be needed. Check with your supervisor to determine if respirators are required to protect against exposure to vapors in handling polyol resin blends under the circumstances unique to your workplace. If so, wear them when instructed. Employers must comply with the OSHA Respiratory Protection Standard (29 CFR 1910.134).

The PPE specified above is for routine handling only. Additional equipment may be required for emergency response operation (29 CFR Part 1910.120). (See "Emergency Response," page).

Ventilation

When working with polyol resin blends, use adequate ventilation and do not breathe vapors. Normal air movement may provide adequate ventilation if there are no obstructions and the area is relatively open. However, in confined spaces or poorly ventilated areas, mechanical exhaust may be required for ventilation.

Decontamination

Perform proper decontamination of exposed clothing and apparatus. Typically, soap and water are used; however, review the manufacturer's SDS for information on the recommended decontamination solutions to use with polyol resin blends. Used decontamination fluids must be handled and disposed of according to OSHA regulations.

Fire and Explosion Hazards

In general, the flash point of polyol resin blends that do not contain hydrocarbons or acetone will be high enough so as not to present a fire or explosion hazard. However, those that contain hydrocarbons or acetone may have lower flashpoints, and these types of polyol blends do present fire and explosion hazards. As with most fires, combustion of polyol resin blends will produce carbon monoxide and carbon dioxide. Additional compounds that may be generated depending on formulation include nitrogen oxides, halogen acids, phosphorus oxides, and others. (See "Emergency Response" page for additional information on fire).

Emergency Response

Fires, spills, bulging drums, and other emergencies involving polyol resin blends require immediate responses. If you are not a trained, designated emergency responder, leave the area immediately and notify the appropriate emergency response personnel.

If you need assistance with a spill or other emergency involving polyol resin blends, call CHEMTREC at 1-800-424-9300. CHEMTREC operators are available 24 hours a day, seven days a week.

First Aid

See the manufacturer's SDS for recommended first aid procedures. General guidance is provided below.

- Eye Contact: Flush eyes with water, preferably from an eyewash fountain for up to 15 minutes.

- Skin Contact: Wash skin with soap and water. Do not use solvents! Any clothing or items such as shoes, belts, and watchbands that have been contaminated with polyol resin blends should be properly discarded.
- Ingestion: If swallowed, seek medical attention immediately. Do not induce vomiting.

Waste Disposal Considerations

Dispose of waste in compliance with your local, state and federal regulations.

Disposal of Empty Drums

- Dispose of drums in accordance with applicable regulations (see "Additional Information" page).
- Empty drums may contain liquid or vapor residue, which may be dangerous. Do not hammer, strike, torch cut, weld, braise, solder, drill, grind or expose containers to heat or flame.
- Drums must be "drip dry" (i.e., emptied by pouring, pumping or aspirating) before disposal.

Note: The "one-inch" residue rule, stated in 40 CFR section 261.7, for determining whether a drum is empty applies to non-flowable products (e.g., very viscous resins).

Empty drums can be reconditioned. Contact the Reusable Industrial Packaging Association (RIPA – www.reusablepackaging.org) to locate a drum reconditioner near you.

Storage

General guidance is provided below:

- Maintain good housekeeping in the work area.
- Store in an enclosed, ventilated area.
- Segregate containers from materials that are incompatible with polyols.
- Provide secondary containment.
- Store materials within the temperature range recommended by supplier.

Additional Information

Consult these Center for the Polyurethanes Industry (CPI) publications for additional information:

PMDI User Guidelines for Chemical Protective Clothing Selection (AX178)

Guidance for Working with MDI and Polymeric MDI: Things You Should Know (AX205)

Guidance for Working with TDI: Things You Should Know (AX202)

TDI User Guidelines for Chemical Protective Clothing Selection (AX179)

Guidelines for the Responsible Disposal of Wastes and Containers from Polyurethane Processing (AX151)

All publications are available free on CPI's website at http://polyurethane.americanchemistry.com

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ALLIANCE FOR THE POLYURETHANES INDUSTRY
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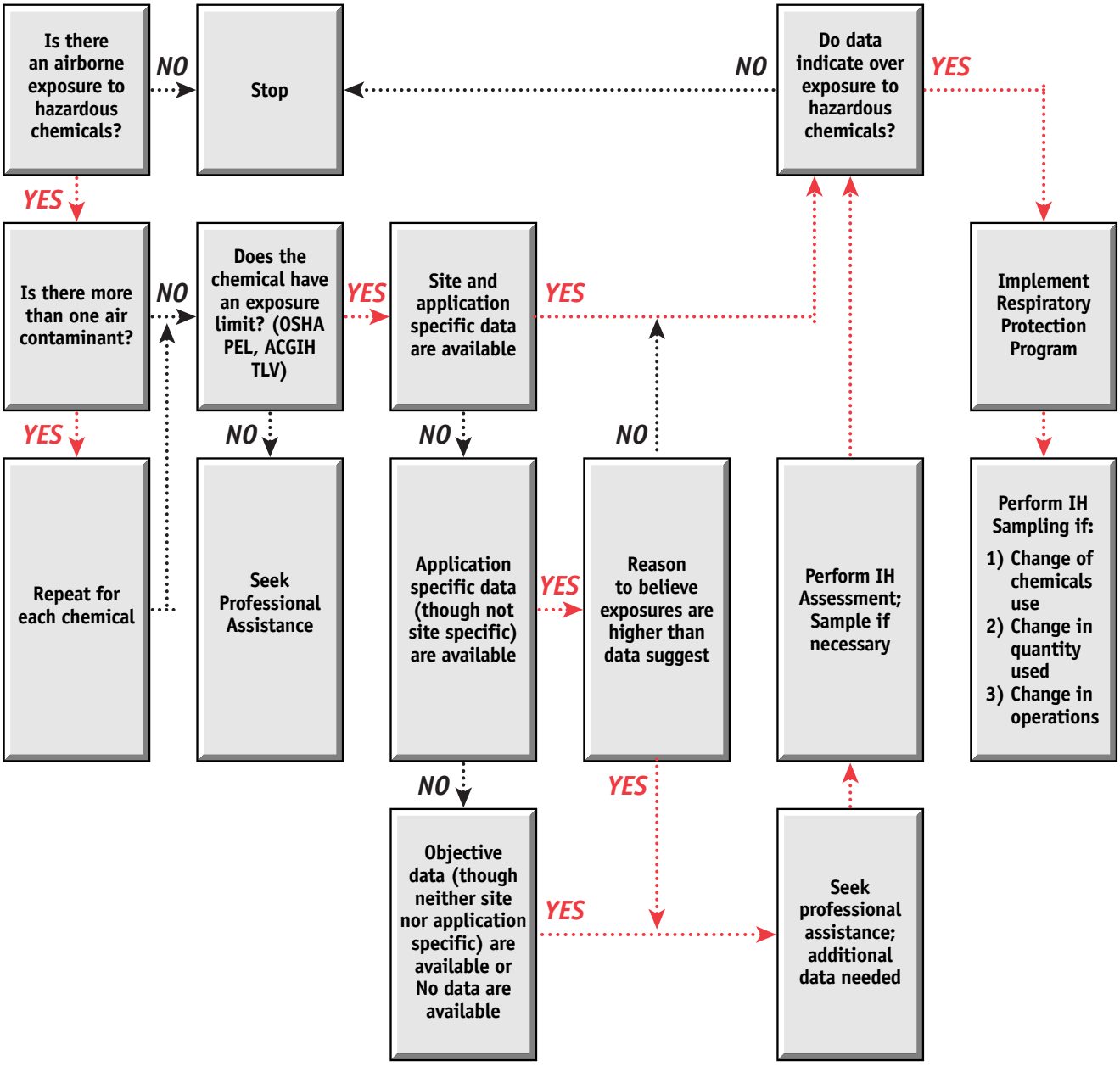
Model Respiratory Protection Program for Compliance with the Occupational Safety and Health Administration's Respiratory Protection Program Standard 29 C.F.R. §1910.134

MDI Exposure Assessment Decision Matrix for Selecting Respiratory Protection



Prepared for:

ALLIANCE FOR THE POLYURETHANES INDUSTRY
A business unit of the American Plastics Council
by Keller and Heckman LLP
Washington, DC 20001
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IMPLEMENTATION GUIDE and REGULATORY BACKGROUND

29 C.F.R. §1910.134 applies to all respirator use in general industry and construction workplaces. The standard applies when (1) employees are required to wear respirators to protect themselves from exposure to air contaminants above a specific exposure limit, (2) if the employer requires respirators to be worn, or (3) if respirators are otherwise necessary to protect employee health.

Additionally, limited requirements apply when employees, for personal, comfort, or other reasons, voluntarily choose to wear certain kinds of air-purifying respirators (APR). The standard affirms OSHA's long-standing policy that personal protective equipment - in this instance, respirators - are the last line of defense when engineering and work practice controls are inadequate to reduce employee exposure, or during the development and installation of other controls.

Among other requirements, the standard mandates that employers:

- ***Develop a written program;***
- ***Assign a Program Administrator;***
- ***Prepare work site-specific procedures;***
- ***Select respirators based on the hazard(s) and the required protection;***
- ***Train employees on the usage, fit, maintenance, cleaning, and storage of respirators;***
- ***Fit test employees who will use any respirator with negative or positive pressure tight-fitting face piece, prior to first use and annually thereafter;***
- ***Provide medical evaluation to determine employee ability to wear the selected respirator via (1) medical examination or (2) confidential questionnaire and, when required by the responses to the questionnaire, a follow-up medical examination;***
- ***Provide the tools and replacement parts necessary for respirator cleaning, maintenance, and repair; and***
- ***Perform periodic program evaluation to ensure effectiveness.***

A major change in the standard is the provision governing when APR may be used. In the past, OSHA and the National Institute for Occupational Safety and Health (NIOSH) both prohibited the use of APR against gases and vapors that had inadequate warning properties — principally when the odor threshold was above the applicable exposure limit. The new standard permits the use of APR without limit, if the employer has objective data (1) that APR provide adequate protection, and (2) on the service life of the cartridges, upon which a cartridge change out schedule may be based. OSHA confirmed this interpretation in a letter to API's Counsel, Keller and Heckman LLP dated July 18, 2000, specifically with respect to diisocyanates (see Attachment 8).

The following document is a draft that must be edited to address company specific procedures, personnel, and operations. **In implementing the program, the following steps must be completed:**	
☐	1. Using the flow chart in Section III.B., determine which company operations require the use of respirators and determine what kind of respirator is required for each operation. Complete the Table in Attachment 9 following the example in Section I of the model program.
☐	2. Designate the Program Administrator in Section II.
☐	3. Designate the physician or other licensed health care professional in Section III.
☐	4. Identify operations where respirators are required and designate the types of respirator to be used, following the methods in the flow chart in Section III.B.; prepare a Table showing the respirator assignments using the blank table in Attachment 9.
☐	5. Arrange for medical examinations for employees assigned to wear respirators.
☐	6. Perform a respirator fit test and assess the impact of other Personal Protection Equipment (particularly safety glasses and goggles) on respirator performance and fit. Cross-reference PPE assessment in the blank table in Attachment 9.
☐	7. Designate the area or location where atmosphere-supplying respirators, air-purifying respirators, and a supply of replacement parts will be stored, as defined in Section III.E.
☐	8. Conduct training for employees and supervisors assigned to jobs requiring respirators.
☐	9. Establish forms and procedures for annual program evaluation under Section IV.
☐	10. Insert appropriate information into fields designated by "_____" to create a written respiratory protection program for your company. Include all applicable attachments (i.e., this book).

RESPIRATORY PROTECTION PROGRAM

for

_____

(COMPANY NAME)

_____

(street address)

_____

(city, state, zip code)

as required by 29 C.F.R. §1910.134

RESPIRATORY PROTECTION PROGRAM

for

_____

(COMPANY NAME)

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I. Purpose and Scope

The purpose of this program is to protect all employees of _____
(company)
from respiratory hazards, and to ensure that _____
(company)
is in compliance with OSHA's Respiratory Protection Program Standard 29 C.F.R. §1910.134(c).[1]

Engineering controls, such as ventilation and substitution of less toxic materials, may not be completely effective in controlling airborne hazards. In these situations, respirators, and in emergency conditions, respirators and other types of personal protective equipment must be used to safeguard employees' health.

*Note to Program Administrator: Table I is to be customized for*_____.
(company)
Table 1a is a generic overview; Table 1b is an example for a spray foam operation. Table 1c is a blank form to be completed to communicate where respirators are required in the operations of _____.
(company)

Mandatory use of respirators

_____ has determined that some employees in
(company)
certain work tasks are exposed to respiratory hazards. All employees performing these tasks must wear the designated equipment, or equipment providing greater or equivalent protection. Additionally, _____ requires these employees to
(company)
participate in the company's respiratory protection program, as a condition of continued employment. An employee's failure to do so may result in disciplinary action, up to and including termination for serious or repeated infractions.

Employees of _____ **are required to wear respirators**
(company)
or personal protective equipment (PPE) when the following situations exist:

- There is exposure to air contaminants above a specific exposure limit;
- If respirators or PPE are necessary to protect employee health;
- During specific routine work practices, processes or tasks identified by _____ as requiring use of a respirator or PPE; and
(company)
- During some non-routine or emergency operations, (for example, clean-up of hazardous **spills.**

In all cases, employees participating in this program do so at no cost to themselves. The expenses associated with training, medical evaluations and equipment are the sole responsibility of _____.

[1] Attachment 1

(company)

Voluntary use of respirators

If an employee desires to wear a respirator during certain operations in non-hazardous areas, _____ will review each such request on a case-by-case basis.
(company)

An employee may use the respirator provided or may provide his/her own for voluntary use, if

- doing so does not jeopardize the employee's health or safety, or that of his/her co-workers,
- the equipment itself does not create a workplace hazard and
- _____ Respiratory Protection Program Administrator
  (Program Administrator's name)
  has approved the use.

All employees voluntarily wearing respirators are required to receive a copy of **"Information for Employees Using Respirators When Not Required Under the Standard."** See Appendix D (page 89). _____ must review this OSHA information
(company)
with each employee prior to their voluntary use of respiratory protective equipment.

In addition, employees voluntarily using tight-fitting respirators must follow the medical surveillance, cleaning, maintenance and storage procedures in this program.

_____ may assign other additional program requirements
(company)
for those voluntarily wearing respirators or other PPE.

Employees voluntarily wearing dust masks (filtering facepiece) or escape-only respirators are not subject to the program's medical evaluation. However, their equipment must be clean and free of contamination, and not interfere with the employee's ability to work safely.[2] These employees are also provided a copy of Appendix D and given a review of the information before their use of dust masks.

[2] OSHA Directive CPL 2-0.120 D(3)(c)(2), page 15.

TABLE 1 (a) Voluntary and Required Respirator Use		
Respirator Type	**Department/Task**	**Respiratory Hazard/PEL**
<e.g. *Dust Mask (Filtering facepiece)*>		<e.g. *None - Voluntary use*>
<e.g. *Half-face Air Purifying Respirator with organic vapor/acid gas cartridge; P-100 pre-filter*>	*<e.g. Application of MDI in outdoor operations>*	<e.g. polymeric *MDI*[3]>
<e.g. *Half-face Air Purifying Respirator with organic vapor/acid gas cartridge*>	<e.g. *Maintenance/ Paint Stripping*>	<e.g. *organic acids and vapors*—(list)>
<type of respirator>	*<operations>*	*<hazard description>*

TABLE 1 (b) Voluntary and Required Respirator Use		
Respirator Type	**Department/Task**	**Respiratory Hazard/PEL**
<e.g. *Dust Mask (Filtering facepiece)*>		*None - Voluntary use*
<e.g. *Half-face Air Purifying Respirator with organic vapor/acid gas cartridge; P-100 pre-filter*>	*Application of MDI in outdoor operations>*	Polymeric *MDI*[4]
<e.g. Type C Supplied Air Respirator or self-contained breathing apparatus	*Application of polymeric MDI in interior applications (such as perimeter wall insulation)*	Polymeric *MDI*[5]

[3] 4,4'-Methylenediphenyl diisocyanate (MDI).
[4] 4,4'-Methylenediphenyl diisocyanate (MDI).
[5] 4,4'-Methylenediphenyl diisocyanate (MDI).

TABLE 1 (c)
Voluntary and Required Respirator Use for _____
(Company)

Respirator Type	Department/Task	Respiratory Hazard/PEL

II. Program Administration

Program Administrator Responsibilities

_____ is responsible for administering the
(Program Administrator's name)
Respiratory Protection Program.

The Program Administrator's duties include the following:

- Identifying work areas, processes, or tasks[6] that require workers to wear respirators, and evaluating the associated hazards;
- Selecting appropriate, approved respiratory protection options;
- Monitoring respirator use to ensure that respirators are used in accordance with their certifications;
- Arranging for and or conducting training;
- Ensuring proper storage and maintenance of respiratory protection equipment;
- Conducting qualitative fit testing;
- Administering the medical surveillance program;
- Maintaining required program records;
- Evaluating the respiratory protection program; and,
- Updating the written program, as necessary.

Supervisor Responsibilities

Supervisors are responsible for ensuring that the Respiratory Protection Program is implemented in their work areas in accordance with all OSHA standards. In addition to being knowledgeable about the program requirements for their own protection, supervisors must also ensure that the program is understood and followed by the employees under their supervision.

Supervisory duties include the following:

- Ensure supervised employees (including all new hires) receive appropriate training, fit testing, and annual medical evaluations.
- Ensure the availability of appropriate respirators and accessories.
- Be aware of tasks requiring the use of respiratory protection.
- Enforce the proper use of respiratory protection.
- Ensure that respirators are properly cleaned, maintained, and stored in accordance with the program.
- Monitor work areas and operations with sufficient frequency to identify respiratory hazards and select proper equipment.
- Coordinate with the Program Administrator on how to address respiratory hazards or other concerns regarding the program.

[6] Routine operations and reasonably foreseeable emergency situations associated with the operations are considered when assessing where respiratory protection is necessary.

Employee Responsibilities

Each employee must wear his or her respirator when and where required, under the conditions specified by this program. They are also obligated to use the equipment according to the training procedures for each model. Employees are also responsible for the following:

- Being familiar with this program.
- Caring for and maintaining the respirators as instructed, and store them in a clean sanitary location.
- Informing the supervisor if the respirator no longer fits well, and request a new one that fits properly.
- Informing the supervisor or Program Administrator of any potential respiratory hazards or other concerns regarding the program.

III. Program Elements

A. Medical Evaluation

Any employee who

- is required to wear a respirator, or
- chooses to wear an air-purifying respirator (APR) voluntarily,
  must first pass a medical examination and have medical approval before wearing the equipment on the job.[7]

Employees refusing the medical evaluation cannot work in areas requiring respirator use.

The evaluation is conducted using the questionnaire provided in Appendix C (p.81) or an actual examination that obtains the same information.[8]

The Company's consulting _____
"Medical Group" or "Physician"

is _____
(name of clinic, or name of physician/PLHCP)

_____
(name of Physician/PLHCP)

determines how the medical exams are conducted.

Evaluation Procedures

- Every employee requiring medical evaluation is given a copy of the medical questionnaire in Appendix C (p. 73) along with a stamped envelope, addressed to the physician or other PLHCP. The employee is to complete the confidential questionnaire during his/her work shift and mail it in the envelope provided.

- To the extent feasible _____
  (company)
  accommodates employees unable to read the questionnaire.[9] At an employee's request someone other than _____ may be asked to
  (Program Administrator)
  assist in reading the document. If this is not possible, the employee will be sent to the PLHCP for a medical evaluation.[10]

- Follow-up medical exams are given to employees as required by the OSHA standard, or as deemed necessary by the PLHCP.

[7] Voluntary use of dust masks (filtering facepieces such as 3 M's 8710, Survivair's N95 Disposable or MSA's Affinity Plus) and individuals equipped with escape-only respirators are excluded from this requirement.
[8] All examinations and questionnaires are to remain confidential between the employee and the physician or other licensed health care professional (PLHCP).
[9] For those individuals who speak only Spanish, a translated questionnaire is available in Appendix C of the OSHA Standard (Attachment 1).
[10] OSHA Directive CPL 2-0.120 Inspection Procedure for the Respiratory Protection Standard, page 23.

- All employees can speak with the PLHCP about their medical evaluation.

- Any employee required by medical reasons to wear a positive pressure air purifying respirator is provided a powered air purifying respirator.

- After an employee has received approval and started using a respirator, an additional medical evaluation is conducted for the following reasons:

    1. The employee reports signs and/or symptoms related to his/her ability to use a respirator, such as shortness of breath, dizziness, chest pains, or wheezing;
    2. The PLHCP or supervisor informs the Program Administrator of a reevaluation need
    3. Information from this program, including observations made during fit testing and program evaluation, indicates a need for reevaluation; or,
    4. A change occurs in the workplace conditions that may result in an increased physiological burden on the employee.

Determination of fitness

A physician or other licensed health care professional (PLHCP) at _____
(name of clinic, or name of PLHCP)
evaluates the completed health care questionnaire.[11]

Prior to making a formal determination, _____,
(company)
provides the PLHCP with the following information on respirator usage:

- the equipment's type and weight,
- use frequency and duration,
- expected work effort,
- additional personal protective clothing/equipment to be used, and
- estimated temperature and humidity extremes expected in the work area where the respirator is to be used.[12]

The PLHCP provides an assessment of each employee's physical ability to wear a respirator and perform the assigned work. Such evaluations will be provided in writing according to one of the following three formats:

- The employee is qualified to perform assigned work and wear the assigned respirator.
- The employee is not qualified to perform assigned work and wear the assigned respirator.
- The employee is qualified to perform assigned work and wear the assigned respirator with the following limitations: <insert limitations and other considerations>.

[11] Sections 1 and 2, Part A of Appendix C, pg. 83. Prior to implementing the program, the company provides the PLHCP with a copy of the respiratory protection program and a copy of Appendix C. If a new PLHCP is selected, the company provides these document or they are transferred from the former PLHCP.
[12] If the PLHCP and the noted conditions remain the same, the information need not be provided for subsequent medical evaluations.

Follow-up medical examination

If an employee responds positively to any of questions 1 through 8 in Section 2 of the questionnaire, or if the PLHCP deems it necessary, a follow-up exam is provided. This exam includes any medical tests, consultations, or diagnostic procedures that the PLHCP needs to make a final determination for safe respirator usage.

B. Respirator Selection

_____ has performed an exposure assessment
(Company)
identifying the respiratory hazard(s) found in its workplace.[13] The decision matrix used in this process is shown in Figure 1.

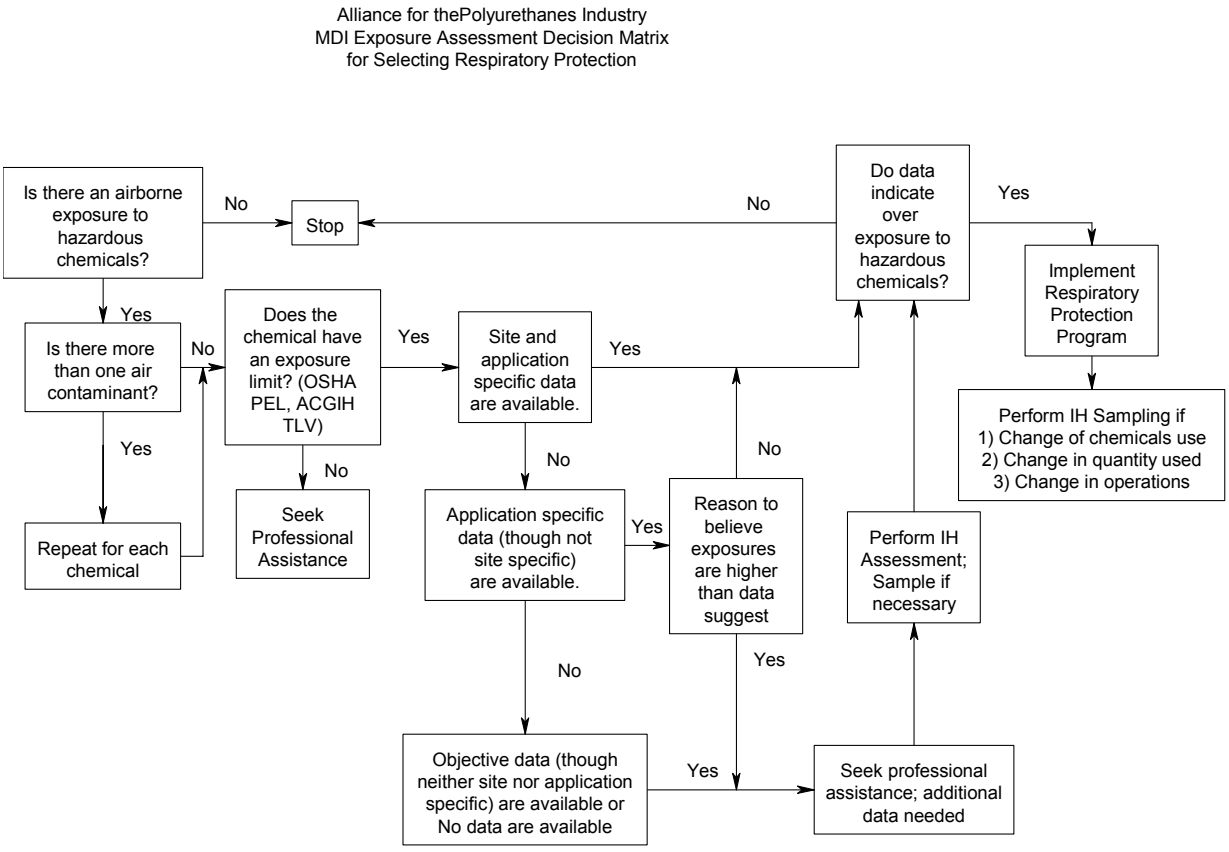

Figure 1.

Based on this information, and in accordance with all OSHA Standards, the Program Administrator selects the respirator to be used. See Attachment 9 (page 251) for a detailed description of _____ work operations requiring the use
(company's)
of a respirator, the type of respirator to be used, and the hazardous chemical(s) present.

[13] _____ has evaluated its operations as required by the Personal Protective Equipment (PPE) Standards in Subpart I, 29 C.F.R. 1910.132-138.
(company)

Air-purifying respirators may now be used in compliance with OSHA's Respirator Standard to protect against limited diisocyanate exposures. This was not true before the Standard was revised in 1998. The revised Standard requires that

- The respirator cartridge/filter combination is appropriate for diisocyanates and
- Objective data are used to establish cartridge change schedules to prevent cartridges from being used past their service life.

C. Respirator Fit Testing

Fit testing is required for employees wearing respirators with a negative or positive pressure, tight-fitting facepiece. The fit test is conducted using the respirator the employee will be wearing on the job.

Fit testing is conducted:

- Prior to initial use of the respirator.
- If a different respirator facepiece (size, style, model or make) is used.
- On an annual basis.
- If the employee, _____, PLHCP, supervisor or Program Administrator
  (company)
  makes a visual observation of changes in the employee's physical condition that could affect respirator fit. This might include: facial scarring, dental changes, cosmetic surgery or a drastic change in weight.

The company uses a qualitative fit test (QLFT) or a quantitative fit test (QNFT) method as designated in Table 2.[14] If an employee passes either test, but notifies the employer that the fit is unacceptable, the employee is allowed to select a different respirator, and is retested.

Table 2
Acceptable Fit-Testing Methods

	QLFT	QNFT
Half-Face, Negative Pressure, APR (<100 fit factor)	Yes	Yes
Full-Face, Negative Pressure, APR (<100 fit factor) used in atmospheres up to 10 times the PEL	Yes	Yes
Full-Face, Negative Pressure, APR (>100 fit factor)	No	Yes
PAPR	Yes	Yes
Supplied-Air Respirators (SAR), or SCBA used in Negative Pressure (Demand Mode) (>100 fit factor)	No	Yes
Supplied-Air Respirators (SAR), or SCBA used in Positive Pressure (Pressure Demand Mode)	Yes	Yes
SCBA-Structural Fire Fighting, Positive Pressure	Yes	Yes
SCBA/SAR-IDLH, Positive Pressure	Yes	Yes
Mouth-bit Respirators	Fit-testing is not required	
Loose-fitting Respirators (e.g. hoods, helmets)	Fit-testing is not required	

[14] As established in Appendix A of the standard (Attachment 1).

D. Respirator Use

General Use Instructions

Each time a respirator is worn, the wearer must conduct a 'user seal check'. Employees may select either the positive or negative pressure check.[15] Additional PPE, combined with respirator use, may be necessary to adequately prevent exposure. The use of eye, face or skin protection may be required during certain processes. Employees must consult the process supervisor for the required equipment.

Tight fitting facepiece respirators are **not** permitted for use if:

- An employee has facial hair that interferes with either the sealing surface of the respirator and the face, or interferes with the valve function.
- Corrective glasses/goggles or other personal protective equipment interferes with the seal of the facepiece.
- Any other condition interferes with the facepiece seal.

The employee must vacate the respirator use area for the following reasons:

- To wash his/her face and respirator facepiece, as necessary to prevent respirator- induced eye or skin irritation;
- If vapor or gas breakthrough is detected;
- If there is a change in breathing resistance;
- If there is facepiece leakage; or
- To replace the respirator/filter or change the cartridge/canister.

Cleaning, Maintenance, and Storage

Respirators are to be regularly cleaned and disinfected according to the manufacture's instructions.
APR's are to be cleaned and disinfected as often as necessary, but at least once each day they are used.[16]
SARs and emergency use respirators are to be cleaned and disinfected after each use.

Cleaning
These seven steps are to be followed for cleaning and disinfecting respirators, unless the manufacturer directs otherwise:

- Disassemble respirator, removing all filters, canisters, or cartridges.
- Wash the facepiece and associated parts in a mild detergent with warm water. Do not use organic solvents or bleach.
- Rinse thoroughly in clean, warm water.
- Wipe the respirator with disinfectant wipes (70% isopropyl alcohol) to kill germs.

[15] The tests are performed in accordance with Appendix B-1 of the standard or the manufacturer's direction — whichever is most effective.
[16] Or as outlined in 29C.F.R. 1910.134(h)(1) of the Standard.

- Air dry in a clean area. If a clean area is not available, use clean disposable paper towels to blot excess moisture.
- Reassemble the respirator and replace any defective parts (noting the condition of the head straps and valve flaps.)
- Place in a clean, dry plastic bag or other airtight container.

The Program Administrator is responsible for ensuring there is an adequate supply of cleaning and disinfecting supplies. If supplies are low, employees must notify their supervisor or the Program Administrator.

Maintenance

After leaving the respirator use area, employees can do limited maintenance on their equipment only in an area that is free from respiratory hazards.
Maintenance involves a thorough visual inspection for cleanliness and/or defects. Worn or deteriorated parts must be replaced prior to equipment use. No components are replaced or repairs made beyond those recommended by the manufacturer. Regulator or alarm repairs of atmosphere-supplying respirators are to be conducted by the manufacturer.

Respirator Inspection Checklist:

- ✔ Facepiece: cracks, tears, holes, facemask distortion, cracked or loose lenses/face shield
- ✔ Head straps: breaks, tears, broken buckles/clasps, overstretched elastic bands
- ✔ Valves: residue/dirt, cracks or tears in valve material, absence of valve flap
- ✔ Filter/Cartridges: proper cartridge for hazard, approval designation, intact gaskets, cracks or dents in housing
- ✔ Air Supply Systems: breathing air quality/grade, condition of supply hoses, hose connections, settings on regulators and valves

Defective respirators or those with defective parts are taken out of service immediately.
Employees should notify their supervisor about all respirator defects.
It is the supervisor's responsibility to give the defective equipment either to the Program Administrator or to the individual charged with replacement/repair. The appropriate person then decides whether to:

- Temporarily take the respirator out of service until it can be repaired;
- Have it repaired; or
- Dispose of it if the problem is irreparable.[17]

[1] When a respirator is taken out of service, it is tagged as such to prevent accidental use of a malfunctioning device. All defective respirators are stored separately from functional respirators.

Storage

APRs are stored in a clean, dry area and following the manufacturer's recommendations. Employees inspect and clean their own respirators according to the provisions of this program. The equipment is stored in plastic bags or airtight containers. Each bag/container is marked with an employee name, and only that particular employee can use it for their equipment storage.

Atmosphere supplying respirators are stored in _____
(area or location)

A supply of respirators and replacement components are stored in the original manufacturer's packaging in the in _____
(area or location)

Cartridge and Canister Change Out Schedules

Organic vapor/acid gas cartridges/canisters with a P-100 prefilter that are used in the application[18] of product containing MDI must be changed after 8 hours of use or at the end of the shift, which ever is shorter. The basis for this change-out schedule is included in Attachment 2 (page **95**).
Employees wearing APR with P-100 filters for protection against wood dust and other particulates must change their cartridges when they experience difficulty breathing (i.e. resistance).

Equipment Malfunction

Air-Purifying Respirators (APR)

If an APR or any of its components malfunctions (breakthrough, facepiece leakage, or faulty valve), the wearer must leave the respirator use area immediately and notify the supervisor about the malfunction. The supervisor is then responsible for ensuring that the employee receives the necessary repair parts or a new functional respirator.

[18] APR cannot be used if (1) the employee is working in the zone of the contaminant — e.g. visible overspray is evident on the workers body, or (2) in the construction industry where spray foam application is inside a structure or a confined space with inadequate ventilation. In these situations, PAPR are provided.

Supplied-Air Respirator (SAR)

Usually, employees using SAR work in pairs. If one experiences an SAR malfunction, then he/she notifies the partner of the problem by using hand signals. The partner then escorts the affected employee outside the respirator use area

Supplied-air respirators use only Grade D breathing air as described in ANSI/Compressed Gas Association Commodity Specification for Air, G-7.1-1989.[19] The Program Administrator will maintain a Certificate of Analysis from the supplier that (1) Grade D breathing air is contained in the cylinders used to supply breathing air; (2) cylinders are tested and maintained as required in the Shipping Container Specification Regulations of the Department of Transportation; and (3) the moisture content in the cylinder does not exceed a dew point of -50 degrees Fahrenheit at 1 atmosphere pressure for each shipment of cylinders received or for the purification system used to clean breathing air in a hose/compressor system.

[19] The oxygen content (v/v) is between 19.5% and 23.5%; hydrocarbon (condensed) content is 5 mg/m^3 or less; carbon monoxide content is 10 ppm or less; and carbon dioxide content is 1,000 ppm or less.

E. TRAINING

The Program Administrator provides training to respirator users and their supervisors on:

- Contents of _____ (Company's) respiratory protection program,
- Responsibilities of employees and supervisors
- Requirements of OSHA's respiratory protection standard.

All training occurs prior to any respirator use in the workplace. Supervisors receive their training prior to supervising employees required to use respirators.

The training program covers the following topics:

- All elements of _____ (Company's) respiratory protection program;
- The information covered under OSHA Standard 29 C.F.R. 1910.134;
- Respiratory hazards encountered at the worksite;
- Proper selection and use of respirators;
- Additional PPE;
- Respirator limitations;
- How to perform user seal (fit) checks;
- Fit testing;
- Emergency respirator use procedures;
- Respirator maintenance and storage;
- Medical signs and symptoms limiting effective respirator use.

Employees are required to demonstrate their understanding of the topics covered in the training through hands-on exercises and a written quiz. The Program Administrator documents respirator training. This documentation includes the type, model, and size of respirator on which each employee has been trained and fit tested.
Employees are retrained annually, or as needed (i.e., relocation to another department using a different type of respirator.)

IV. Program Evaluation

The Program Administrator and other responsible supervisors conduct periodic evaluations of the workplace to ensure that the provisions of this program are being implemented.
These evaluations include regular consultations with both the employees using respirators and their supervisors. This is done to identify areas for improvement and to address problems.
Records' reviews, site inspections and periodic air monitoring also assist in program review.

V. Documentation and Recordkeeping

The Program Administrator maintains the following records:

- A written copy of this program and the OSHA standard. This information is available to any interested employee.
- All training and fit testing records. These records are updated as new employees are trained; when existing employees receive refresher training; and/or when new fit testing is conducted.
- All written recommendations from the PLHCP on an employee's ability to use respirators. (Medical evaluations are maintained n accordance with the OSHA Medical Records Standard 29 C.F.R. §1910.1020.)

VI. Attachments

1. 29 C.F.R. § 1910.134 Respiratory Protection Standard and Appendices, OSHA.

   Click on the link above to open the full text of Attachment 1.
   For the most up-to-date information on these sections of OSHA regulations, click below to visit the OSHA website
   http://www.osha-slc.gov/OshStd_toc/OSHA_Std_toc_1910_SUBPART_I.html
   and
   http://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=STANDARDS&P_id=12716&p_text_version=FALSE

   A. Fit Testing Procedures.

   http://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=STANDARDS&p_id=9780&p_text_version=FALSE

   B-1. User Seal Check Procedures.

   http://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=STANDARDS&p_id=9781&p_text_version=FALSE

   B-2. Respiratory Cleaning Procedures

   http://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=STANDARDS&p_id=9782&p_text_version=FALSE

   C. OSHA Respirator Medical Evaluation Questionnaire.

   http://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=STANDARDS&p_id=9783&p_text_version=FALSE

   D. Information for Employees Using Respirators When Not Required Under the Standard.

   http://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=STANDARDS&p_id=9784&p_text_version=FALSE

2. Using Air-Purifying Respirators for Protection Against Isocyanates Under OSHA's New Respiratory Protection Standard: Validation for Cartridge/canister Change-out Schedule. Prepared by Keller and Heckman.

3. Excerpts from "Risk Assessment - Methylenediphenyl diisocyanate, CAS-No.: 26447-40-5, EINECS-No.: 247-714-0," Draft of 5.02.99.

4. OSHA Standard for Respiratory Protection requirements for Allowable Use of Air-purifying Respirators (APR) Against Gases and Vapors - Excerpts from OSHA documents.

5. *Evaluation of the Effectiveness of Air-purifying Respirator Cartridges in Removing MDI Aerosols From Air*, M. W. Spence, T. D. Landry, D. W. Huff; Environment, Health, and Safety, The Dow Chemical Company, Midland, Michigan 48674; (517)636-2331.

6. National Institute for Occupational Safety and Health (NIOSH) Policy Statement, *NIOSH Respirator Use Policy/OSHA's §1910.134*, August 4, 1999.

   Click on the link above to open the full text of Attachment 6.
   For the most up-to-date information on this topic, click below to visit the NIOSH website
   http://www.3m.com/market/safety/ohes2/html/nioshPolicyStatement.html

7. Questions and Answers on the Respiratory Protection Standard (English only). OSHA and Appendices.

   1. Appendix D (Spanish Translation)
   2. Respirator-Use Requirements Flowchart
   3. State Licensing Boards Information
   4. Respirator Medical Evaluation Questionnaire (English)

   Click on the link above to open the full text of Attachment 7.
   For the most up-to-date information on this topic and for the translations, click below to visit the OSHA website
   http://www.osha-slc.gov/qna.pdf

8. Letter from Richard Fairfax, OSHA, Directorate of Compliance Programs, to David G. Sarvadi, Keller and Heckman, LLP, July 18, 2000, and Larry Janssen, CIH, 3M Company, July 18, 2000.

9. Company prepared hazard and PPE respiratory assignment.

Reference Number: AX246

Note: **This Model Respiratory Protection Program has been prepared by the Alliance for the Polyurethanes Industry (API), a business unit of the American Plastics Council (APC), as a service to its members and their customers. It is intended to assist in the development of individual respiratory protection programs tailored to specific applications. The information herein is provided in good faith and is believed to be accurate when prepared, but is offered without any warranty, express or implied. API, its members and contributors disclaim all responsibility for any regulatory challenge, loss, or damage arising from reliance on this program by any party, and assume no responsibility for compliance with applicable laws and regulations by users of the program. Specific questions relating to respirator protection should be addressed to legal counsel, respirator manufacturers, or individual technical advisors.**

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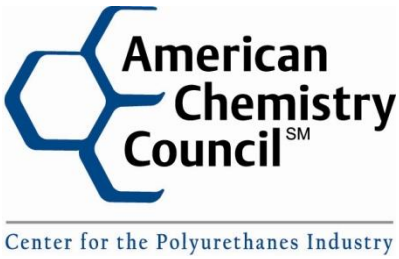

Health and Safety

Product Stewardship Workbook

for

High-Pressure Application of

Spray Polyurethane Foam (SPF)

March 15, 2010

LEGAL

This Work presents general Information with respect to the use of spray polyurethane foam chemicals and other associated chemicals used in spray polyurethane foam applications. It cannot and does not present chemical-specific information with respect to a particular job. For specific information related to the chemicals used on a particular job, and the specific health hazards that may be presented by such chemicals, consult the manufacturer's Material Safety Data Sheets (MSDS) for information.

The Information presented in this Work is necessarily general in nature and individual companies may vary their approach with respect to particular practices based on specific factual circumstances and the practicality and effectiveness of particular actions. Any mention of any specific product, service, supplier, or vendor is for illustrative purposes only and is not intended to constitute an endorsement.

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Contents

1 Scope of Workbook

This Workbook provides guidance to applicators and helpers who apply professional grade high pressure spray polyurethane foam (SPF) in both interior and exterior construction applications. While other SPF products (including but not limited to 1-component foams (OCF) and 2-component low pressure kits) may also be used at construction sites, they are not the primary focus of this Workbook. Further guidance is provided in Appendix A to this Workbook with respect to low-pressure SPF products.

When this Workbook refers to "SPF Chemicals," we mean the chemical components that are used to make professional grade, high pressure SPF. Other chemicals, coatings, and solvents may be used at a spray foam application site, and this Workbook also will address some of the more commonly used materials.

This Workbook addresses the spray foam application job including initial site assessment, occupant outreach, site preparation, SPF chemical storage and handling, SPF application, trimming and cutting, coating and priming of the foam surface, site cleanup, spill response, disposal of SPF chemicals, and reoccupancy.

2 Overview of Spray Polyurethane Foam (SPF)

Spray polyurethane foam (SPF) is formed via an exothermic (heat-releasing) chemical reaction between approximately equal amounts of methylene diphenyl diisocyanate (MDI) and MDI-based isocyanates with a polyol blend, referred to as the A-side and the B-side, respectively. Within a few minutes of application, the foam achieves a tack-free state when the foam surface is no longer sticky. Respirators and other protective equipment are needed to minimize exposure to vapors, aerosols, and particulates of MDI and other chemicals during the spray application and subsequent operations. Depending on the characteristics of the foam including the composition of the B-side chemicals, the heat dissipated during the exothermic reaction, and ambient conditions including temperature and humidity, it can take an additional 23 to 72 hours before the foam is fully cured (i.e. optimum physical properties of the foam are achieved). Follow the manufacturer's instructions regarding the amount of time between applying layers or passes.

The A-side is typically a mixture of 50% MDI and 50% polymeric MDI (pMDI). The B-side, or resin, is a mixture of polyols and other chemicals that have specific roles in the reaction process or impart important characteristics to the finished foam insulation. These chemicals may include catalysts, blowing agents, fire retardants, or surfactants. Among these constituents, the A-side is generally considered to present the greatest potential hazard due to its potential to produce respiratory and dermal sensitization.

3 Potential for Exposure during SPF Application

The potential risk from exposure to a chemical is dependent on several factors, including the route of entry, the dose, the frequency and duration of exposure, and the individual's susceptibilities -- such as whether the individual has already become sensitized to the chemical. The **route of entry** is how a substance enters the body. For SPF chemicals, the exposure would typically occur through breathing (inhalation), direct skin contact, or eye contact. Skin or eye contact may occur through direct contact with the chemical or through contact with contaminated supplies, equipment, or personal protective equipment (PPE). However, if an individual eats, drinks, or smokes after working with chemicals and does not wash hands prior, the chemical may be inadvertently ingested. The **dose** is the amount of a

chemical which enters the body. The chemical must enter the body through one of the routes of exposure for an effect to occur. The **frequency and duration** of exposure are other important considerations. How long did the exposure last? How often did the exposure occur? **Individual susceptibilities** affect the likelihood of an individual to experience a response such as whether the individual has become sensitized to the chemical.

It is critical to avoid inhalation of, and skin and eye contact with, SPF chemicals.

For inhalation exposure, occupational exposure limits to various chemicals have been set by regulatory agencies and other organizations, including the Occupational Safety and Health Administration (OSHA), the National Institute of Occupational Safety and Health (NIOSH), and the American Conference of Governmental Industrial Hygienists (ACGIH). These limits are the air concentrations that these expert organizations believe represent exposures that are acceptable from a health perspective for healthy workers and include time-weighted averages (TWA) for the duration of an entire workshift, short-term exposure limits (STEL), and ceiling limits (C). Additional information regarding occupational exposure limits and a table including occupational exposure limits for some chemical components in SPF chemicals, coatings, and solvents are included in Appendix C of this workbook.

As a general matter, if employee exposure exceeds the occupational exposure limit, employers must take steps to control and reduce exposure. Examples of these controls may include engineering controls such as ventilation systems; work practices; air monitoring; the selection, provision, and maintenance of appropriate PPE to help prevent exposures; training; and medical surveillance.

The following sections detail chemical substances that may be encountered during application of SPF.

Note: this Workbook does not discuss chronic health hazards that may be presented by SPF chemicals or other chemicals, coatings, or solvents at a worksite. Generally, the terms "acute" and "chronic" are used to delineate between effects on the basis of severity or duration. "Acute" effects usually occur rapidly as a result of short-term exposures, and are of short duration. "Chronic" effects generally occur as a result of long-term exposure, and are of long duration. Consult the manufacturer's MSDS for more information with respect to potential chronic health hazards.

3.1 A-Side

The A-side is typically a mixture of approximately 50% methylene diphenyl diisocyanate (MDI) and 50% polymeric methylene diphenyl diisocyanate (pMDI). A-side chemicals are very reactive and reactions can result from improper mixing with water; acids; inorganic bases (such as sodium hydroxide), ammonia, and amines; magnesium, aluminum and their alloys; other metal salts, especially halides (such as tin, iron, aluminum and zinc chlorides); oxidizing agents (such as bleach or chlorine); or polyols.

Personnel may be exposed to airborne concentrations of both A-side (and B-side, for that matter) SPF chemicals during: (1) handling of SPF chemicals prior to beginning work, (2) application of SPF, (3) trimming, cutting, and shaping SPF after application, (4) cleanup and equipment maintenance, and (5) and spill response. Access to the work area during these tasks should be appropriately restricted to personnel whose job responsibilities require them to be in the work area, and who are trained in the hazards of exposure to A-side chemicals and are using the appropriate PPE properly. Hazardous concentrations of A-side chemicals are not anticipated within a few hours after application. (However, due to the potential risk of airborne exposure to B-side chemicals, contact your supplier for information regarding when applicators, helpers, other trade workers, and occupants may re-enter the work area.)

Inhalation overexposure can cause 1) irritation of the nose, throat, and lungs, causing runny nose, sore throat, coughing, tightness in the chest, and shortness of breath, and 2) respiratory tract sensitization (i.e., the development of asthma) with symptoms of chest tightness, shortness of breath, coughing, and/or wheezing. Sensitization is an allergic reaction in which an individual may be more responsive to a chemical exposure at progressively lower concentrations, even below concentrations considered safe for most people. An asthma attack can be life-threatening. NIOSH notes that "early recognition of sensitization and prompt and strict elimination of exposures is essential to reduce the risk of long-term or permanent respiratory problems for workers who have become sensitized." www.cdc.gov/niosh/topics/isocyanates. **Individuals sensitized to SPF chemicals should not be assigned work tasks where there is potential for exposure to SPF chemicals.**

A-side chemicals have a musty odor, but because of the relatively high odor threshold, most people cannot smell A-side chemicals when present in concentrations equal to applicable occupational exposure limits. **As a practical matter, this means that if you smell MDI (musty odor), you have probably exceeded the exposure limits.** If a musty odor is recognized over the course of work, exit the work area and re-evaluate engineering controls and PPE to prevent overexposure. The occupational exposure limits for MDI, which makes up approximate 50% of A-side chemicals, are presented in Appendix C.

Skin or eye contact may occur throughout the application when there is a potential to contact A-side chemicals or any items contaminated with A-side chemicals, such as supplies, tools, equipment, and PPE. Skin contact can cause 1) irritation, and 2) sensitization (allergy). Symptoms include reddening, itching, swelling, and rash. Skin contact alone may lead to respiratory sensitization (asthma). Eye contact can cause reddening, tearing, stinging, and/or swelling of the eyes.

3.2 B-side

The B-side is a polyol resin system which typically contains a blend of several different classes of chemicals. These include the polyols—the principal ingredients—and smaller amounts of amine and/or metal catalysts, blowing agents, surfactants, and flame retardants. There is a large variation in what chemicals are included in the B-side. A summary of the typical composition of a polyol resin system is depicted in Figure 1.

Figure 1: Typical Composition of Polyol Resin Systems

Component	Low Density, Open Cell SPF	Medium Density, Closed Cell SPF
Polyols	60%	20-40%
Blowing Agents	20%	20%
Catalysts	3%	3%
Flame Retardants	15%	20-40%
Surfactants and Glycerin	2%	2%

Personnel may be exposed to airborne concentrations of both A-side and B-side SPF chemicals during: (1) handling of SPF chemicals prior to beginning work, (2) application of SPF, (3) trimming, cutting, and shaping SPF after application, (4) cleanup and equipment maintenance, and (5) and spill response. Access to the work area during these tasks should be appropriately restricted to personnel whose job responsibilities require them to be in the work area, who are trained in the hazards of exposure to SPF chemicals, and who are using the appropriate PPE properly. Contact your supplier for information regarding when applicators, helpers, other trade workers, and occupants may re-enter the work area.

Inhalation overexposure of the B-side can cause irritation of the respiratory tract, causing cough, sore throat, and runny nose. Cardiac arrhythmia (irregular heartbeat) is a symptom of overexposure to certain blowing agents. Inhalation of some amine catalysts vapors can temporarily cause vision to become foggy or blurry, and halos may appear around bright objects such as lights.

Skin or eye contact may occur throughout the work when there is a potential to contact SPF chemicals or any items contaminated with SPF chemicals including supplies, tools, equipment, and PPE. For most B-side chemicals, skin or eye contact with B-side chemicals may cause irritation. In addition, skin contact with some amine catalysts may lead to skin sensitization.

3.2.1 Polyols

Polyols are the primary compounds in polyol resin systems. Polyols are polyfunctional alcohols with low vapor pressure and toxicity through all routes of entry into the body. However, they may be irritating to the eyes, skin, and respiratory tract at high exposure levels, especially during spray applications. Polyols react with A-side chemicals to form polyurethane.

3.2.2 Catalysts

Catalysts promote the reaction between the polyol and the A-side, helping polyurethane foam cells develop sufficient strength to maintain their structure to resist collapsing or becoming deformed, and help with the completion of the reaction or "cure" in the finished foam. Most catalysts used in SPF are amine based, and some B-side formulations may use metal catalysts.

The polyol resin typically contains 1 to 5% amine catalyst. Overexposure to airborne concentrations of amine catalysts may result in irritation to the respiratory system, skin, and eyes. Inhalation exposure may cause a reversible effect known as glaucopsia or “blue haze” or “halovision” in the eyes. Glaucopsia is characterized by clouding or fogging of vision due to swelling of the outer layer of the cornea. Once removed from the exposure, vision is gradually restored. If vision is not restored within a few hours seek medical attention. Amines are derived from ammonia and often have a characteristic ammonia/fishy odor. In general, exposure limits are not yet established for the majority of the amine catalysts used in SPF systems.

Metal catalysts usually comprise less than 0.15% of the polyol resin and may include tin compounds or, less commonly, lead or other metals. Metal catalysts can absorb through the skin resulting in headache and/or nausea. Organic tin compounds can irritate the eyes, skin, and respiratory tract. Prolonged skin contact can cause organic tin compounds dermatitis. Lead naphthenate is a less-commonly-used metal catalyst which may be absorbed through the skin. Systemic effects on the peripheral and central nervous systems may result from excessive exposure to lead compounds. Many metal catalysts used in polyol resins do not have occupational exposure limits.

3.2.3 Blowing Agents

The B-side polyol resin blend typically contains less than 20% by weight of blowing agents. Formulations may use chemical (reactive) blowing agents, physical blowing agents, or a combination of both types of blowing agents.

A chemical blowing agent reacts with another raw material to generate a gas. Water is often used as a chemical blowing agent in a polyol blend. It reacts with MDI to generate carbon dioxide.

Physical blowing agents are vaporized by the heat of the polyurethane reaction. Hydrofluorocarbons (HFCs) are common physical blowing agents. Skin and eye contact with HFC can result in contact irritation. Overexposure to airborne concentrations of HFC can be irritating to the respiratory tract, cause central nervous system effects, and in some cases can cause irregular heartbeat.

If large amounts of blowing agents are released in an enclosed area, oxygen can be displaced, resulting in an oxygen-deficient atmosphere which is a hazardous atmosphere. However, because blowing agents comprise a small percentage of SPF, an oxygen-deficient atmosphere is not likely to develop.

3.2.4 Flame Retardants

Flame retardants modify the characteristics of the foam to increase fire resistance characteristics of the finished foam. Flame retardants can range from 15% to 40% depending on the particular polyol resin system.

Chemical overexposure to flame retardants may be irritating to the respiratory tract and direct contact with flame retardants may be irritating to the eyes and skin. There are different classes of flame retardants and different toxicological profiles for these compounds, so the MSDS must always be consulted for acute and chronic chemical-specific information.

3.2.5 Surfactants

Surfactants affect cell size and structure. Surfactants are typically 1% of the polyol resin system. Surfactants include silicone polymers which typically have low toxicity by all routes of entry into the body. Some surfactants can cause slight irritation to the eyes, skin, and respiratory system. Occupational exposure limits have not been established for surfactants.

3.3 Coatings, Primers, and Organic Solvents

A variety of coatings may be used in foam applications to protect the polyurethane foam from physical damage and exposure to ultra-violet (UV) light. These include acrylic, butyl, silicone, polyurea and polyurethane materials. Many of these roof coatings contain organic solvents such as toluene, petroleum distillates, xylene, methyl ethyl ketone, varnish makers and painters (VM&P) naphtha and n-butyl acetate. In addition, solvents may be used to prepare the surface prior to application or for cleanup after application is completed. A list of some of the solvents included in coatings and used for cleanup and their respective occupational exposure limits is included in Appendix C.

Skin contact with organic solvents may result in defatting, drying, and cracking of the skin. Many organic solvents are readily absorbed through the skin, and can be inhaled. Effects due to overexposure to organic solvents may include headache, nausea, and vomiting followed by unconsciousness at higher levels of exposure. There also are reports of permanent nervous system damage resulting from long-term overexposure to many of the common organic solvents. Refer to the Material Safety Data Sheet (MSDS) for specific information related to the coatings, primers, and solvents you are working with.

3.4 Dust

Dust may be generated during all phases of construction. Use good housekeeping throughout the project to prevent buildup of dust. In addition to the inhalation hazards associated with exposure to airborne dust, high levels of dust also are associated with reduced visibility and slip hazards.

Carefully evaluate the need to wear PPE appropriate for SPF chemicals if there is a potential for exposure to dust after the spray application has concluded but before the cure time has been reached. This includes respiratory protection for the protection from inhalation exposure, protective clothing and gloves to reduce the risk of skin contact, and eye and face protection to reduce the risk of eye contact. Although SPF typically reaches 90% of its cure and will have obtained at least 90% of its optimal physical properties within one hour of application, it can take an additional 23 to 72 hours for a complete cure, depending on the ambient temperatures. Refer to the MSDS for specific information related to the SPF chemicals you are working with.

4 Hazard Communications

The OSHA Hazard Communications Standard was designed to provide employees with information on the identities and hazards of all chemicals used in the workplace and recommended protective measures. According to the OSHA Hazard Communications Standard (29 CFR 1910.1200), all employers are required to have a written hazard communications program to meet the requirements addressed in 29 CFR 1910.1200. Violations related to the Hazard Communications Standard are some of the most frequently cited by OSHA compliance officers. Requirements of the standard include development of a written program to address the followings components: labels and other forms of warning, MSDSs, and employee training and information. A sample written program for Hazard Communications may be found in OSHA publication 3186-06R 2003 *Model Plans and Programs for the OSHA Bloodborne Pathogens and Hazard Communications Standards* (available at www.osha.gov/Publications/osha3186.pdf). Additional product stewardship guidance related to *Hazard Communications* is included in Appendix E-1 of this workbook.

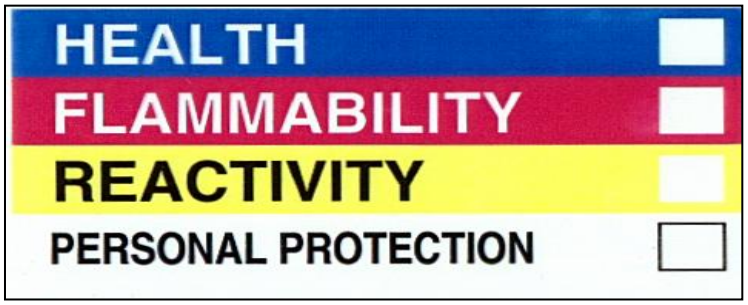
4.1 Labels and Other Forms of Warning

According to the OSHA Hazard Communication Standard, chemical containers must be labeled and the information contained on the label must be legible and prominently displayed. Chemical labels identify the contents of a container used at a worksite. In addition, labels also convey information related to the toxicological, chemical, and physical properties associated with the chemical. It is good practice to maintain the original manufacturer's label. When chemicals are transferred into unmarked containers, OSHA requires that these containers be labeled with the required information as well, except when transferred for immediate use by the employee who performed the transfer.

Many systems have been developed for labeling potentially hazardous chemicals. The two most common are the Hazardous Material Identification System (HMIS) and the National Fire Protection Association (NFPA) systems. A brief description of these follows. The HMIS refers to hazards during anticipated use while the NFPA system describes hazards under fire conditions. Therefore, the two systems may have different hazard categories for the same material.

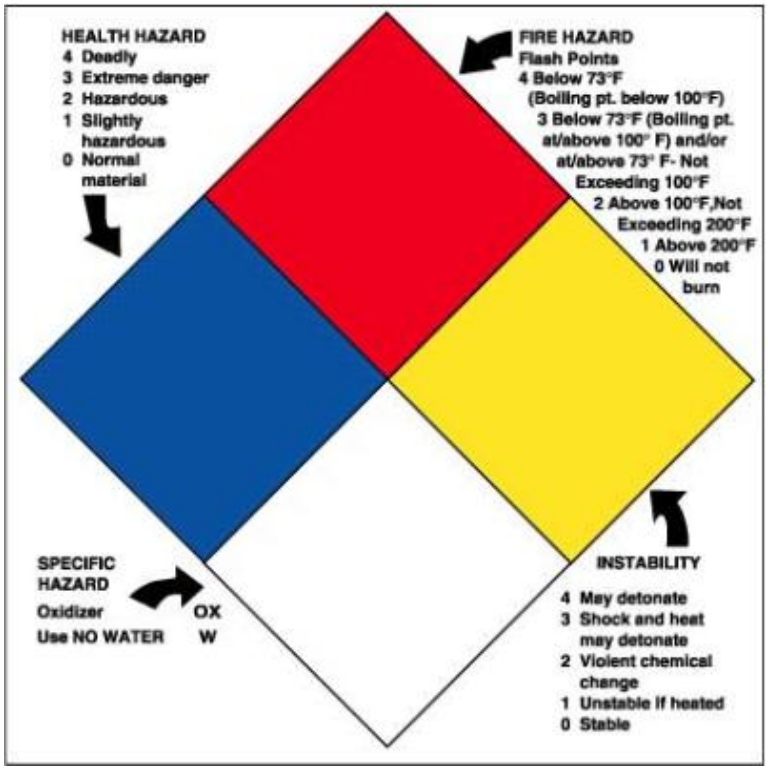
An example of a typical HMIS hazard-warning label is shown in Figure 2. It ranks the hazard the material poses from 0 to 4 in these categories: Health (blue), Flammability (red), and Physical Hazard (yellow). A rank of 0 indicates that the material presents a minimal hazard for that category. A rank of 4 indicates a severe hazard for that category. The HMIS label also may depict the type of PPE required, but the narrative descriptions on the drum label and in the MSDS should be reviewed.

Figure 2: Example of HMIS Label



An example of a typical NFPA hazard-warning label is shown in Figure 3. It is in the shape of four small diamonds that make up a larger diamond. Each small diamond contains a numerical ranking, again on a 0 to 4 scale, for the severity of the hazard in a particular category. In the NFPA label, the left diamond is for the health ranking (blue), the top for the fire or flammability ranking (red), and the right for the instability ranking (yellow. The bottom diamond (white) denotes any other significant hazards associated with the material such as a chemical that is reactive with water.

Figure 3: Example NFPA Label



4.2 Material Safety Data Sheets (MSDS)

As part of the Hazard Communications Standard, OSHA requires chemical manufacturers and importers to obtain or develop an MSDS for each hazardous chemical they produce or import. Employers are

required to have an MSDS in the workplace for each hazardous chemical they use. If you do not have an MSDS for a chemical used at your worksite, contact the manufacturer.

Before using any SPF product, you should read and understand the entire MSDS for the product. The MSDS contains very important information about the product, including the chemicals constituents and the approximate concentrations; the PPE appropriate for the job; information on how to handle accidental releases; and information on storage, handling, transportation, and disposal.

Because these documents are so important, make them as readily accessible at a job site as possible. Keeping one clean copy of each MSDS in a clearly marked binder is a good practice that helps keep the information readily accessible. Many contractors like to keep several spare copies of MSDSs on hand; in the event of an emergency or incident, this allows multiple copies to be available for emergency responders. Another good practice is to review the location of the MSDS binder with all workers on the SPF jobsite before the job begins. Note that OSHA requires that all MSDS be readily available to all workers at the jobsite, which may include other trade workers.

Note that many MSDS are now available online, so workers with enabled mobile devices or in-truck internet service may also be able to access them electronically on site. In addition, it may be possible to obtain the MSDS in multiple languages if needed. Contact the manufacturer for more information.

Additional product stewardship guidance titled *Have You Read the MSDS?* is included in Appendix E-1 of this workbook.

4.3 Employee Training and Information

As a component of the OSHA Hazard Communication Standard, employees are provided Hazard Communication training upon initial assignment. The training includes information on the hazardous chemicals the employees are working with, the control measures to reduce the potential for exposure, and how to read the MSDS and product labels. The training also includes worksite-specific information including work practices, PPE to be used, and emergency procedures. OSHA requires that the employee have the opportunity to ask questions and be able to demonstrate comprehension.

The training must be understandable for the employee. When employees receive work instructions in languages other than English, employers are required to provide training in that language as well. Additional training is needed when a new physical or health hazard is introduced into the work area. At multi-employer worksites, additional training may be needed so that all employees know where the MSDSs are located, details related to the labeling systems, and the hazards associated with other chemicals at the worksite they may be exposed to.

4.4 “Green” Marketing Claims and Hazard Communications

"Green claims" are in many spray polyurethane foam advertisements, promotional materials, sales claims, and labels today. Green claims are the marketing response to consumers' increasing interest in protecting the environment. They can help consumers better understand the environmental attributes of a product or service, like its contribution to energy efficiency, and help inform purchasing decisions.

An SPF marketing claim often points out a particular product feature or benefit; for example, an SPF marketing claim may point out that a product is made using a renewable, plant-based resource. A properly qualified "green" marketing claim about a particular attribute, such as renewable content in a product, should never be confused with the toxicity profile of a product. Application and use

instructions should always be consulted, including MSDS, manufacturer's instructions, and label instructions. ***An SPF marketing claim should not be confused with instructions on how to safely use and apply the SPF product.***
Additional product stewardship guidance related to *Marketing Claims* is included in Appendix E-5 of this workbook.

5 Good Practices

It is critical to avoid inhalation of, and skin and eye contact with, SPF chemicals, for applicators, helpers, occupants, and adjacent workers. The following good practices include engineering controls, work practices, and PPE intended to reduce the potential for exposure to SPF chemicals via inhalation or skin or eye contact. Consider a combination of engineering controls, work practices, and PPE for SPF applications. Engineering controls must always be the first line of defense against chemical exposure, followed by the use of work practices and PPE.

5.1 Engineering Controls

Proper containment and ventilation techniques can help prevent workers and building occupants from potential chemical exposure due to SPF application, particularly in interior applications when buildings cannot be vacated. Containment creates a contained workspace while the ventilation system removes SPF chemicals from the work area by drawing the air out of the workspace through the use if a fan. In addition to the engineering controls, PPE may be needed to further reduce the potential for inhalation exposure.

5.1.1 Workspace Containment

Workspace containment is used in conjunction with ventilation to isolate and remove chemicals from the work area. A workspace does not need to be perfectly airtight, but containment is most effective when a workspace is as close to airtight as can practically be achieved. If a workspace is contained, clearly mark the area externally, and take appropriate steps to restrict entry into the workspace to personnel wearing proper PPE.

One example of a way to create an effective containment space is to bound the workspace by solid walls (e.g., the outside walls where foam is applied), and solid floors and ceilings. Shut windows and doors, and seal them well; typically, plastic sheeting such as 4-6 mil polyethylene is used, secured well with a suitable tape. Temporary containment walls or curtains can be created by attaching the plastic sheeting to existing interior framing, or by using temporary framing. In either case, seal the seams and boundaries of the sheets with tape. An illustration is provided in Figure 4. When selecting a sealing technique, remember to maintain the function of windows and doors as emergency egress points. It also is important to note that this approach features a ventilation trade off; windows and doors are closed and sealed to create the containment space, whereas in many applications, open windows and doors to support improved ventilation are desirable.

Figure 4: Example of Temporary Containment Using Plastic Sheeting and Tape

After the contained workspace has been created, check it for air leakage. Activate the fans and get a visual check to be sure a negative pressure is being created. This can be as simple as observing an inward billowing of the plastic sheets. Air leaks can also be readily detected with a smoke pencil, shown in Figure 5, which are available at building supply stores.

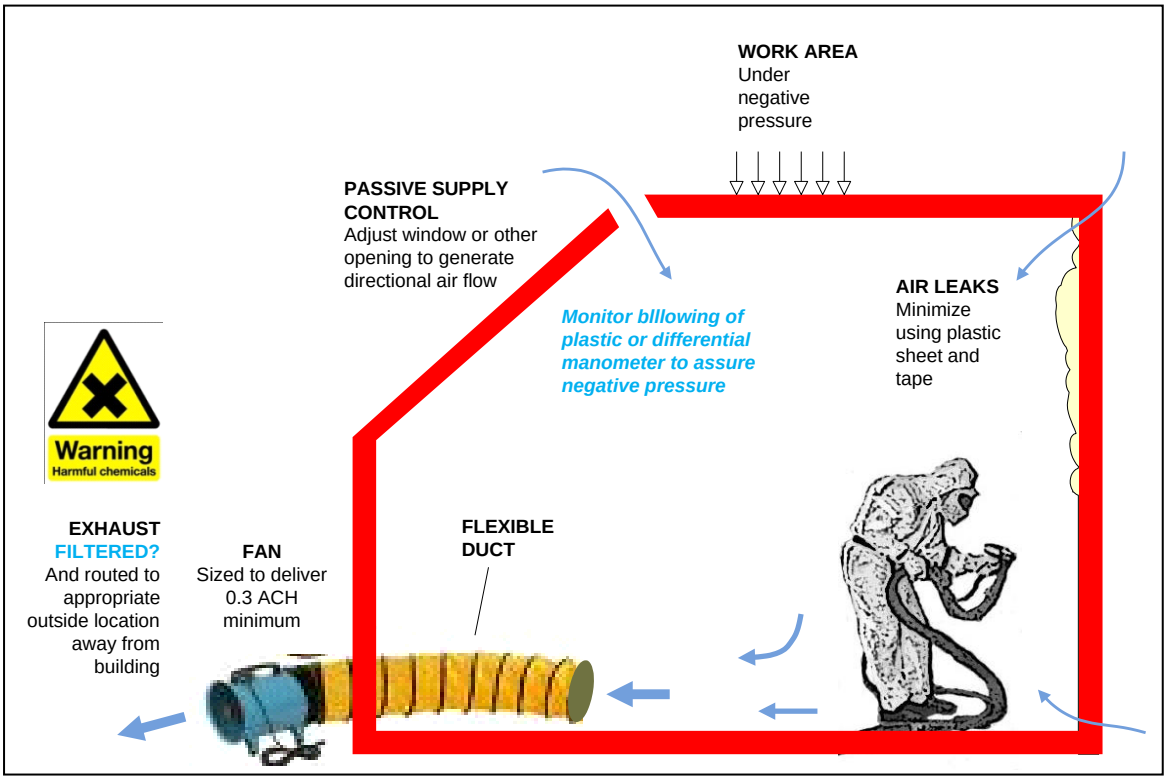
Figure 5: Smoke Pencil Used to Check for Air Leaks

5.1.2 Ventilation Design

Ventilation used with workspace containment removes chemicals from the isolated area via negative pressure. Having a negative pressure in a contained work zone will draw in air from small cracks and gaps around the workspace boundary and exhaust the work zone air. Active ventilation is achieved by using one or more fans to draw air to or from the workspace and create a negative pressure inside the workspace.

Give careful consideration to the location of the exhaust. Ideally, exhaust is released to an unoccupied space where it is not likely to be drawn through an air intake. This will help protect occupants and workers in adjacent areas from potential chemical exposure. Figure 6 provides an example of a ventilation system that may be used during SPF application.

Figure 6: Example Containment and Ventilation System for SPF Application



5.2 Work Practices

Employee work practices are an important factor in the overall safety performance at any worksite. Work practices are used in combination with engineering controls and PPE to reduce the risk of exposure to SPF chemicals via inhalation or skin or eye contact. The following work practices can be reviewed with employees involved in the spray foam application process, including applicators, helpers, and other trade workers who may work adjacent to the application area.

The use of hygienic practices can help minimize the possibility of ingesting SPF chemicals. Consideration is given to practices that may introduce SPF chemicals to the mouth and result in ingestion or inhalation, so worksites typically prohibit the storage, preparation, or consumption of food in areas where SPF chemicals are used, as well as smoking, tobacco, or gum chewing.

5.2.1 Site Preparation

There are many factors to consider when planning an SPF installation. Will the work take place in an occupied building or a building under construction? Will the building be vacated? Will other trades

workers be present at the time of application? Will the application take place indoors or outdoors? What is the size of the work area – a large open area or an attic or crawlspace with limited ventilation? HVAC systems are typically shut down during some parts of roof preparation, as well as during application of primers, spray polyurethane foam, and coatings. System shut down stops the drawing of dusts, aerosols and/or vapors into interior spaces. Once the HVAC system is shut down, seal the air intakes with plastic sheeting and tape, which will prevent dust and spray from entering the intakes. Keep the plastic sheeting in place at least several hours after the spray application is completed, typically 24 hours or more; a longer period may be appropriate for coatings, depending on when the coatings have hardened or set and are no longer emitting vapors. The HVAC system should not be restarted until appropriate time has elapsed and the plastic sheeting and tape is removed.

Consider the following practices when preparing a site for SPF application:

- If the entire building is not vacated, consider the potential for SPF chemicals to migrate to other floors. Containment and ventilation methods may help prevent migration. Discuss with property management or other contractors which floors will be occupied.
- If local exhaust ventilation and containment methods are not used, establish a work zone around the work area to protect adjacent workers. The distance between the work area and adjacent workers is typically 25 feet, but depends on several factors, including but not limited to the volume of SPF applied, the area covered, and air movement. Signage may be used to communicate access restrictions.
- Before beginning work, designate an area for putting on and removing PPE.
- Determine in advance the potential for overspray damages. Have a plan in place to address overspray damages to adjacent property. Train all employees in overspray prevention.
- Identify and protect surfaces that could be damaged (e.g., windows, doors, equipment, or building exterior) in advance of application.
- For work outdoors, take wind direction into account for all spraying operations. Note that for a job that takes place over several days, the wind direction may change and the work area should be adjusted as needed. In slightly windy conditions, use windscreens.
- Do not spray foam or coatings in excessively windy conditions. Sustained wind speeds or gusts of about 15 mph (24 kph) make controlled application more difficult.

Additional product stewardship guidance on *Effective Workplace Practices* related to the application of SPF chemicals and interior and exterior applications is available in Appendix E-2 of this workbook.

5.2.2 Occupant Outreach

SPF applicators and their helpers receive professional training regarding the hazards associated with spray foam application, including this course. Building occupants are not necessarily aware of the potential health hazards associated with SPF application or safety precautions to minimize the risk. SPF application involves the potential for exposure to a variety of chemicals, including SPF chemicals, coatings, and solvents. Consider potential exposures to all of the chemicals used on a job when developing an occupant outreach strategy.

Applicators and contractors can educate building occupants about the health hazards associated with SPF and the ways they can protect themselves from these hazards. A sample checklist of information you may wish to consider discussing with owners, designees, or occupants is included as Appendix D. Although there is a lower degree of risk of inhalation exposure to SPF chemicals in exterior applications

than interior applications due to natural ventilation, contractors may wish to consider use of the checklist as a tool to guide discussions with occupants. In commercial and public buildings, contractors may choose to provide outreach to building owners or their designee as well as to individual tenants.

On occasion, owners or their designee may wish to enter the work area before the building is cleared for occupancy in order to review the work. PPE may be needed for entry into the work area even for persons who are not involved in the application of SPF chemicals. You may wish to discuss alternatives for viewing the application or the work status with the owner or designee that avoid exposure issues, such as using photographs or real-time video to allow the owner or designee the opportunity to view the work.

5.2.3 Chemical Storage and Handling

It is important that SPF chemicals be stored properly before and during use on the job site. Improper storage conditions can make the components unusable, and also can create a potential for fire and/or explosion. It is also important to store materials which are incompatible with each other separately.

Storing drums in a secured cool area away from direct sunlight, excessive heat, and general storage areas helps protect them. Consult the manufacturer's instructions for the temperature at which to store drums; typically, temperatures between 45 and 75^{o}F are suggested. Materials which are allowed to freeze and then thaw, or overheat, can present hazards, so follow the manufacturer's instructions with respect to storage. Ventilate the storage space well, and locate the storage space away from possible sources of ignition.

MDI (A-side) drums are stored an appropriate distance from contact with water, acids, caustics (such as lye), alcohols, and strong oxidizing and reducing agents. Oxidizing agents include oxygen and chlorine. Oxidizers can be recognized by a yellow diamond shaped label on the container marked "oxidizer." Most strong reducing agents also are corrosive. These can be identified by a half-black, half-white diamond-shaped label marked "corrosive." Contact of MDI with any of these kinds of materials can trigger a violent reaction that could cause significant damage or injury.

In addition to storing containers away from incompatible materials, it is important to maintain a tight seal on MDI (A-side) containers to help protect against moisture or direct contact with water. Contamination with water could result in the drum rupturing or exploding because water slowly reacts with MDI to produce carbon dioxide gas.

Polyol system resin (polyol blend) drums, likewise, are stored an appropriate distance from acids, caustics, and strong oxidizing and reducing agents in order to avoid contact. When opening the "B" drums, the slow opening of the bung on top of the drum helps release built-up pressures so the drum can be opened safely. If heating drums with a blanket heater (or other methods), loosening the "B" side bung on the top of the drum will allow for off-gassing. A thermometer can be inserted into the material to monitor the material temperature to help prevent overheating; 24" thermometers are available that assist in access to the liquid drum contents. Gentle agitation of materials helps evenly heat the contents.

Finally, coating or primer material drums or containers that contain solvents may have a United States Department of Transportation (USDOT) "Flammable" or "Combustible" label. Flammable labels are red and bear the word "flammable." Regulatory requirements require these drums to be stored away from heat and ignition sources, in a designated area or cabinet.

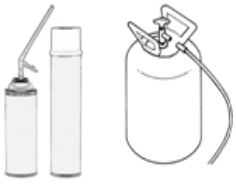
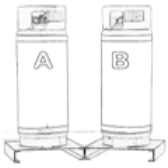
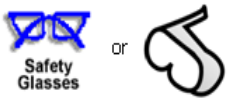
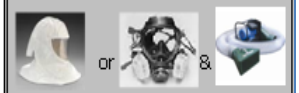
Appropriate PPE is worn by personnel handling containers with A-side or B-side chemicals to minimize the potential risk of exposure to SPF chemicals via inhalation or skin or eye contact. Depending on the task, this may include chemical-resistant gloves, chemical-resistant clothing, and eye protection. Respiratory protection may be needed if there is the potential for inhalation exposure to SPF chemicals.

5.2.4 SPF Application

When applying SPF, applicators and helpers can be instrumental in helping to reduce the potential risk of exposure to SPF chemicals for occupants and other trade workers at the worksite. The work area should be appropriately restricted to personnel who are required to be in the work area due to their job responsibilities, have completed the required training, and who are properly using the required PPE.

Generally, appropriate PPE for high pressure applications includes at a minimum chemical-resistant gloves, protective clothing, eye and face protection, and respiratory protection. The specific types of PPE may vary depending on the conditions at the jobsite, such as whether the application takes place indoors or outdoors, the amount of ventilation, the specific components of the B-side chemicals, and the quantity of SPF chemicals applied. Figure 7 lists the PPE guidance for different SPF applications by product type.

Figure 7: PPE Guidance for Applicators and Helpers - All Systems

	Low Pressure			High Pressure
	One-component Cans	Two-Component Kits	Refillable Systems	High Pressure Spray Systems
				
Routes of Exposure	PPE	PPE	PPE	PPE
Eyes	Safety Glasses  Safety Glasses	Safety Glasses  Safety Glasses or Goggles	Safety Glasses  Safety Glasses or Goggles	 or FF Mask/ Hood
Skin	Long Sleeves 	Long Sleeves 	Long Sleeves 	Full Body Suits  Full Suit
Hands	Gloves 	Gloves 	Gloves 	Gloves 
Lungs	Avoid Breathing Vapors  Provide Good Ventilation	Respirator  &/or Air Purifying OV / Pre-filter Provide Good Ventilation	Respirator  &/or Air Purifying OV / Pre-filter Provide Good Ventilation	Air Supply  FF Mask/ Hood Airline *or* FF Air Purifying OV/Pre-filter Provide Good Ventilation
For more available information see the Spray Polyurethane Foam Health & Safety Website at www.spraypolyurethane.com				

Attic and crawl spaces present unique hazards due to the potential to generate hazardous atmospheres in confined spaces. Refer to the OSHA Permit Required Confined Space Standard and the American National Standards Institute (ANSI) Standard Z117.1 *Safety Requirements for Confined Spaces* for information on additional requirements.

Ambient conditions (including temperature, humidity, and wind conditions) may affect the cure time and the time between material application passes. Interior application areas should be ventilated for a period of time following installation to allow aerosols and vapors to dissipate.
If working outdoors, work upwind of the spray as much as possible.

Additional product stewardship materials related to *Interior Spray Polyurethane Foam Applications* and *Exterior Spray polyurethane Foam Applications* are included in Appendices E-3 and E-4 of this workbook, respectively.

5.2.5 Trimming and Cutting

SPF typically reaches 90% of its cure and will have obtained at least 90% of its optimal physical properties within one hour of application. As the exothermic reaction of the foam subsides, the rate of cure slows down considerably, and it can take an additional 23 to 72 hours for a complete cure, depending on the ambient temperature and humidity. In addition, study data currently available indicate that the surface reaction for SPF is complete within 15 minutes (Lesage *et. al.,* 2007). Trimming and cutting activities that will move beyond the surface into the interior of the applied SPF where cure may still be occurring may present the potential for exposures to SPF chemicals, and appropriate PPE should be worn for this activity. PPE that may be needed during trimming and cutting may include chemical-resistant gloves, coveralls for skin and clothing protection, eye protection, and respiratory protection for inhalation exposure to dust and SPF chemicals.

5.2.6 Coating and Priming

Chemicals used for coating and priming during SPF projects also may present a risk of potential chemical exposure. Generally, coatings and primers may contain organic solvents, although other chemicals also may be present. Consult your MSDS for specific information related to the contents and precautions during coating and priming. Some coatings and primers may be harmful if inhaled or upon skin contact. When using coatings and primers, consider the following PPE: chemical resistant gloves, protective clothing, eye and face protection and respiratory protection. In addition, if the SPF has not completely cured, then respiratory protection may be needed.

5.2.7 Cleanup and Equipment Maintenance

After the application is completed, decontaminate the equipment and clean up the work area. Appropriate PPE should be worn while cleaning equipment contaminated with A-side or B-side chemicals and equipment and while handling any containers with A-side or B-side chemicals (e.g., drums, buckets, spray guns). Use of a vacuum equipped with a HEPA filter can help reduce the amount of dust generated during cleanup.

Upon exiting the work area, remove PPE in a designated clean zone away from the areas where there is a potential risk of exposure to SPF chemicals. Remove and dispose of PPE according to applicable local or state regulations. Inspect and clean reusable PPE for continued effectiveness. Remove damaged PPE from service until repaired, or dispose of the damaged PPE and replace it.

It is a good work practice to keep work clothing at work. Note that contaminated leather items including shoes, belts, and watch bands or clothing, that have been exposed to SPF chemicals cannot be decontaminated, and are, therefore, to be appropriately disposed of.

5.2.8 Spill Response

A spill or release is the unplanned discharge of a material to the ground, water, or air. It is advisable to have an emergency spill containment kit available that contains absorbent materials such as clay, pads, or socks to contain or minimize the affected area.

A clean work site helps reduce trips, slips, and falls. Because B-side chemicals can be extremely slippery, mark and clean up spills, particularly from smooth walkways or floors, as soon as possible.

Although infrequent, sizable spills and releases of A- and B-side chemicals can occur. If this happens, it is important to take immediate action to minimize environmental contamination.

You may be required to report spills and releases of spray foam and coating ingredients to local, state, and/or federal authorities. For this reason, keep all containers of chemicals tightly sealed except when they are actually in use.

In the event of a large A-side chemical spill or release (i.e., more than a few pounds or gallons), consider the following:

- Direct all personnel away from the immediate area to avoid unnecessary exposure.
- Provide appropriate PPE for individuals involved in the cleanup. PPE for cleanup crews may include appropriate respiratory protective devices, impervious clothing, footwear, eye protection, and gloves in accordance with OSHA regulations.
- Absorb the A-side chemicals with sand, wet earth or absorbent clays (e.g., vermiculite or cat litter). Place the absorbed material in drums and neutralize. Do not seal these drums for an appropriate period (typically, at least 48 hours).
- Check to see if you have exceeded the reportable quantity (RQ) (Reportable quantity for MDI is 5,000 lbs), which is the equivalent of approximately 15 drums of a typical A-side material. Note that 10 drums of A-side chemicals are a large quantity; a typical single family residence or commercial application is likely to have fewer drums present. Call the EPA's Superfund Call Center 1-800-424-9346 or consult 40 CFR §302.4. If it is determined that you have exceeded this amount, you must report the spill to various government agencies.
- Characterize waste (i.e., hazardous or nonhazardous waste) and dispose of waste in accordance with all applicable regulations.

You may be required to report sizable MDI or solvent spills or releases to a Local Emergency Planning Committee (LEPC), State Emergency Response Commission (SERC), and the National Response Center (NRC). The penalties associated with not reporting are quite substantial, so it is better to be conservative.

Job site wastes consisting solely of construction debris, such as old roofing materials, do not normally require any special handling or packaging for disposal, unless they contain asbestos or other unusual hazardous materials. If you are unsure, it is suggested that they be treated as hazardous. However, cured polyurethane foam does not meet the criteria of a hazardous waste according to Resource Conservation and Recovery Act (RCRA), and should be acceptable for landfill disposal. Some landfill facilities may ask for a MSDS on cured polyurethane foam before allowing disposal. It is suggested that the state and/or local waste disposal regulatory authority be consulted prior to disposal of any type of waste.

5.2.9 Disposal of SPF Chemicals

This section provides general guidance related to disposal of SPF chemicals. Not covered here are the many other materials and chemicals that may be present at a job site, including but not limited to solvents, oils and fuels, coatings, primers, and other chemicals, all of which may have separate and very specific waste disposal requirements under applicable law. All persons involved in waste disposal have an independent obligation to ascertain that their actions are in compliance with current federal, state, and local laws and regulations. Consult the manufacturer for additional assistance on waste disposal.

The proper disposal of any remaining SPF chemicals is a crucial part of an SPF application. Likewise, drums containing SPF need to be properly prepared, decontaminated, and disposed of in accordance with regulatory requirements. It is never acceptable to abandon or discard a drum without following

proper disposal procedures in accordance with legal requirements. Consult the MSDS for more information.

Note that small amounts of unused A-side chemicals can be reacted with small amounts of unused B-side chemicals to produce foam. Cured foam is typically non-hazardous, and if it is determined to be non-hazardous, cured foam can be disposed of as non-hazardous waste.

Always wear appropriate PPE at all times when handling SPF chemicals and the drums containing these materials. Consult the manufacturer's MSDS for specific information about PPE.

Contact the Center for the Polyurethanes Industry of the American Chemistry Council (www.americanchemistry.com/polyurethane) for additional guidance on disposal of drums used to contain or transport SPF chemicals.

5.2.10 Reoccupancy

Reoccupancy time is dependent on a number of factors, including SPF formulation, the amount of foam applied per volume of space, and the degree of ventilation. In addition to the release of airborne SPF chemicals during spray application, certain components can be liberated from some newly-installed SPF products for a short period of time following installation. Contact your supplier for guidance on ventilation time and reoccupancy.

Some SPF manufacturers may have had their SPF products tested using the Canadian Standard Laboratory Guide for the Determination of Volatile Organic Compounds from Polyurethane Foam (CAN/ULC S774-06). If so, request from the manufacturer the recommended reoccupancy time for that SPF product. In addition, such information is publicly available in some cases. The Canadian Construction Materials Centre has a searchable Registry of Product Evaluations available at www.nrc-cnrc.gc.ca/eng/services/irc/ccmc/registry-product-evaluations.html that contains product evaluations for many types of building products, including SPF insulation. The evaluation reports for specific SPF insulation products often include the recommended reoccupancy time, which is variable (24 hours is common).

5.3 Personal Protective Equipment (PPE)

Even with effective engineering controls, personnel who work with SPF chemicals still need to wear appropriate PPE. This section provides general information about PPE. Although not exhaustive, the information provided may complement the information contained within your company's safety program, as well as the MSDS. An MSDS is an important source of safety and handling information for a product.

Generally, PPE is required for applicators, helpers, and other adjacent workers who may enter a spray foam application work area before the foam is fully cured. However, bear in mind that formulations of SPF may vary, particularly with respect to B-side chemicals. Contact your supplier for more detailed information regarding re-occupancy time. Implement appropriate work area restrictions to limit entry into the spray enclosure or spray area to personnel wearing proper PPE until the level of airborne concentrations of chemical substances is below the applicable occupational exposure limits.

It is critical to avoid inhalation of, and skin and eye contact with, SPF chemicals. A PPE evaluation prior to beginning work is a useful tool to determine the appropriate PPE for the job. PPE to consider includes: protective clothing, gloves, eye and face protection, and respiratory protection.

The effectiveness of PPE depends on both proper selection and proper use. It is important for workers to understand what PPE is needed, how to put on, operate, and take off the equipment, and how to maintain and/or dispose of the equipment.

5.3.1 PPE Evaluation

PPE evaluations are conducted to determine the appropriate type of PPE needed for a job task, depending on the conditions at the worksite. Consider the following when selecting PPE for a job task:

- Location of the job tasks, such as outdoors vs. indoors, whether the work will take place in an enclosed space, the type of ventilation available, and the ambient temperature and relative humidity and wind speed and direction if applicable.
- Potential for inhalation exposure or eye or skin contact with SPF chemicals based on the job tasks.
- The quantity of SPF chemicals applied and the delivery method.
- The type of work being conducted and the potential for wear and tear on the PPE.
- Characteristics of the PPE that may affect the wearer's ability to complete a task such as gloves that permit dexterity and respiratory protection that allows adequate peripheral vision.
- Wearer acceptance. PPE that does not fit the user may not provide sufficient protection. In addition, if an individual does not like the PPE he or she may be less likely to use it when needed.

Air monitoring is one way to evaluate the potential for inhalation exposure to SPF chemicals. Air samples may be collected at specific time intervals during application and after spray application has ceased. These data are helpful in determining when it is safe to enter the enclosure or spray area. An environmental health and safety professional can help develop a sampling strategy for contractors that would like to explore the use of this tool.

When working with SPF chemicals, respiratory protection is usually needed due to the relatively low occupational exposure limit for A-side chemicals as well as the potential for exposure to B-side chemicals, coatings, and solvents.

Additional considerations are given when there is the potential to be exposed to multiple chemicals simultaneously. It is possible that exposures to one chemical may be below occupational exposure limits, while exposures to another may exceed occupational exposure limits. In addition, when selecting gloves and protective clothing it is important to make sure that the gloves or clothing are protective for all of the chemicals used. Refer to the MSDS when selecting PPE.

5.3.1 Protective Clothing

The use of appropriate protective clothing is necessary whenever there is possibility of direct contact with SPF chemicals. The appropriate protective clothing varies depending upon the potential for exposure. Applicators and helpers typically wear disposable coveralls (Figure 8) to keep spray and mist from contacting skin and clothing. To protect skin, wear PPE in such a manner as to protect all skin (in other words, there should be no exposed skin showing). When not wearing a hood respirator, select a coverall with an attached hood or spray head cover. For tasks where there is a potential for splash, consider a suit coated with an impermeable coating such as PVC.

Figure 8: Disposable Coverall

Disposable overboots with skid-resistant soles (Figure 9) may be used for protection from overspray if it does not compromise the grip of the work boots or create a tripping or slipping hazard.

Figure 9: Boot Covers with Skid-Resistant Soles

5.3.2 Gloves

Gloves made of nitrile, neoprene, butyl or PVC generally provide adequate protection against A-side materials. (*See* PMDI User Guidelines for Chemical Protective Clothing Selection, Alliance for the Polyurethane Industry (API) Technical Bulletin AX178, January 2002). A-side protection is generally considered adequate to provide B-side protection as well; however, consult the manufacturer's MSDS for specific information about B-side protection. A range of sizes should be available. A glove which is too large or small for the user may not provide proper protection. A fabric glove fully coated with nitrile, neoprene, butyl, or PVC provides good protection for SPF applicators.

Figure 10: Fabric Gloves Coated with Nitrile

5.3.3 Eye and Face Protection

Appropriate eye protection helps prevent eye contact from splashes of liquid SPF chemicals, accidental sprays of reacting foam, aerosols and vapors that are likely to be present during spraying, and airborne particulate associated with sanding and grinding operations. The type of eye protection needed depends on the nature of the activity.

Persons handling liquid SPF chemicals in open containers can protect their eyes by wearing safety goggles or safety goggles in combination with face shields. The use of contact lenses is discouraged.

Figure 11: Chemical Resistant Safety Goggles

During application of SPF, eye protection may be provided by virtue of wearing a full-face or hood respirator.

OSHA requires that an eyewash or safety shower be provided in the work area where the eyes or body may be exposed to "injurious corrosive materials." Consult the MSDS for all materials to be used on the job in advance to help inform whether such materials will be present, and if so, comply with applicable OSHA requirements.

5.3.4 Respiratory Protection

Engineering controls, such as local exhaust ventilation, can be used to control SPF chemical exposures. Administrative controls, such as work schedules and work practices, are used concurrently to minimize exposure. Respirators are needed when air concentrations continue to exceed occupational exposure

limits when engineering and administrative controls are implemented. These limits have been set for a number of SPF chemicals and some common chemicals encountered during SPF application are listed in Appendix C of this workbook.

Air-purifying respirators (APR) and powered air-purifying respirators (PAPR) are generally appropriate for exterior applications and may be used when spraying polyurethane foam in exterior applications. Supplied air respirators (SAR) are typically used in interior applications. Refer to the NIOSH *Respirator Decision Logic* (2004) for more information regarding respirator selection at www.cdc.gov/niosh/docs/2005-100/pdfs/05-100.pdf.

5.3.4.1 Respiratory Protection Program Requirements

The OSHA Respiratory Protection Standard (29 CR 1910.134) requires employers to have a written respiratory protection program for employees required to use respiratory protection. The Standard outlines requirements for respirator selection, respirator maintenance, annual fit testing, medical surveillance, and annual training. Refer to your company's policy for specific information regarding your respiratory protection program. To assist site managers in developing their own Respiratory Protection Programs, the Center for the Polyurethanes Industry (CPI) has created a Model Respiratory Protection Program for reference and guidance, available online at www.americanchemistry.com/polyurethane.

OSHA requires employers to provide medical evaluations administered by a physician or licensed healthcare professional for all employees required to wear respirators. Employees must receive approval prior to fit testing and subsequent issuance of the respirator. Sometimes the medical approval has a limitation such as the use being restricted to a PAPR or for emergency only. Adhere to the limitations described by the examining medical provider.

OSHA also requires that employees complete a successful fit test using a respirator of the same make, model and size respirator issued according to 29 CFR 1910.134(f). Fit testing is repeated annually thereafter. Fit testing must be completed for any employee issued a tight-fitting APR, PAPR, SAR, or self-contained breathing apparatus (SCBA). Fit testing is not required for personnel wearing a loose-fitting hood with a PAPR or SAR.

Fit testing cannot be conducted and respirators cannot be used if there is any clothing, jewelry, or hair growth between the skin and the facepiece sealing surface, such as stubble beard growth, beard, mustache or sideburns which cross the respirator sealing surface. Annual training is required under the OSHA standard for all personnel required to wear respiratory protection.

E**ach time the user dons a tight-fitting respirator, the user must complete a negative-pressure and positive-pressure user seal check** in accordance with 29 CFR 1910.134 Appendix B-1 to confirm that the mask has been donned correctly prior to entering the work area.

5.3.4.2 Air-Purifying Respirators (APR)

Full-face APRs may be appropriate for exterior applications of SPF. Air-purifying respirators are not appropriate in confined spaces or in atmospheres with less than 19.5% oxygen. Due to the potential for eye exposure during SPF application, full-face APRs are often selected when applying SPF. Full-face APRs may be used in the exterior application of SPF when there is sufficient oxygen (19.5-23.5%) and air concentrations of MDI are less than 0.250 parts per million (equal to 50 times the 8-hour occupational exposure limit).

Figure 12: Full-face APR with Organic Vapor (OV) Cartridge and Particulate (P100) Filter

APRs remove contaminants from the air by mechanical filtration and/or chemical adsorption. Protection provided by APR is dependent on the cartridge selected, the condition of the cartridge, and the respirator fit. For protection from SPF chemicals, an APR is equipped with cartridges certified by NIOSH for protection against particulates and organic vapors. According to the ANSI standard Z88.7 *Color Coding of Air-Purifying Respirator Canisters, Cartridges, and Filters*, the appropriate cartridges have been color coded as magenta for protection against particulates (P100) and black for protection against organic vapors (OV). Respirator cartridges must be of the same make as the respirator. If you have any doubt about which cartridge to use, contact the supplier of the respirators for advice.

When respirator filters become clogged, it becomes difficult for the user to breathe through the cartridge. Chemical breakthrough may occur when chemical vapors can pass through a cartridge because the adsorbent material in the cartridge has been used up. Respirator cartridges must be changed out according to a change-out schedule to prevent clogging of the filter or chemical breakthrough. According to the OSHA Respiratory Protection Standard, employers must prevent clogging and chemical breakthrough by replacing cartridges according to a change-out schedule based on the respirator manufacturer's end-of-service life indicator (ESLI) or based on objective information or data to ensure the cartridges are changed out before the end of their service life.

A clogged respirator, or detection of a chemical substance while wearing a respirator through smell or other signs, are indicative that the respirator may not be functioning properly. Exit the work area immediately to attend to the respirator, and replace it or the cartridges if necessary. Exposure to a chemical agent while wearing a respirator may be due to either an incomplete face-to-facepiece seal or chemical breakthrough. If the filter has become clogged or breakthrough has occurred, replace the filter.

5.3.4.3 Powered Air-Purifying Respirators

Powered Air-Purifying Respirators (PAPRs) are APRs equipped with a battery-operated blower unit designed which supplies filtered breathing air to the user's facepiece. The facepiece used with a PAPR may be a tight-fitting facepiece or a loose-fitting hood. When the blower unit is operating, the tight-

fitting respirator facepiece is under positive pressure. When the blower unit is turned off, the mask is under negative pressure. For persons wearing a tight-fitting PAPR, annual fit testing and user seal checks prior to each use must be completed when the mask is under negative pressure (i.e. when the blower unit is turned off). For the loose-fitting hood, the respirator is under positive pressure. For both the tight-fitting respirator and hood, the respirator cartridges also must be changed out according to the change-out schedule as discussed in 5.3.4.1. Fit testing is only required for users of tight-fitting PAPR.

PAPRs are often used in exterior or other applications and may be selected for use in applications where APRs are typically used for several reasons. When outdoor temperatures are hot, the PAPR can provide an air-conditioning-like effect, making the wearer cooler and more comfortable. Also, fit testing is not required for loose-fitting hood PAPR. Additionally, for medical or other reasons, some individuals may be unable to use negative-pressure APR, but can use PAPR. In addition, due to the reduced physiologic burden, in some instances, during medical surveillance the examining healthcare professional may determine that the employee is permitted to wear a PAPR but not a negative-pressure APR.

5.3.4.4 Supplied-Air Respirator (SAR)

Supplied Air Respirators (SARs) are typically used in interior applications. SARs provides a supply of breathing air from an outside source such as a compressor, a bottle of compressed air, or a low pressure pump attached to an air-line hose. SARs also are called "Type C" systems or “air-line” respirators. SARs, when used properly, can provide the greatest protection for the wearer. An SAR consists of a tight-fitting full-facepiece, or a loose fitting hood or helmet to which air is supplied through a small-diameter hose connected to an air source. There are three types of SAR:

1. Continuous flow, which supplies a constant airflow to the face piece or hood/helmet no matter what the worker's breathing rate is.
2. Pressure-demand, which supplies a constant flow of air to create a slight positive pressure in the facemask and also responds to the worker's breathing rate.
3. Demand airflow, which is less protective than continuous flow and pressure-demand modes, and provides breathing air to the facemask at a rate that depends on the worker's breathing rate. Demand airflow SARs have significant drawbacks that limit their utility for SPF application; therefore, many contractors opt not to use demand-type SARs.

Figure 13: Full-face Supplied Air Respirator (SAR) with portable breathing air compressor

Note: Portable breathing air compressors do not require a CO or high temperature alarm if using carbon vanes as the air mover. OSHA also requires that employees have a reliable source of air with an oxygen content of at least 19.5% according to 29 CFR 1910.134(d).

Specific requirements for breathing air quality and use are available at 29 CFR 1910.134(i). Under this regulation, compressors used to supply breathing air must be set up to prevent re-entrainment of contaminated air into the breathing air. Users should also be aware that the Compressed Gas Association Specification G7.1 states that air supplied to the facepiece or hood or helmet must meet the requirements of ANSI Z86.1973 for Type 1, Grade D compressed breathing air. The ANSI standard requires:

- Oxygen content between 19.5% and 23.5%;
- No more than 5 milligrams per cubic meter of condensed hydrocarbon contamination;
- No more than 10 parts per million of carbon monoxide;
- Lack of noticeable odor;
- A maximum of 1000 ppm of carbon dioxide.

WARNING: Never use pure oxygen in supplied-air systems because it is a fire hazard and can be toxic to the user.

Another consideration is that overheating internally lubricated, piston-type compressors may produce carbon monoxide. Therefore, OSHA requires monitoring to prevent carbon monoxide in the breathing air from exceeding 10 ppm through the use of:

1. A high temperature alarm with periodic monitoring of CO concentrations;
2. A carbon monoxide alarm; OR
3. Use of both to monitor carbon monoxide levels.

Internally lubricated, piston-type (industrial) compressors are typically used to supply air for spray foam application. They also may be used to supply air for SARs, provided the air is properly filtered and monitored. There are systems designed to be used between this type of industrial compressor and SARs, as shown in Figure 14. These self-contained systems filter moisture, particulates, oils, organic vapors and odors, and actively monitor CO levels.

Figure 14 - Filtration and monitoring system for supplied air respirators (SARs) when connected to industrial compressors

5.3.5 PPE Care and Maintenance

Dispose of single-use (disposable) PPE in accordance with local or state environmental regulations, depending on the chemical(s) they may be contaminated with. Decontaminate reusable PPE after exiting the work area. Regular cleaning and disinfection is typically needed as well to keep the PPE in good condition. Follow the manufacturer's instructions regarding respirator cleaning and disinfection.

Inspecting PPE periodically helps identify equipment or components that need to be replaced, repaired, or refilled. It is important to verify that the PPE available includes the range of sizes needed. PPE should be inspected for tears, cracks, or other signs of wear that might compromise its effectiveness. It may be preferable to have trained employees inspect their own PPE before and after each use. Remove defective materials from service and discard or repair them as appropriate.

Respirators are inspected per 29 CFR 1910.134. Generally, an APR inspection includes inspecting the mask and cartridges for damage and adhering to the ELSI or the respirator filter/cartridge/canister change-out schedule. For PAPR, the inspection includes the elements of the APR inspection as well as the blower unit and the battery. For SAR, the masks, hoses, and air source are inspected. Refer to the manufacturer's instructions for specific information related to your respirators.

Store PPE in areas where the PPE is not exposed to conditions that could compromise the effectiveness of the PPE, such as sunlight, chemical contamination, extreme temperatures, moisture, and animals or insects. You might want to consider designating a cool dry area away from sunlight for PPE storage.

6 Other Considerations for SPF Application

In addition to the possibility of chemical exposure when applying SPF chemicals, other aspects of the job can present hazards. Identify these in advance of the job to address them most effectively. Consider potential electrical hazards, confined spaces, pressurized equipment, walking and working surfaces, occupational noise, and temperature stress.

6.1 Electrical Hazards

Power lines near a work site can be a source of ignition and other extreme hazards, including shock and electrocution. If you notice downed power lines in the area, secure all ignitable materials and evacuate personnel until the lines are repaired. Never let equipment touch or come close to overhead electric lines or other sources of electricity.

For work near energized equipment, contractors should follow the OSHA standards (29 CFR § 1926.417 or 1910.147) to properly lock out or tag out machines and equipment during repair or servicing activities.

Electrical equipment that is used in SPF applications should be equipped with Ground Fault Circuit Interrupters (GFCI) to prevent electrical shock or electrocution. This is especially important when working near water, or on wet floors or roofs.

Job equipment and containers of flammable materials ne should be grounded. Plastic containers used to transport solvents cannot be grounded. Use non-sparking tools (such as those made of brass or aluminum) where flammability may be a concern. Do not plug in or unplug any power supply cords in the spray/dispersing area when there is a chance of igniting vapors still in the air. Check your local electrical code for detailed grounding instructions for your area and type of equipment, and consult manufacturer's instructions for specific instructions for the equipment.

6.2 Confined spaces

Attics and crawlspaces may be considered confined spaces. Work in a confined space that may produce a hazardous atmosphere should meet the requirements specified in the American National Standards Institute (ANSI) Standard Z117.1 *Safety Requirements for Confined Space* or the OSHA Permit-Required Confined Space Standard (29 CFR 1910.146), depending on which standard applies. These standards

require monitoring for oxygen, flammables, and toxic gases before and during entry; disabling all sources that may suddenly release stored energy into the space (e.g., electrical equipment); using the right personal protective equipment; and arranging for standby personnel equipped and trained in emergency and rescue problems.

6.3 Pressurized Equipment

Handle high-pressure applications equipment with care, because pressurized fluid can be very dangerous. If the hose develops a leak, split or rupture due to any kind of wear, damage, or misuse, the high-pressure spray emitted from it can cause a fluid injection injury or other serious bodily injury or property damage. All fluid hoses have spring guards on both ends, which helps protect the hose from kinks or bends at or close to the coupling, which can result in hose rupture. Tighten all fluid connections securely before each use. High-pressure fluid can dislodge a loose coupling or allow high-pressure spray to be emitted from the coupling. Never use a damaged hose.

Before each use, check the entire hose for cuts, leaks, abrasions, bulges, or damage or movement of the hose couplings. If any of these conditions exist, replace the hose immediately. Do not try to re-couple high-pressure hose or mend it with tape or any other device. A repaired hose cannot contain the high-pressure fluid. Handle and route hoses carefully. Do not pull on hoses to move equipment.

If you receive a cut or abrasion in handling pressurized fluid seek emergency care immediately, because chemical fluid may have entered the wound. Do not treat as a simple cut. Tell the doctor exactly what fluid was injected, and provide a copy of all relevant MSDS documents to the doctor.

6.4 Walking and Working Surfaces

Elevated working surfaces are a common hazard in SPF application operations. Poor construction and improper use of elevated work platforms are two of the leading causes of injury in the construction industry. All ladders and scaffolding must be constructed and used in accordance with current OSHA standards, and all elevated work must comply with OSHA's fall protection standards. For construction projects, these requirements are described in subparts L (Scaffolds), M (Fall Protection) and X (Ladders) of 29 CFR Part 1926. For manufacturing and maintenance projects, these requirements are found in subpart D (Walking Surfaces) of 29 CFR Part 1910.

6.5 Occupational Noise

During SPF application, workers may be exposed to high levels of occupational noise from sources like operation of construction equipment. The OSHA Construction Standard 29 CFR 1926.52, which regulates employee exposure to hazardous noise, requires feasible administrative and engineering controls to be used when employees are exposed to occupational noise in excess of the OSHA PEL for noise of 90dBA over 8 hours with a 5dBA doubling rate. When feasible engineering and administrative controls are not sufficient to reduce employee exposure below the PEL, hearing protection is required.

As a general guide, if you have to raise your voice to speak with someone at a distance of approximately three feet, the noise exposure likely exceeds 90dBA.

6.6 Temperature Stress

Application of SPF may take place outdoors or in work areas where the HVAC system is turned off or not available. As a result, workers may be applying SPF in very hot or cold conditions. The following conditions may contribute to cold or heat stress:

- Increased metabolism due to physical nature of the work. Also, an increased metabolism due to use of PPE ensembles.
- Increased radiant heat when working outdoors.
- Variations in the temperature and humidity of possibly unconditioned circulation via local exhaust ventilation. This may result in an increase in cold or heat stress depending on the ambient temperature.
- Increased sweat rate which can increase cold or heat stress depending on ambient conditions.

Due to these conditions, consider the potential for the potential for workers to experience cold or heat stress over the course of their work. It is helpful for all workers, including applicators and helpers, to be familiarized with the signs and symptoms of cold and heat stress and know when to seek medical attention.

Heat stroke can be a life-threatening condition characterized by hot, dry, skin (no sweating) and high body temperature. If you suspect someone may be experiencing heat stroke, move the individual to a cool shaded area and call 911 for medical attention immediately. Refer to the OSHA standards interpretation letter, "Acceptable methods to reduce heat stress hazards in the workplace" (2001), www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=INTERPRETATIONS&p_id=24008, for further guidance regarding cold and heat stress monitoring and control measures.

6.7 Environmental Reporting

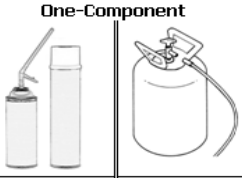
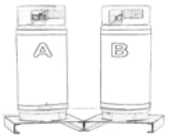
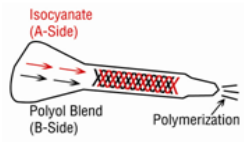
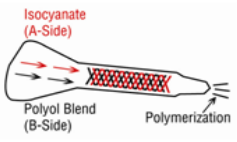
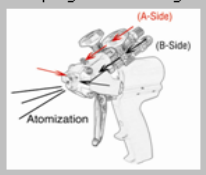
If you store 10,000 pounds (approximately 15 individual 55-gallon drums) of any SPF chemicals at any one time at your warehouse, you are required to submit an initial and annual chemical inventory report for these chemicals under the Emergency Planning and Community Right-to-Know Act (EPCRA) Sections 311 and 312, respectively.

Copies of MSDSs or a list of the chemicals must be submitted to the Local Emergency Planning Commission (LEPC), the State Emergency Response Commission (SERC), and the local fire department within 90 days after storing 10,000 pounds or more of SPF chemicals at a facility or on-site.

Section 312 of EPCRA requires facilities to submit an annual inventory report, called the Tier II report, to the LEPC, SERC, and local fire department for any chemical reported under Section 311. The Tier II report includes the types of hazard the material may pose, the quantities stored, general storage locations, and type of storage. The reports for each calendar year are due by March 1 of the following year.

Note: Most SPF operations fall under the SIC code of 238310 and are exempt from reporting requirements of ECPRA Section 313.

Appendix A: SPF Systems – High Pressure and Low Pressure

	Low Pressure				High Pressure
	One-Component		**Two-Component Kits**	**Refillable Systems**	**High Pressure Spray Systems**
					
Delivery Systems Pressure	<150 psi	<250 psi	<250 psi	<250 psi	1000 psi-1300 psi
Contents	.5lbs - 2lbs	10lbs - 23lbs	2lbs - 110lbs *Combined*	250lbs - 1700lbs *Combined*	900lbs - 1000lbs *Combined*
Output	Full Trigger: up to 2-5 lbs per min		Full Trigger: up to 5-7 lbs per min *Standard fan or cone nozzle*	Full Trigger: up to 5-7 lbs per min *Standard fan or cone nozzle*	Full Trigger: up to 30 lbs per min
Mixing	Prepolymer	Prepolymer  Shake Well	Static Mixing 	Static Mixing 	Impingement Mixing 
Mixer			Static Mixer	Static Mixer	Chamber Mixing
Housing			Nozzle	Nozzle	Spray Gun
Container *Most Popular Size Sold*	Metal Cans	Single Use Cylinder	Single Use Cylinders	Refillable Tanks	55 gallon drums
Hoses		5-9 ft Hose Assembly	9-15 ft Hose/Gun Assembly	30ft to 60 ft Hoses 30ft to 150ft Heated Hoses	transfer pump system up to 400ft Heated Hoses
Product Temperature Recommended Use	70°F-90°F (21°C-32°C)		70°F-90°F (21°C-32°C) *optimal temp for std systems*	70°F-90°F (21°C-32°C) *optimal temp for std systems*	120°F-150°F (49°C-65°C) *machine heater system*
Foam Properties Curing Tack-Free Time	Moisture Cure 3-20 minutes		Chemical Cure < 1 minute	Chemical Cure < 1 minute	Chemical Cure < 15 seconds
How it is used	Bead Application		Bead Application Spray Coating	Bead Application Spray Coating	Large Area Spray Coating

Note: one-component, and low pressure two-component, SPF products deliver a smaller volume of foam, and typically are used to cover smaller surface areas. In addition, low-pressure foams do not aerosolize the two primary chemicals, but instead the chemicals are combined in a small mixing chamber before release. These application factors combine to result in a significantly lower inhalation exposure potential than is typically associated with the high-pressure SPF systems, but it is still important to minimize skin and eye exposures.

Appendix B: OSHA Standards Related to SPF Application

Table B-1: List of OSHA Standards related to SPF Application		
Title	**Industry**	**Reference**
General Duty Clause	All	29 CFR 5 (a)(1)
Air Contaminants	General	29 CFR 1910.1000
Limits for Air Contaminants	General	29 CFR 1910.1000 Table Z-1
Hazardous Atmospheres and Substances	Marine Terminals	29 CFR 1917.23
Hazardous Atmospheres and Substances	Longshoring	29 CFR 1918.93
Gases, Vapors, Fumes, Dusts, and Mists	Construction	29 CFR 1926.55
Hazard Communication	General	29 CFR 1910.1200
	Shipyard	29 CFR 1915.1200
	Marine Terminals	29 CFR 1917.28
	Longshoring	29 CFR 1918.90
	Construction	29 CFR 1926.59
Personal Protective Equipment	General	29 CFR 1910, Subpart I
Personal Protective Equipment	Shipyard	29 CFR 1915, Subpart I
Personal Protection	Marine terminals	29 CFR 1917, Subpart E
Personal Protective Equipment	Longshoring	29 CFR 1918, Subpart J
Personal Protective and Life Saving Equipment	Construction	29 CFR 1926, Subpart E
Respiratory Protection	General	29 CFR 1910.134
	Shipyard	29 CFR 1915.154
	Marine Terminals	29 CFR 1917.92
	Longshoring	29 CFR 1918.102
	Construction	29 CFR 1926.103
Ventilation	General	29 CFR 1910.94
Ventilation and Atmospheric Conditions	Longshoring	29 CFR 1918.94
Ventilation	Construction	29 CFR 1926.57
The Control of Hazardous Equipment (Lockout/Tagout)	General	29 CFR 1910.147
Permit-Required Confined Spaces	General Industry	29 CFR 1910.146
Work in Confined or Isolated Spaced	Shipyard	29 CFR 1915.94
Confined and Enclosed Spaces and Other dangerous Atmospheres in Shipyard Employment	Shipyard	29 CFR 1915, Subpart B
(Proposed) *Confined Space Standard for Construction*	Construction	29 CFR 1926.1200
Walking and Working Surfaces	General Industry	29 CFR 1910 Subpart D
Scaffolds, Ladders, and Other Working Surfaces	Shipyard	29 CFR 1915, Subpart F
Working Surfaces	Longshoring	29 CFR 1918, Subpart D
Occupational Noise Exposure	General Industry	29 CFR 1910.95
Occupational Noise Exposure	Construction	29 CFR 1926.52

Appendix C: Occupational Exposure Limits

To reduce the risk of adverse effects due to inhalation of chemical substances, occupational exposure limits of various chemicals have been set by regulatory agencies and other organizations, including the Occupational Safety and Health Administration (OSHA) Permissible Exposure Limits (PEL) included in 29 CFR 1910.1000 Subpart Z *Limits for Air Contaminants* , the National Institute of Occupational Safety and Health (NIOSH) Recommended Exposure Limits (REL) listed in the *NIOSH Pocket Guide to Chemical Hazards*, and the American Conference of Governmental Industrial Hygienists (ACGIH) Threshold Limit Values (TLV). These limits are the air concentrations that these expert organizations believe represent exposures that are acceptable from a health perspective for healthy workers and include time-weighted averages (TWA) for the duration of an entire workshift, short-term exposure limits (STEL), and ceiling limits (C).

For the duration of a workshift, the OSHA PEL and the ACGIH TLV are based on an eight-hour time weighted average (TWA) whereas the NIOSH REL is based on a 10-hour workday. These limits are all based on a 40-hour workweek. For short-term exposures, short-term exposure limits (STEL) and ceiling (C) limits have been developed. STEL is the maximum 15-minute average concentration to which personnel may be exposed. The ceiling limit (C) is the concentration that should never be exceeded for any period of time. A table including occupational exposure limits for some chemical components in SPF chemicals, coatings, and solvents are included in Table C-1. Table C-1 does not include all products, so read the MSDS thoroughly for each product used during applications.

Table C-1: Occupational Exposure Limits for Some Chemical Components of SPF Chemicals, Coatings, and Solvents				
Product Type	**Chemical Name (abbreviation)**	**OSHA PEL**	**NIOSH REL**	**ACGIH TLV**
A-side	Methylene bisphenyl isocyanate (MDI)	NA 0.02 ppm (C)	0.005 ppm (TWA) 0.020 ppm (C)	0.005 ppm (TWA) NA
Aromatic Polyurethane Coatings	2,4- Toluene diisocyanate (TDI)[4]	0.02 ppm (C)	NA NA	0.005 ppm (TWA)[1] 0.02 ppm (STEL)[2]
Aliphatic Polyurethane Coatings	1,6-Hexamethylene diisocyanate (HDI)	NA NA	0.005 ppm (TWA) 0.020 ppm (C)	0.005 ppm (TWA) NA
Butyl Polyurethane Coatings	o-, m-, and p-Xylene	100 ppm (TWA) NA	100 ppm (TWA) 150 ppm (STEL)	100 ppm (TWA) 150 ppm (STEL)
Polyurethane Coatings	n-Butyl acetate	150 ppm (TWA) NA	150 ppm (TWA) 200 ppm (STEL)	150 ppm (TWA) 200 ppm (STEL)
Polyurethane Coatings	Methyl Isobutyl ketone (MIBK)	100 ppm (TWA) NA	50 ppm (TWA) 75 ppm (STEL)	50 ppm (TWA)[3] 75 ppm (STEL)
Polyurethane Coatings	Toluene	200 ppm (TWA) 300 ppm (C)	100 ppm (TWA) 150 ppm (STEL)	20 ppm (TWA) NA
Polyurethane Coatings and Solvents	Methyl ethyl ketone (MEK)	200 ppm (TWA) NA	200 ppm (TWA) 300 ppm (STEL)	200 ppm (TWA) 300 ppm (STEL)
Polyurethane Coatings and Solvents	v-, m-, and p- Naphtha	100 ppm (TWA) NA	100 ppm (TWA) NA	NA NA
Solvents	2-Ethoxyethanol	200 ppm (TWA) NA	0.5 ppm (TWA) NA	5 ppm (TWA)[4] NA
Solvents	Isopropyl alcohol	400 ppm (TWA)	400 ppm (TWA) 500 ppm (STEL)	200 ppm (TWA) 400 ppm (STEL)
Solvents	Triorthocresyl phosphate (TCP)	0.1 mg/m^3 (TWA) NA	0.1 mg/m^3 (TWA) NA	0.1 mg/m^3 (TWA)[4] NA

[1]ACGIH has requested comments regarding a proposed Notice of Intended Change for the TLV-TWA for TDI. The Notice includes a proposal for a TLV-TWA for inhalable fractions and vapors of TDI, lowering the TLV-TWA from 0.005 ppm to 0.001 ppm, and adding a skin notation due to the potential for skin absorption.

[2]ACGIH has requested comments regarding a proposed Notice of Intended Change for the TLV-STEL for TDI. The Notice includes a proposal for a TLV-STEL for inhalable fractions and vapors of TDI, and lowering the TLV-STEL from 0.02 ppm to 0.003 ppm.

[3]ACGIH has requested comments regarding a proposed Notice of Intended Change for the TLV-TWA for MIBK. The Notice includes a proposal to lower the TLV-TWA from 50 ppm to 20 ppm.

[4]ACGIH assigned a "SKIN" notation to these chemicals because they can be readily absorbed through the skin.

Appendix D: Discussing Spray Foam Application with Building Owners and Occupants

This guidance is intended to assist contractors in their discussions with building owners and occupants about some of the health and safety considerations of the spray foam application. While it contains suggested discussion topics for consideration, it is not exhaustive. Consider additional health and safety topics depending on the specific circumstances of the job site.

- ☐ General discussion about the duration, schedule, and size/scope of job, with focus on electric and water access, breaker boxes, emergency ingress and egress by workers on site and owners/occupants
- ☐ Information about chemicals used in the SPF application
  - How spray foam is made; reacting A and B-sides
  - Potential health hazards of A-side and B-side chemicals. Explain that MSDSs for all chemicals to be used are readily available on the job site, and review these documents with the owner/occupant if requested.
  - Point out locations of first aid kits, eyewash stations

- ☐ Explanation of controls designed to protect applicators, helpers, adjacent workers, and occupants
  - Ventilation and/or containment plans
  - Review HVAC system location and operation, and discuss shutdown during application and until reoccupancy
  - PPE to be used, and why
  - Review plans to restrict access to the work area, including plans for postings around the perimeter of the work zone

- ☐ Discussion with owner/occupant about plans to vacate building during and after application
  - Identify whether building is occupied by individuals who may have special sensitivities (e.g., persons with respiratory illness or sensitivities) and address
  - For large commercial buildings, multi-family residences (e.g., duplexes, condominiums, or apartment buildings), discuss whether partial or full vacation of premises is planned; discuss HVAC and ventilation issues; discuss external venting issues
  - Provide specific guidance on reoccupancy times, following appropriate consultation with the product manufacturer

- ☐ If owner/occupant will not vacate building during application, discuss plans to address exposure issues
  - PPE requirements for owner/occupant to enter work area and view application (discuss alternative approaches to inspect or view work that minimize potential exposure, such as photographs or real-time video)
  - Venting and ventilation issues
  - Procedures for air monitoring, if used

- ☐ Discuss with the owner what to do to prevent damage to property due to overspray

- ☐ Inform occupants that a fishy or ammonia smell may be indicative of amine catalysts contained in the SPF, and provide guidance and contact information in the event of strong smells or smells that do not dissipate.

- ☐ Review procedures for post-job cleanup and handling of dust and trimmings

Appendix E-1: Hazard Communications

Guidance Document

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Hazard Communication for Spray Polyurethane Foam Insulation Applications

OSHA Standard 29 CFR 1910.1200
OSHA Standard 29 CFR 1926

Overview

The Standard was designed to provide employees with information on:

- The hazards and identities of all chemicals used in the workplace.
- Protective measures against adverse effects from use and handling including potential exposure.

Employers

- Do you have a written Hazard Communication Program?
- Do you have a list of all chemicals in the workplace and their potential hazards?
- Are all Material Safety Data Sheets (MSDSs) readily accessible to every employee?
  - Do you have MSDSs in a language that all employees can read and understand?
- Have your employees been trained on:
  - Reading labels?
  - Reading and understanding an MSDS?
  - How to obtain and use hazard information?
  - Appropriate work procedures?
  - Emergency procedures?
  - Proper personal protective equipment for each job?
- Do you have a medical surveillance program for employees if hazardous chemicals are being used (such as respiratory and skin sensitizers)?

Our Standard

The OSHA Standard requires employers to develop a written HAZARD COMMUNICATION program, which must include:

- A list of all hazardous materials used in the work place. This list needs to be reviewed annually and updated as new materials enter the workplace.
- The procedures used to collect and maintain an MSDS for each chemical used in the workplace. The MSDSs must be readily available to the employees at each worksite.
- A description of the labeling system used for chemical containers.
- The procedures used to ensure that all containers are properly labeled.
- The methods of training and providing hazardous material information to employees.
- Procedures for safely conducting non-standard work practices.
- Procedures for ensuring contractors and other non-employees are informed of the hazardous materials in the workplace.

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Appendix E-1: Hazard Communications

Guidance Document

Training

Here are some key points to cover in training:

- Requirements of the OSHA standard.
- Information on any operation in the area where hazardous materials are present.
- Procedures for identifying hazardous materials.
- Safe handling procedures, including:
  - personal protective equipment to be used;
  - appropriate work practices;
  - non-routine tasks; and
  - emergency procedures.
- Storage procedures.
- Use of labels and MSDSs.
- Employee access to MSDS files.
- How to interpret MSDS information.
- Your written hazard communication policy.
- Communication with contractors.

If respirators are required, as with spray polyurethane foam applications, a detailed written Respirator Program is required.

This program should include:

- Appropriate respirator identified for each job performed at the work site such as:
- Supplied-air respirator (full face, hood, or helmet)
- Air-purifying respirator, etc.
- Medical exam
- Respirator fit test

Sources of Additional Information

OHSA website:
www.osha.gov/SLTC/hazardcommunications/index.html

NIOSH website:
www.cdc.gov/niosh/homepage.html

NIOSH Pocket Guide:
www.cdc.gov/niosh/npg/

International Chemical Safety Cards:
www.cdc.gov/niosh/ipcs/nicstart.html

National Fire Protection Association:
www.nfpa.org

For more information, visit:

The American Chemistry Council's Center for the Polyurethanes Industry
www.americanchemistry.com/polyurethane or
www.spraypolyurethane.com

Spray Polyurethane Foam Alliance
www.sprayfoam.org

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This document was prepared by the American Chemistry Council (ACC) Center for the Polyurethanes Industry (CPI) and the Spray Polyurethane Foam Alliance (SPFA). It is intended to provide general information to persons who may handle or apply spray polyurethane foam chemicals. It is not intended to serve as a substitute for in-depth training or specific handling or application requirements, nor is it designed or intended to define or create legal rights or obligations. It is not intended to be a "how-to" manual, nor is it a prescriptive guide. All persons involved in handling and applying spray polyurethane foam chemicals have an independent obligation to ascertain that their actions are in compliance with current federal, state and local laws and regulations and should consult with their employer concerning such matters. Any mention of specific products in this document is for illustration purposes only and is not intended as a recommendation or endorsement of such products.

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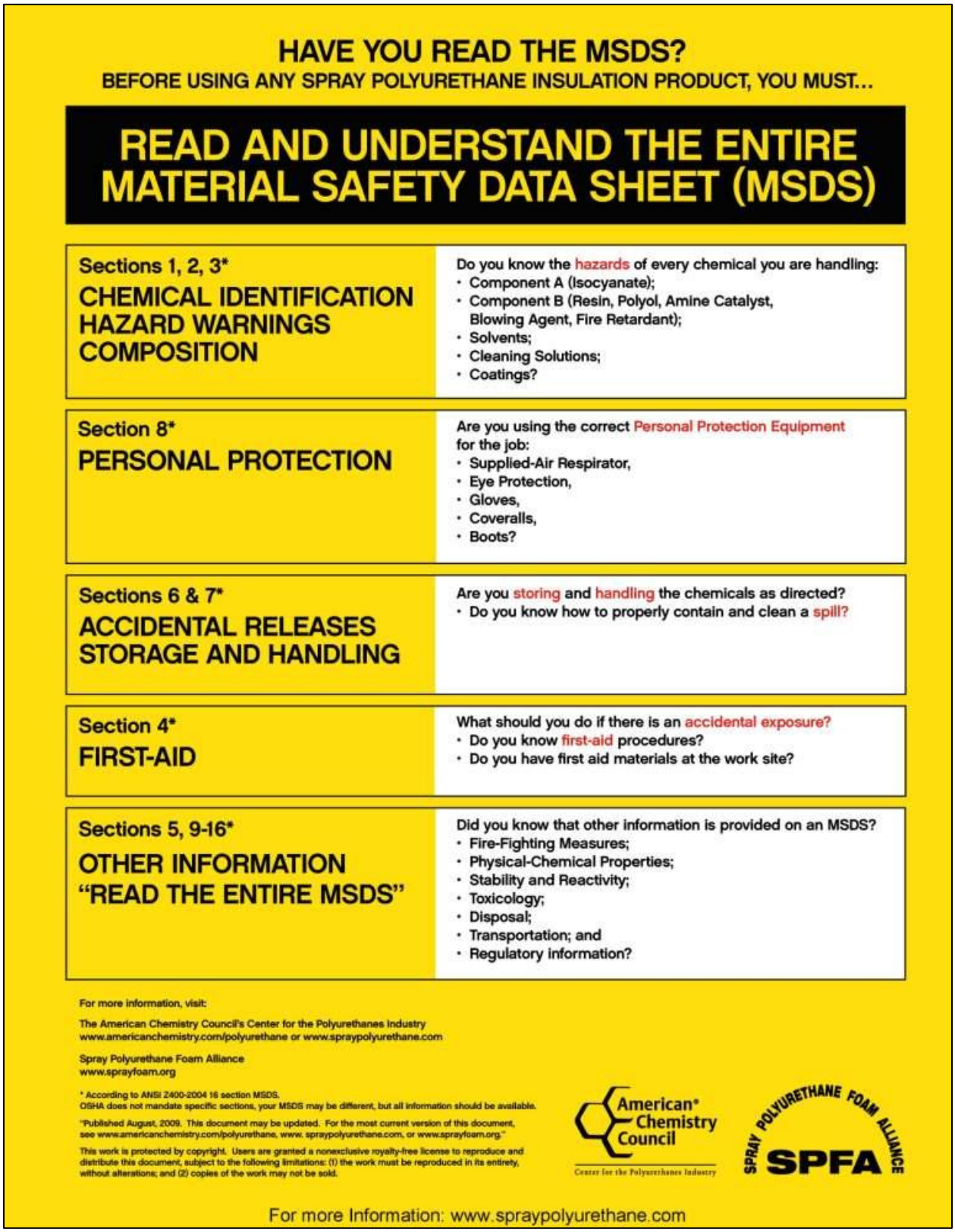
Appendix E-1: Hazard Communications



HAVE YOU READ THE MSDS?

BEFORE USING ANY SPRAY POLYURETHANE INSULATION PRODUCT, YOU MUST...

READ AND UNDERSTAND THE ENTIRE MATERIAL SAFETY DATA SHEET (MSDS)

Sections 1, 2, 3* **CHEMICAL IDENTIFICATION HAZARD WARNINGS COMPOSITION**	Do you know the hazards of every chemical you are handling: • Component A (Isocyanate); • Component B (Resin, Polyol, Amine Catalyst, Blowing Agent, Fire Retardant); • Solvents; • Cleaning Solutions; • Coatings?
Section 8* **PERSONAL PROTECTION**	Are you using the correct Personal Protection Equipment for the job: • Supplied-Air Respirator, • Eye Protection, • Gloves, • Coveralls, • Boots?
Sections 6 & 7* **ACCIDENTAL RELEASES STORAGE AND HANDLING**	Are you storing and handling the chemicals as directed? • Do you know how to properly contain and clean a spill?
Section 4* **FIRST-AID**	What should you do if there is an accidental exposure? • Do you know first-aid procedures? • Do you have first aid materials at the work site?
Sections 5, 9-16* **OTHER INFORMATION "READ THE ENTIRE MSDS"**	Did you know that other information is provided on an MSDS? • Fire-Fighting Measures; • Physical-Chemical Properties; • Stability and Reactivity; • Toxicology; • Disposal; • Transportation; and • Regulatory information?

For more information, visit:

The American Chemistry Council's Center for the Polyurethanes Industry
www.americanchemistry.com/polyurethane or www.spraypolyurethane.com

Spray Polyurethane Foam Alliance
www.sprayfoam.org

* According to ANSI Z400-2004 16 section MSDS.
OSHA does not mandate specific sections, your MSDS may be different, but all information should be available.

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Appendix E-2: Effective Workplace Practices

GOOD SAFETY PRACTICES
APPLICATION

FULL PERSONAL PROTECTIVE EQUIPMENT (PPE)
- Chemical resistant suit*
- Nitrile rubber glove*
- Approved respiratory protection (clean and maintain)
- Eye protection with side shields (clean and maintain)
- Headcover*

* These items are made to be disposed of after use. Follow MSDS instructions for the disposition of any liquid materials that may be present before disposal.

NITRILE/PVC GLOVES WORN DURING GUN REPAIR
- Protects from potential chemical contact to exposed skin area
- Use chemical splash protection for the eyes if cleaning solvents are being used in the maintenance procedure

HOSE INSPECTION FOR INTEGRITY
- Inspect for leaks, abrasion and exposed chemical hoses

CHEMICAL CHANGEOVER
- Reduces spill potential
- Reduces thread damage
- Liquid splash PPE, nitrile gloves and eye splash protection

FULL PERSONAL PROTECTIVE EQUIPMENT (PPE)
- Chemical resistant suit*
- Nitrile rubber glove*
- Approved respiratory protection (clean and maintain)
- Eye protection with side shields (clean and maintain)
- Headcover*

* These items are made to be disposed of after use. Follow MSDS instructions for any liquid materials that may be present before disposal.

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Appendix E-2: Effective Workplace Practices

GOOD SAFETY PRACTICES
DRUM HANDLING

DRUM BRACING
- Reduces spill potential
- Transit requirement D.O.T.
- Drums tightly sealed
- Drums labeled with necessary information
- Read and Understand MSDS for product before handling
- Part A, Isocyanate is moisture sensitive
- Part B, Resin, open slowly to allow pressure to escape

DRUM DISPOSAL
- Do not reuse drums
- Reclaiming Drums reduces waste
- Crushing reduces waste volume
- Reference: Guidelines for the Responsible Disposal of Wastes and Containers from Polyurethane Processing (#AX-151)
- Cut with pneumatic chisel only – never use flame

DRUM CHANGE OUT
DO
Pulling pump out straight helps avoid excess drainage on drum
- Reduces spill potential
- Reduces thread damage
- Liquid splash PPE, nitrile gloves and eye splash protection

DRUM CHANGE OUT
DON'T

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Appendix E-2: Effective Workplace Practices

GOOD SAFETY PRACTICES

EQUIPMENT STORAGE

DRUM BRACING

- Reduces spill potential
- Transit requirement D.O.T.
- Drums tightly sealed
- Drums labeled with necessary information
- Read and understand MSDS for product before handling

HOSES/CORDS NEATLY ORGANIZED

- Reduces tripping/falling hazard
- Reduces excessive wear on equipment

FIRE EXTINGUISHER ON TRUCK

- Fully charged and Inspected
- Accessible and Trained Operators
- Water, dry extinguishing media, carbon dioxide, foam are acceptable for use.

FIRST AID KIT

- Portable kit desirable for minor injuries
- Include emergency phone numbers near cabinet
- Periodically check kit for completeness
- Clean water available for eye wash; Construction areas may need several gallons clean water carried in for this use

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Appendix E-2: Effective Workplace Practices

GOOD SAFETY PRACTICES
GUN MAINTENANCE

FIRST AID KIT
- Portable kit desirable for minor injuries
- Include emergency phone numbers near cabinet
- Periodically check kit for completeness

EYE PROTECTION
- Side shields protect against side splash
- Designed for possible chemical splash

FULL PERSONAL PROTECTIVE EQUIPMENT (PPE)
- Chemical resistant suit *
- Nitrile rubber glove *
- Approved respiratory protection (clean and maintain)
- Eye protection with side shields (clean and maintain)
- Headcover *

* These items are made to be disposed of at the end of their protection. Follow MSDS instructions for disposition of any liquid materials that may be present before disposal

NITRILE/PVC GLOVES WORN DURING GUN REPAIR
- Protects from potential chemical contact to exposed skin area
- Use chemical splash protection for the eyes if cleaning solvents are used in the maintenance procedure

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Appendix E-2: Effective Workplace Practices

GOOD SAFETY PRACTICES
PERSONAL PROTECTIVE EQUIPMENT

FULL PERSONAL PROTECTIVE EQUIPMENT (PPE)
- Chemical resistant suit *
- Nitrile rubber glove *
- Approved respiratory protection (clean and maintain)
- Eye protection with side shields (clean and maintain)
- Headcover *

* These items are made to be disposed of at the end of their protection. Follow MSDS instructions for disposition of any liquid materials that may be present before disposal

CHEMICAL CHANGEOVER
- Reduces spill potential
- Reduces thread damage
- Liquid splash PPE, nitrile gloves and eye splash protection

NITRILE/PVC GLOVES/COTTON GLOVES WORN DURING SPRAYING
- Nitrile gloves protect the skin from possible chemical exposure
- Cotton glove or work gloves protect hands from warmth and fatigue

NITRILE/PVC GLOVES WORN DURING GUN REPAIR
- Protects from potential chemical contact to exposed skin area
- Wear chemical splash protection for the eyes if cleaning solvents are being used in the maintenance procedure.

FULL PERSONAL PROTECTIVE EQUIPMENT (PPE)
- Chemical resistant suit *
- Nitrile rubber glove *
- Approved respiratory protection (clean and maintain)
- Eye protection with side shields (clean and maintain)
- Headcover *

* These items are made to be disposed of after use. Follow MSDS instructions for any liquid materials that may be present before disposal.

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Appendix E-2: Effective Workplace Practices

GOOD SAFETY PRACTICES
SPILL CONTAINMENT

PIGS FOR SPILL CONTAINMENT
- Available on truck with compounds
- Appropriate quantity on hand for possible spills
- Follow MSDS to dispose of properly

SPILL ABSORBENT CAN BE
- Sand
- Sweeping compound
- Kitty litter or other absorbing material
- Decontaminate and dispose per MSDS

MSDS ON TRUCK
- Current editions
- Clear/dry storage area
- Readily available

FULL PERSONAL PROTECTIVE EQUIPMENT (PPE)
- Chemical resistant suit *
- Nitrile rubber glove *
- Approved respiratory protection (clean and maintain)
- Eye protection with side shields (clean and maintain)
- Headcover *

* These items are made to be disposed of after use. Follow MSDS instructions for disposition of any liquid materials that may be present before disposal.

DECONTAMINATION SOLUTION
- Portable unit
- Solution made up for compound per MSDS for part A and part B and kept on hand

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Appendix E-3: Interior Spray Polyurethane Foam Applications

Guidance Document

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Interior Spray Polyurethane Foam Insulation Health & Safety Q&A

For Spray Foam Contractors

This Interior Spray Polyurethane Foam Insulation Health & Safety Q&A document (describing spray applications done on the inside of a building) and the companion Exterior Spray Polyurethane Foam Insulation Health & Safety Q&A document (describing spray applications done on the outside of a building) were created to provide general guidelines for safe spray polyurethane foam application.

These general guidelines are intended to supplement the specific and detailed information from the materials suppliers (Material Safety Data Sheet and Product Data Sheet) that you are using for your installation. Many different variables are present in the various applications, so each case must be evaluated individually so that proper protection is afforded. It is applicable to those on or around the worksite where spray foam is being installed.

What are the chemicals used in spray polyurethane foam (SPF)?

A-Side or "Iso": Also known as polymeric methylene diphenyl diisocyanate or "PMDI" and typically contains 50% MDI and 50% higher molecular weight oligomers of MDI.

B-Side or "Resin": Also known as the polyol blend, and is comprised mostly of polyols, with smaller amounts of catalysts, blowing agents (closed cell foam only), flame retardants, and surfactants.

What are the potential health hazards of SPF chemicals?

A-side

Inhalation overexposure can result in 1) irritation of the nose, throat, and lungs, causing runny nose, sore throat, coughing, tightness in the chest, and shortness of breath, and 2) respiratory tract sensitization (i.e., the development of asthma) with symptoms of chest tightness, shortness of breath, coughing, and/or wheezing. Note that severe asthma attacks can be life threatening. NIOSH notes that "early recognition of sensitization and prompt and strict elimination of exposures is essential to reduce the risk of long-term or permanent respiratory problems for workers who have become sensitized."

Skin contact can cause 1) irritation, and 2) sensitization (allergy). Symptoms include reddening, itching, swelling, and rash. Skin contact alone may lead to respiratory sensitization. Eye contact can cause reddening, tearing, stinging, and/or swelling of the eyes.

B-side

Inhalation overexposure may result in irritation of the respiratory tract, causing cough, sore throat, and runny nose. Irritation of the eyes (liquid or vapor) and skin (liquid) also are possible. In addition, skin contact with some amine catalysts may lead to skin sensitization. Cardiac arrhythmia (irregular heartbeat) is a symptom of overexposure to certain blowing agents. In addition, the vapors of some amine catalysts can temporarily cause vision to become foggy or blurry, and halos may appear around bright objects such as lights.

Refer to your supplier's Material Safety Data Sheets (MSDS) for a complete listing of the composition and potential health effects of A and B-side chemicals.

For more Information: www.spraypolyurethane.com

Appendix E-3: Interior Spray Polyurethane Foam Applications

Guidance Document

Due to the potential health hazards just mentioned, it is important to avoid inhalation of, and skin and eye contact with SPF chemicals.

What type of personal protective equipment (PPE) should sprayers wear during spraying?

- NIOSH-approved full-face or hood-type supplied air respirator (SAR) operated in positive pressure or continuous flow mode.

Note: Respirators should be used in accordance with your company's written Respiratory Protection Program (RPP), which is required by the U.S. Occupational Safety & Health Administration (OSHA). Among other items, the RPP should include provisions for medical evaluations, fit testing, training, and cartridge change-out schedules.

- Disposable coverall with attached hood. It is important that all exposed skin be covered. Where heat stress may be a concern, consider the use of lightweight disposable coveralls.

- Disposable over-boots with skid-resistant soles. In circumstances where overboots may create a slip/fall hazard, its use may be omitted.

- Fabric gloves fully coated with nitrile, neoprene, butyl, or PVC. Alternatively, cotton gloves over nitrile gloves may be used.

What type of PPE should helpers wear while spraying is being conducted?

Helpers working in the application area should wear a full-face or hood-type SAR, disposable coveralls with attached hood, and nitrile, neoprene, butyl, or PVC gloves. Other glove options include 1) fabric gloves fully coated in nitrile, neoprene, butyl, or PVC; and 2) cotton gloves over nitrile gloves. In some cases, such as when the work area is well ventilated or when helpers are not working in the immediate vicinity of the applicator, helpers may be able to wear full face air purifying respirators (APR) with organic vapor/particulate (P100) cartridges instead of SARs. Professional judgment must be exercised in making this determination, taking into consideration the specific circumstances of the job site/application.

Appropriate PPE, such as respiratory protection, disposable coverall with attached hood, and gloves (see glove options mentioned in the preceding paragraph), should be worn during trimming of foam and during clean-up activities in the application area following spraying.

Should the work area be ventilated during application?

Depending on the weather and conditions of the job site (e.g. proximity to other buildings, vehicles, bystanders/passersby), ventilation of the application area may be necessary. For example, if a room has windows and/or doors on opposite sides, these can be opened to allow air to flow through the spray area. Other techniques for containing and ventilating the spray area may also be used. Further detail on these techniques is being developed and will be available in the near future. Also, it is important to note that confined areas such as attics and crawlspaces should be ventilated.

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What type of PPE should be worn during handling of liquid SPF chemicals?

The type of PPE used will depend on the particular activity and the associated potential for exposure. The following suggestions are offered as general guidance.

- Chemical safety goggles

- Nitrile, neoprene, butyl, or PVC gloves
- If splash to the body is possible, impermeable protective clothing (e.g., PVC, polyethylene)

- If handling heated SPF chemicals, NIOSH-approved APR with combination organic vapor/particulate (P100) cartridges

What type of PPE should be worn during handling of solvents?

Consult the manufacturer's MSDS.

What are the suggested first-aid measures?

First-aid measures can be found on the MSDS. Here are some typical first-aid suggestions:

Inhalation
- Move the individual to fresh air.
- Administer CPR and/or oxygen if needed.
- Seek immediate medical attention.

Eyes
- Flush with lukewarm water for at least 15 minutes.
- Seek medical attention.

Skin
- Remove contaminated clothing.
- Wash thoroughly with soap and water.
- Seek medical attention if irritation develops or persists.

Ingestion
- Do not induce vomiting.
- If conscious, rinse mouth with water.
- Seek medical attention.

What are some good work practices to follow?
- Have the most current MSDS for each chemical brought onto the jobsite readily available (e.g., keep in the spray rig)
- Prior to the start of each job, it is advisable to have a discussion with the building owner and/or occupant(s) to talk about items such as potential odors associated with the newly-installed foam and any other questions the owner/occupant may have, such as reoccupancy times.
- Exposure to others can be minimized by vacating the entire building of persons other than the spray foam application team during SPF application and for a period of time following installation. For projects where this is not feasible or necessary, (e.g., large commercial buildings), take steps to keep other persons out of part of the building to be sprayed, and discourage entrance into the spray area by using warning/caution tape and/or signage.
- Shut down HVAC system, and temporarily seal off (e.g., plastic sheeting and tape) HVAC system components in the work area.
- Always follow the manufacturer's application instructions with respect to lift (layer or pass) thickness and time between lifts. Spraying foam too thickly in a single lift or not permitting sufficient time between lifts may generate excessive heat to the point where the foam may char, smolder, or burn.
- Ventilate the application area for a period of time following installation to purge aerosols and vapors from the structure (preferably via fans exhausting air at one side, and open windows/doors on the opposite side). The post-installation ventilation time will vary based on the size of the area, amount of foam applied, the particular foam formulation applied, ventilation rate, and other relevant factors.

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Discourage entrance by others during the ventilation period. Contact your SPF supplier for recommendations as to ventilation and reoccupancy time.
- Display prominent warning signs at all entrances to the work area identifying the fire dangers of open flames, welding, and sparks until a thermal barrier (e.g., drywall) is applied over the installed foam.
- General housekeeping and clean-up is an important part of the job. Conduct jobsite quality controls before, during and after a project (e.g. warning signs/tape, equipment/material staging). Dispose of waste materials in accordance with applicable regulatory requirements.

How should spills be addressed?
- Direct all personnel away from the immediate area.
- Have individuals trained in spill clean-up don appropriate personal protective equipment.
- Absorb the spilled material with sand, earth or absorbent clays (e.g., vermiculite or cat litter). Place the absorbed material in drums (for MDI, use a neutralization solution (see MSDS), and do not seal these drums for an appropriate period (e.g., at least 72 hours).
- If a very large amount of MDI has been spilled (approximately 10,000 lbs of PMDI, or about 15 55-gallon drums), you must report the spill to various government agencies. In addition, contact CHEMTREC® (1-800-424-9300) for assistance.
- Comply with all applicable federal, state, and local waste disposal regulations, and dispose of accordingly.

How should empty drums be disposed?
- Offer the empty drums to a qualified reconditioner.
- Offer the empty drums to a reclaimer for recycling (note: neutralization of empty PMDI drums is wise prior to transfer to the recycler).
- Empty the drums in accordance with the drum reconditioner's or recycler's instructions, as well as in accordance with state and federal regulations (e.g., less than 1" of liquid product in a drum is considered empty by the U.S. Environmental Protection Agency.

Where can I get more information?
- American Chemistry Council (ACC):
  - ACC Center for the Polyurethanes Industry (CPI) websites:
    - www.americanchemistry.com/polyurethane - Select "Safety" or "Health"
    - www.americanchemistry.com/spf or www.spraypolyurethane.com
    - "Health & Safety Aspects of SPF Applications" DVD - 2002. www.americanchemistry.com/polyurethane - Select "Order Publications".
    - "Safe Handling of Diphenylmethane Diisocyanate (MDI)" - 2007. www.spraypolyurethane.com.
  - ACC Diisocyanates Panel (DII):
    - http://www.americanchemistry.com/s_acc/sec_iso.asp?CID=1547&DID=5866
- Spray Polyurethane Foam Alliance (SPFA) - www.sprayfoam.org - Select "Health & Safety"
- U.S. National Institute of Occupational Safety and Health (NIOSH) - www.cdc.gov/niosh/topics/isocyanates - Safety and Health Topic: Isocyanates
- Material Safety Data Sheets and other health and safety literature can be obtained by contacting your spray polyurethane foam supplier.

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INTERIOR SPRAY POLYURETHANE FOAM (SPF) INSULATION
PERSONAL PROTECTIVE EQUIPMENT

OSHA REQUIRES PROTECTION FOR SPRAY POLYURETHANE FOAM APPLICATORS - THOSE USING HIGH PRESSURE DISPENSING EQUIPMENT - AS FOLLOWS:

- **HARD HAT:** Use if needed to protect head from falling objects.
- **EYE PROTECTION:** Must be worn when spraying or working in areas where spray polyurethane foam aerosol or mist is present. Eye protection can be provided by a full face mask design.
- **SKIN PROTECTION:** Disposable coveralls are used to keep spray and mist from contacting skin and clothing. Disposable coveralls are not just for convenience - in rare circumstances, skin exposure to spray or mist may result in serious health concerns.
- Fabric gloves fully coated in nitrile, neoprene, butyl, or PVC; or cotton gloves over nitrile gloves could be used for spraying. Tape may be used to seal arm and feet openings as needed.
- If a breach of gloves or garments is noticed, change out the personal protective garments immediately or repair with tape over tears or rips.
- **RESPIRATORY PROTECTION:** For interior applications, sprayers must wear a NIOSH-approved full face or hood-type Supplied Air Respirator or SAR. Helpers also may need an SAR. If working in close proximity to the sprayer in some cases, a full facepiece Air Purifying Respirator or APR with organic vapor/particulate (P100) cartridges may be used by helpers if adequate ventilation is provided or if outside the immediate overspray area.
- **MAINTENANCE:** Employees should care for and maintain respirators as instructed by the manufacturer and store in a clean, dry, sanitary location (such as in a sealed bag or container - especially for organic vapor cartridges), and away from direct sunlight.

  Inform job superintendents about:
  - damaged or imperfect respirators
  - workplace hazards; and
  - questions about the Respiratory Protection Program
- **WORK BOOTS:** Steel-toed work boots are desirable in most work areas. Protection from overspray can be provided by disposable overboots with skid-resistant soles, if it does not compromise the grip of the work boot.
- Always read and understand the spray polyurethane foam manufacturer's Material Safety Data Sheet or MSDS before starting any spray foam application.

ACTIVITY	Chemical Handling	Gun and Equipment Maintenance	Interior SPF Application	Trimming and Cleanup
Safety Glasses with Side Shields or Safety Goggles	✔	✔	✔	✔
Supplied Air Respirator (SAR); Full Face Mask or Hood			✔	
Air Purifying Respirator (APR); Organic Vapor Particulate (P100) Cartridge	✔			✔
Fabric Gloves Fully Coated in Nitrile, Neoprene, Butyl, or PVC; or Cotton Over Nitrile Gloves	✔	✔	✔	✔
Disposable Coveralls	✔		✔	✔

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Spray Polyurethane Foam Alliance www.sprayfoam.org

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Indoor Commercial and Residential Insulation Using Spray Polyurethane Foam Containing MDI/PMDI: Seven Important Points for Spray Polyurethane Foam Contractors

Here are seven important points you will want to know when applying spray polyurethane foam (SPF) products for indoor commercial and residential insulation containing methylene diphenyl diisocyanate (MDI) and/or polymeric MDI (PMDI).

This document provides general guidance to spray polyurethane foam contractors about important health and safety aspects of working with MDI during the spraying of polyurethane foam. Although MDI is a commonly used material in spray polyurethane foam (SPF) for commercial and home insulation systems, it is not the only material in the system that can present health hazards. SPF systems also contain "B-side," which is a mixture of other chemicals, including polyols, amine catalysts, flame retardants, and surfactants, among other ingredients that may pose potential health hazards. Therefore, it is important to read all information contained in your supplier's Material Safety Data Sheet (MSDS) for the particular SPF product you are using. MSDSs are the primary source of extensive and specific information on MDI, PMDI and other SPF system ingredients.

This guidance document is intended to help SPF companies educate their workers and provide appropriate worker protection related to MDI/PMDI. This document does not include a discussion of the "B-side" chemicals present in the SPF system. Consult the MSDS for more information. Always follow the product-specific information in the MSDS.

1. What is MDI?

The acronym MDI was derived from one of the chemical's many names, methylene diphenyl diisocyanate. Polymeric MDI is a mixture of monomeric MDI and polymeric MDI and is a brownish liquid at room temperature. MDI/PMDI is one component used in the application of SPF products; typically referred to as the "A-side" or the "iso-side" of the system and requires special handling and care.

2. Recognizing Potential Health Hazards

Contact with excessive amounts of MDI can be harmful to your health. When MDI is sprayed, you may be overexposed by:

- Breathing high airborne concentrations of MDI
- Getting MDI on your skin
- Getting MDI in your eyes
- Swallowing MDI

In addition to what is identified in the product's MSDS, here are some examples of the effects of overexposure and some commonly used first-aid procedures:

Inhalation: If MDI is sprayed or heated, there is a chance of overexposure. Overexposure means airborne concentrations greater than either 1) the U.S. Occupational Safety & Health Administration (OSHA) Permissible Exposure Limit-Ceiling of 20 parts per billion (ppb) at any time during the workday, or 2) the American Conference of Governmental Industrial Hygienists (ACGIH) Threshold Limit Value (TLV) of 5 ppb as an 8-hour time weighted average (TWA). MDI can irritate your nose and lungs. With overexposure, you may feel tightness in your chest and have difficulty

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breathing. If you continue to be overexposed, you may become sensitized (i.e., allergic) to MDI. Once sensitized, the effects may start as soon as you begin to work with the product, or later on in the day after you've stopped working with the product (e.g., when you've left work). If you are sensitized, you may experience health effects even when airborne MDI levels are very low and may be at risk for experiencing an asthma attack. If this happens, DO NOT CONTINUE TO WORK WITH MDI; asthma attacks can be life-threatening. If you start to feel any of the symptoms listed above, let your supervisor know immediately and seek medical attention.

If you suspect someone has become overexposed, remove the person to an area with fresh air, and try to keep them calm and warm, but not hot. If they are having difficulty breathing, a qualified person may provide oxygen. If they stop breathing, have trained first-aid personnel give artificial resuscitation. Seek emergency medical attention.

Skin Contact: Getting MDI on your skin may result in allergic sensitization. In addition, animal tests have indicated that skin contact, followed by inhalation exposure, may result in lung sensitization. If these symptoms occur, seek immediate medical attention. Repeatedly getting MDI on your skin may cause discoloration, redness, and swelling or blistering; this also could lead to skin sensitization. It is best, therefore, to conduct your work to avoid skin contact, but if you get MDI on your skin, wash it thoroughly with soap and flowing water as soon as possible after exposure.

Eye Contact: Getting MDI in your eyes can be painful and could cause tearing and irritation. If you get MDI in your eyes, wash them immediately with a continuous flow of lukewarm, low pressure water, preferably from an eyewash station, for at least 15 minutes. Seek immediate medical attention.

Ingestion: Swallowing MDI can cause irritation. If you swallow MDI, do not induce vomiting. Wash out the mouth with water. The person affected should be made to rest and seek immediate medical attention.

Additional information about these potential health hazards is available through the product's MSDS and in materials on the American Chemistry Council's Center for the Polyurethanes Industry (CPI) website at www.americanchemistry.com/polyurethane.

3. Protecting Yourself from MDI Exposure
With proper precautions and the use of personal protective equipment (PPE), you can protect yourself from overexposure to MDI during the application of the SPF system.

A: For tasks that do not involve spraying (such as equipment cleaning), but where you may have direct contact with MDI liquid (at room temperature), use:

- Safety glasses or goggles
- MDI-resistant chemical gloves (e.g., nitrile, neoprene, butyl, or PVC)
- MDI-resistant clothing (e.g., apron or coveralls)
- Safety shoes or boots

B: When spraying a spray polyurethane foam system indoors, sprayers and helpers should wear:

- A NIOSH-approved full face or hood-type supplied air respirator (SAR) (as outlined in your company's Respiratory Protection Program)*

* Note: In some cases, such as when a work area is well ventilated or when helpers are not working in the immediate vicinity of the sprayer, helpers may be able to wear full face air purifying respirators (APR), with organic vapor/particulate (P100) cartridges instead of an SAR. Professional judgment must be exercised in making this determination, taking into consideration the specific circumstances of the job site/application.

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- Fabric gloves fully coated in nitrile, neoprene, butyl, or PVC; or cotton gloves over nitrile gloves. Helpers may wear nitrile, neoprene, butyl, or PVC gloves instead of the previously mentioned glove types.
- Disposable coveralls with attached hood. Where heat stress may be a concern, consider the use of lightweight disposable coveralls.

- Disposable overboots with skid-resistant soles. Evaluate whether overboots are to be used by helpers, depending on site conditions. In circumstances where over boots may create a slip/fall hazard, the use of overboots may be omitted.

For other tasks where there is the potential for exposure to MDI vapor/mist, follow the guidelines suggested in Point 3B. Workers not wearing the correct PPE should not enter the perimeter where spraying is occurring until the airborne MDI levels are below the allowable limits mentioned previously. Additional information to help protect you is available through the product's MSDS and in literature on the CPI website, www.americanchemistry.com/polyurethane.

4. Wearing a Respirator

According to the Occupational Safety and Health Administration's (OSHA) Respiratory Protection Standard, you are required to have a medical evaluation and receive medical approval before using a respirator. After approval is given, a fit test is required. The fit test is conducted using the respirator you will be wearing on the job. Each time you use a tight-fitting facepiece, you must conduct a 'user seal check'. However, tight-fitting facepiece respirators are not permitted for use if:

- You have facial hair that interferes with either the sealing surface of the respirator and the face, or interferes with the valve function;
- You wear corrective glasses/goggles or if other personal protective equipment interferes with the seal of the facepiece; and,
- Any other condition interferes with the facepiece seal.

Respirators should be regularly cleaned and disinfected according to the instructions provided by the respirator manufacturer. Deteriorated parts must be replaced prior to equipment use. Respirators should be inspected regularly for:

- Cracks, tears, holes, facemask distortion, cracked or loose lenses/face shield;
- Breaks, tears, broken buckles/clasps, over-stretched elastic bands in head strap;
- Residue/dirt, cracks or tears in valve and absence of valve flap; and,
- Breathing air quality/grade, condition of supply hoses, hose connections; settings on regulators and valves.

*The level of respiratory protection provided by the supplied air system is dependent upon the facepiece that is chosen; therefore consult your company's Respiratory Protection Program and MSDS for guidance.

Take defective respirators or those with defective parts out of service immediately. Notify your supervisor about all respirator defects.

Additional information about respirators is available through the product's MSDS, in your company's Respiratory Protection Program, and in materials on the CPI website at www.americanchemistry.com/polyurethane.

5. Containing the Overspray

When applying SPF indoors, marking the area with caution tape or other signage can help prevent workers from entering the spraying area. While this is a dynamic process which changes as each room is completed, it is possible to prevent entry into the spray area. In addition, depending on the weather and conditions of the job site (e.g., proximity to other buildings, vehicles,

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bystanders/passersby), ventilation of the application area may be necessary. For example, if a room has windows and/or doors on opposite sides, these can be opened to allow air to flow through the spray area. Other techniques for containing and ventilating the spray area also may be used. Further detail on these techniques is being developed and will be available in the near future. Adequate ventilation is especially important in confined areas such as attics and crawlspaces. Only fully protected workers, as described in Point 3B, will be allowed in the spray area.

Ventilation of the application area for a period of time following installation helps purge aerosols and vapors from the structure (preferably via fans exhausting air at one side, and open windows/doors on the opposite side). The post-installation ventilation time will vary based on the size of the area, amount of foam applied, the particular foam formulation applied, ventilation rate, and other relevant factors. Discourage entrance by others during the ventilation period. Contact your SPF supplier for recommendations as to ventilation and reoccupancy time.

6. Completing the Job

Remove PPE after completion of clean-up and exiting the spray area. Continue to wear while cleaning MDI-contaminated equipment and while handling any containers with MDI (e.g., drums, buckets). Point 3 provides guidance on PPE during clean-up.

It is good workplace practice to keep all work clothing at work. Any clothing contaminated with MDI should be removed and properly disposed of or decontaminated with a neutralizer solution (See the product's MSDS for the recommended neutralizer solution). Leather items cannot be decontaminated. Any contaminated leather items including shoes, belts, and watch bands or clothing, that have been exposed to MDI should be properly discarded. MDI is a reactive chemical; therefore, the MDI container should be kept sealed to reduce contamination. However, resealing MDI containers contaminated with water or polyol can cause a buildup of pressure in the container due to the generation of carbon dioxide. A pressurized container may rupture. MDI can self-react in a fire or at very high temperatures and release carbon dioxide. Carbon dioxide can build pressure in sealed containers sufficient to cause rupturing of the container.

Additional information to help protect you is available through the product's MSDS and in materials on the CPI website at www.americanchemistry.com/polyurethane.

7. Responding to Emergencies

Fires, spills, and other emergencies involving MDI require an immediate response by trained and knowledgeable personnel. **If you have not been trained to respond to an emergency, leave the area immediately and notify the appropriate emergency response personnel. If you need additional guidance, CHEMTREC®, the Chemical Transportation Emergency Center, is available to provide assistance by telephone 24-hours a day in the event of an emergency involving a fire, leak, spill or personnel exposure. CHEMTREC's emergency number is 1-800-424-9300.**

The seven important points in this guidance document are exhaustive and do not identify all the safety measures or legal requirements that may apply to your particular worksite. Consult the supplier's MSDS for additional information.

For more information, visit:

The American Chemistry Council's Center for the Polyurethanes Industry
www.americanchemistry.com/polyurethane or www.spraypolyurethane.com

Spray Polyurethane Foam Alliance
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Exterior Spray Polyurethane Foam Insulation Health & Safety Q&A

For Spray Foam Contractors

This Exterior Spray Polyurethane Foam Insulation Health & Safety Q&A document (describing spray applications done on the outside of a building) and the companion Interior Spray Polyurethane Foam Insulation Health & Safety Q&A document (describing spray applications done on the inside of a building) were created to provide general guidelines for safe spray polyurethane foam application.

These general guidelines are intended to supplement the specific and detailed information from the materials suppliers (Material Safety Data Sheet and Product Data Sheet) that you are using for your installation. Many different variables are present in the various applications, so each case must be evaluated individually so that proper protection is afforded. This document is for both new and existing exterior applications. It is applicable to those on or around the worksite where spray foam is being installed.

What are the chemicals used in spray polyurethane foam (SPF)?

A-Side or "Iso": Also known as polymeric methylene diphenyl diisocyanate or "PMDI" and typically contains 50% MDI and 50% higher molecular weight oligomers of MDI.

B-Side or "Resin": Also known as the polyol blend, and is comprised mostly of polyols, with smaller amounts of catalysts, blowing agents (closed cell foam only), flame retardants, and surfactants.

What are the potential health hazards of SPF chemicals?

A-side

Inhalation overexposure can result in 1) irritation of the nose, throat, and lungs, causing runny nose, sore throat, coughing, tightness in the chest, and shortness of breath, and 2) respiratory tract sensitization (i.e., the development of asthma) with symptoms of chest tightness, shortness of breath, coughing, and/or wheezing. Note that severe asthma attacks can be life threatening. NIOSH notes that "early recognition of sensitization and prompt and strict elimination of exposures is essential to reduce the risk of long-term or permanent respiratory problems for workers who have become sensitized."

Skin contact can cause 1) irritation, and 2) sensitization (allergy). Symptoms include reddening, itching, swelling, and rash. Skin contact alone may lead to respiratory sensitization. Eye contact can cause reddening, tearing, stinging, and/or swelling of the eyes.

B-side

Inhalation overexposure may result in irritation of the respiratory tract, causing cough, sore throat, and runny nose. Irritation of the eyes (liquid or vapor) and skin (liquid) also are possible. In addition, skin contact with some amine catalysts may lead to skin sensitization. Cardiac arrhythmia (irregular heartbeat) is a symptom of overexposure to certain blowing agents. In addition, the vapors of some amine catalysts can temporarily cause vision to become foggy or blurry, and halos may appear around bright objects such as lights.

Refer to your supplier's Material Safety Data Sheets (MSDS) for a complete listing of the composition and potential health effects of A and B-side chemicals.

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Due to the potential health hazards just mentioned, it is important to avoid inhalation of, and skin and eye contact with SPF chemicals.

What type of PPE should applicators wear during spraying?

- NIOSH-approved air purifying respirator (APR) with combination organic vapor/particulate (P100) cartridges, or a supplied air respirator (SAR).

Note: Respirators should be used in accordance with your company's written Respiratory Protection Program (RPP), which is required by the U.S. Occupational Safety & Health Administration (OSHA). Among other items, the RPP should include provisions for medical evaluations, fit testing, training, and cartridge change-out schedule.

- Disposable coveralls. It is important that all exposed skin be covered. Where heat stress may be a concern, consider the use of lightweight dis posable coveralls.

- Disposable over-boots with skid-resistant soles. In circumstances where over-boots may create a slip/fall hazard, their use may be omitted.

- Fabric gloves fully coated with nitrile, neoprene, butyl, or PVC. Alternatively, cotton gloves over nitrile gloves may be used.
- Where a full face respirator is not used, safety glasses with side shields or chemical safety goggles.

What type of PPE should helpers wear while spraying is being conducted?

Helpers directly assisting the sprayer (e.g., holding windscreens, hoses, etc.), should wear the same PPE worn by the sprayer.

What type of PPE should be worn during handling of liquid SPF chemicals?

The type of PPE used will depend on the particular activity and the associated potential for exposure. The following suggestions are offered as general guidance.

- Chemical safety goggles

- Nitrile, neoprene, butyl, or PVC gloves

- If splash to the body is possible, impermeable protective clothing (e.g., PVC, polyethylene)

- If handling heated SPF chemicals, NIOSH-approved air purifying respirator with combination organic vapor/particulate (P100) cartridges

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What type of personal protective equipment should be worn during handling of solvents?
Consult the manufacturer's MSDS.

What are the first-aid measures?
First-aid measures can be found on the MSDS. Here are some typical first-aid suggestions:

Inhalation
- Move the individual to fresh air.
- Administer CPR and/or oxygen if needed.
- Seek immediate medical attention.

Eyes
- Flush with lukewarm water for at least 15 minutes.
- Seek medical attention.

Skin
- Remove contaminated clothing.
- Wash thoroughly with soap and water.
- Seek medical attention if irritation develops or persists.

Ingestion
- Do not induce vomiting.
- If conscious, rinse mouth with water.
- Seek medical attention.

What are some good work practices to follow?
- Have the most current MSDS for each chemical brought onto the jobsite readily available (e.g., keep in the spray rig)
- Prior to the start of each job, it is advisable to have a discussion with the building owner and/or occupant(s) to talk about items such as potential odors associated with the newly-installed foam and any other questions the owner/occupant may have, such as reoccupancy times.
- Develop an Overspray Mitigation Plan
  - Determine in advance the potential for overspray issues
  - Discuss any overspray potential with the building owner and make necessary arrangements to relocate vehicles
  - Protect other surfaces that could be damaged from overspray (e.g., windows, doors, equipment, or building exterior) as appropriate
  - Do not spray polyurethane foam or coatings in higher winds (e.g., wind speeds exceeding 15 mph)
  - Use of windscreens in winds less than 15 mph can minimize impact of overspray
  - Have a plan in-place for when overspray damages do occur
  - Train all employees in overspray prevention
- Shut down HVAC system, and temporarily seal off (e.g., plastic sheeting and tape) roof-top air intakes
- Always follow the manufacturer's application instructions with respect to lift (layer or pass) thickness and time between lifts. Spraying foam too thickly in a single lift or not permitting sufficient time between lifts may generate excessive heat to the point where the foam may char, smolder, or burn.
- General housekeeping and clean-up is an important part of the job. Conduct jobsite quality controls before, during and after a project (e.g. warning signs/tape, equipment/material staging). Dispose of waste materials in accordance with applicable regulatory requirements.

How should spills be addressed?
- Direct all personnel away from the immediate area.
- Have individuals trained in spill clean-up don appropriate personal protective equipment.
- Absorb the spilled material with sand, earth or absorbent clays (e.g., vermiculite or cat litter). Place the absorbed material in drums (for MDI, use a neutralization solution (see MSDS), and do not seal these drums for an appropriate period (e.g., at least 72 hours).
- If a very large amount of MDI has been spilled (approximately 10,000 lbs of PMDI, or about 15 55-gallon drums), you must report the spill to various government agencies. In addition, contact CHEMTREC® (1-800-424-9300) for assistance.
- Comply with all applicable federal, state, and local waste disposal regulations, and dispose of accordingly.

For more Information: www.spraypolyurethane.com

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How should empty drums be disposed?

- Offer the empty drums to a qualified reconditioner.
- Offer the empty drums to a reclaimer for recycling (note: neutralization of empty PMDI drums is wise prior to transfer to the recycler).
- Empty the drums in accordance with the drum reconditioner's or recycler's instructions, as well as in accordance with state and federal regulations (e.g., less than 1" of liquid product in a drum is considered empty by the U.S. Environmental Protection Agency).

Where can I get more information?

- American Chemistry Council (ACC):
  - ACC Center for the Polyurethanes Industry (CPI) websites:
    - www.americanchemistry.com/polyurethane - Select "Safety" or "Health"
    - www.americanchemistry.com/spf or www.spraypolyurethane.com
    - "Health & Safety Aspects of SPF Applications" DVD - 2002. www.americanchemistry.com/polyurethane - Select "Order Publications".
    - "Safe Handling of Diphenylmethane Diisocyanate (MDI)" - 2007. www.americanchemistry.com/spf or www.spraypolyurethane.com.
  - ACC Diisocyanates Panel (DII):
    - http://www.americanchemistry.com/s_acc/sec_iso.asp?CID=1547&DID=5866
- Spray Polyurethane Foam Alliance (SPFA) - www.sprayfoam.org - Select "Health & Safety"
- U.S. National Institute of Occupational Safety and Health (NIOSH) - www.cdc.gov/niosh/topics/isocyanates - Safety and Health Topic: Isocyanates
- Material Safety Data Sheets and other health and safety literature can be obtained by contacting your spray polyurethane foam supplier.

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Appendix E-4: Exterior Spray Polyurethane Foam Applications

EXTERIOR SPRAY POLYURETHANE FOAM (SPF) INSULATION
PERSONAL PROTECTIVE EQUIPMENT

OSHA REQUIRES PROTECTION FOR SPRAY POLYURETHANE FOAM SPRAYERS, HELPERS AND OTHERS – THOSE USING HIGH PRESSURE DISPENSING EQUIPMENT - AS FOLLOWS:

- **HARD HAT: Use if needed to protect head from falling objects.**
- **EYE PROTECTION: Must be worn when spraying or working in areas where spray polyurethane foam aerosol or mist is present. Eye protection can be provided by a full face mask design or separate safety glasses with side shields or chemical safety goggles if a half face respirator is selected for use.**
- **SKIN PROTECTION: Protective garments are used to keep spray and mist from contacting skin and clothing. Personal protective garments are not just for convenience – in rare cases, skin exposure to spray or mist may result in serious health concerns.**
- **Fabric gloves fully coated in nitrile, neoprene, butyl, or PVC; or cotton over nitrile gloves could be used for spraying. Tape may be used to seal arm and feet openings as needed.**
- **If a breach of gloves or garments is noticed, change out the personal protective garments immediately or repair with tape over tears or rips.**
- **Respiratory Protection: Exterior applications by definition are conducted in open air and typically have air movement minimizing SPF aerosol concentrations. For exterior applications, sprayers must wear a NIOSH-approved Air Purifying Respirator or APR with an organic vapor/particulate (P100) cartridge. A NIOSH approved Supplied Air Respirator or SAR, if chosen, may provide greater protection for sprayers. Overspray should be monitored to avoid problems with objects, animals or unprotected persons downwind of the sprayer. All spray areas should be posted with warning signs/tape.**
- **MAINTENANCE: Employees should care for and maintain respirators as instructed by the manufacturer and store in a clean, dry, sanitary location (such as in a sealed bag or container – especially for organic vapor cartridges), and away from direct sunlight.**

  Inform job superintendents about:
  - **damaged or imperfect respirators**
  - **workplace hazards; and**
  - **questions about the Respiratory Protection Program**
- **WORK BOOTS: Steel-toed work boots are desirable in most work areas. Protection from overspray can be provided by disposable overboots with skid-resistant soles, if it does not compromise the grip of the work boot.**
- **Always read and understand the spray polyurethane foam manufacturer's Material Safety Data Sheet or MSDS before you start any spray foam application.**

ACTIVITY	Chemical Handling	Gun and Equipment Maintenance	EXTERIOR SPF Application
Safety Glasses with Side Shields or Safety Goggles		✔	✔
Supplied Air Respirator (SAR); Full Face Mask or Hood	✔		
Air Purifying Respirator (APR); Organic Vapor Particulate (P100) Cartridge	✔		✔
Fabric Gloves Fully Coated in Nitrile, Neoprene, Butyl, or PVC; or Cotton Over Nitrile Gloves	✔	✔	✔
Disposal Coverall	✔		✔

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Exterior Applications Using Spray Polyurethane Foam Containing MDI/PMDI: Seven Important Points for Spray Polyurethane Foam Contractors

Here are seven important points you will want to know when applying spray polyurethane foam (SPF) containing methylene diphenyl diisocyanate (MDI) and/or polymeric MDI (PMDI) to exterior applications.

This document provides guidance to spray polyurethane foam (SPF) contractors about important health and safety aspects when working with MDI during the spraying of polyurethane foam. Although MDI is a commonly used material in the spraying of exterior applications such as roofs and tanks, it is not the only material in the system that can present health hazards. SPF systems also contain a "B-side," which is a mixture of other chemicals including polyols, amine catalysts, flame retardants, and surfactants, among other ingredients that may pose potential health hazards. Therefore, it is important to read all the information contained in your supplier's Material Safety Data Sheet (MSDS) for the particular SPF product you are using. MSDSs are the primary sources of extensive and specific information on MDI, PMDI and other SPF system ingredients.

This guidance document is intended to help SPF companies applying SPF to exterior applications educate their workers and provide appropriate worker protection related to MDI/PMDI. This document does not include a discussion of the "B-side" chemicals present in the SPF system; always follow the product-specific information in the MSDS.

1. What is MDI?

The acronym MDI was derived from one of the chemical's many names, methylene diphenyl diisocyanate. Polymeric MDI is a mixture of monomeric MDI and polymeric MDI and is a brownish liquid at room temperature. MDI/PMDI is one component used in the application of spray polyurethane foam, typically referred to as the "A-side" or the "iso-side" of the system. Although the use of SPF insulates and protects exterior applications, the actual spraying application requires special handling and care.

2. Recognizing Potential Health Hazards

Contact with excessive amounts of MDI can be harmful to your health. When MDI is sprayed, you may be overexposed by:

- Breathing high airborne concentrations of MDI
- Getting MDI on your skin
- Getting MDI in your eyes
- Swallowing MDI

In addition to what is identified in the product's MSDS, here are some examples of the effects of overexposure and some commonly used first-aid procedures:

Inhalation: If MDI is sprayed or heated, there is a chance of overexposure. Overexposure means airborne concentrations greater than either 1) the U.S. Occupational Safety & Health Administration (OSHA) Permissible Exposure Limit-Ceiling of 20 parts per billion (ppb) at any time during the workday, or 2) the American Conference of Governmental Industrial Hygienists (ACGIH) Threshold Limit Value (TLV) of 5 ppb as an 8-hour time weighted average (TWA). MDI can

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irritate your nose and lungs. With overexposure, you may feel tightness in your chest and have difficulty breathing. If you continue to be overexposed, you may become sensitized (i.e., allergic) to MDI. Once sensitized, the effects may start as soon as you begin to work with the product, or later on in the day after you've stopped working with the product (i.e., when you've left work). If you are sensitized you may experience health effects even when airborne MDI levels are very low and may be at risk for experiencing an asthma attack. If this happens, DO NOT CONTINUE TO WORK WITH MDI; asthma attacks can be life-threatening. If you start to feel any of the symptoms listed above, let your supervisor know immediately and seek medical attention.

If you suspect someone has become overexposed, remove the person to an area with fresh air, and try to keep them calm and warm, but not hot. If they are having difficulty breathing, a qualified person may provide oxygen. If they stop breathing, have trained first aid personnel give artificial resuscitation. Seek emergency medical attention.

Skin Contact: Getting MDI on your skin may result in allergic sensitization. In addition, animal tests have indicated that skin contact, followed by an inhalation exposure, may result in lung sensitization. If these symptoms occur seek immediate medical attention. Repeatedly getting MDI on your skin may cause discoloration, redness, and swelling or blistering; this also could lead to skin sensitization. It is best, therefore, to conduct your work to avoid skin contact, but if you get MDI on your skin, wash it thoroughly with soap and flowing water as soon as possible after exposure.

Eye Contact: Getting MDI in your eyes can be painful and could cause tearing and irritation. If you get MDI in your eyes, wash them immediately with a continuous flow of lukewarm, low pressure water, preferably from an eyewash station, for at least 15 minutes. Seek immediate medical attention.

Ingestion: Swallowing MDI can cause irritation. If you swallow MDI, do not induce vomiting. Wash out the mouth with water. The person affected should be made to rest and seek immediate medical attention. Additional information about these potential health hazards is available through the product's MSDS and in materials on the American Chemistry Council's Center for the Polyurethanes Industry (CPI) website at

3. Protecting Yourself from MDI Exposure

With proper precautions and the use of personal protective equipment (PPE), you can protect yourself from overexposure to MDI during the application of SPF on exterior applications.

A: For tasks that do not involve spraying (such as equipment cleaning), but where you may have direct contact with MDI liquid (at room temperature), use:

- Safety glasses or goggles
- MDI-resistant chemical gloves (e.g., nitrile, neoprene, butyl, or PVC)
- MDI-resistant clothing (e.g., apron or coveralls)
- Safety shoes or boots

B: When spraying an exterior application (e.g., roofs, tanks, top coatings), both sprayers and helpers directly assisting the sprayer (e.g. holding windscreens, hoses), should wear:

- A NIOSH-approved air purifying respirator (APR) with organic vapor/ particulate (P100) cartridges or a supplied air respirator (SAR), as outlined in your company's Respiratory Protection Program.*
- Safety goggles (where respirator does not cover the eyes).
- Fabric gloves fully coated in nitrile, neoprene, butyl, or PVC; or cotton gloves over nitrile gloves.
- Disposable coveralls. Where heat stress may be a concern, consider the use of lightweight disposable coveralls

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- Disposable overboots with skid-resistant soles. In circumstances where over-boots may create a slip/fall hazard, their use may be omitted.

For other tasks where there is the potential for exposure to MDI vapor/mist, follow the guidelines suggested in Point 3B. Workers not wearing the correct PPE should not enter the perimeter where spraying is occurring until the airborne MDI levels are below the allowable limits mentioned previously. Additional information to help protect you is available through the product's MSDS and in literature on the CPI website at www.americanchemistry.com/polyurethane.

4. Wearing a Respirator

According to the U.S. Occupational Safety and Health Administration's Respiratory Protection Standard, you are required to have a medical evaluation and receive medical approval before using a respirator. After approval is given, a fit test is required. The fit test is conducted using the respirator you will be wearing on the job. Each time you use a tight-fitting facepiece, you must conduct a 'user seal check'. However, tight-fitting facepiece respirators are not permitted for use if:

- You have facial hair that interferes with either the sealing surface of the respirator and the face, or interferes with the valve function;
- You wear corrective glasses/goggles or if other personal protective equipment interferes with the seal of the facepiece; and,
- Any other condition interferes with the facepiece seal.

Respirators should be regularly cleaned and disinfected according to the instructions provided by the respirator manufacturer. Deteriorated parts must be replaced prior to equipment use. Respirators should be inspected regularly for:

- Cracks, tears, holes, facemask distortion, cracked or loose lenses/face shield;
- Breaks, tears, broken buckles/clasps, over-stretched elastic bands in head strap;
- Residue/dirt, cracks or tears in valve and absence of valve flap; and,
- Breathing air quality/grade, condition of supply hoses, hose connections; settings on regulators and valves.

*The level of respiratory protection provided by the supplied air system is dependent upon the facepiece that is chosen; therefore consult your company's Respiratory Protection Program and MSDS for guidance.

Take defective respirators or those with defective parts out of service immediately. Notify your supervisor about all respirator defects.

Additional information about respirators is available through the product's MSDS, in your company's Respiratory Protection Program, and in materials on the CPI website, www.americanchemistry.com/polyurethane.

5. Containing the Overspray

When applying SPF to an exterior application, care must be taken to shield spray mists or vapors from entering the building air intake ventilation system. A typical approach is first, turn off the building ventilation system. Second, apply plastic sheeting (generally polyethylene) over the air intakes to seal and secure them. Third, protect overspray from coating cars or equipment below with SPF particles. All workers applying SPF to an exterior application during spraying (as well as any other workers in the vicinity) should be upwind from the application of SPF. Only fully protected workers, as outlined in Point 3B, will be allowed in the spray area. Remember, the coatings applied over the exterior application also may contain chemicals of concern. Check each coating manufacturer's MSDS for information on potential health hazards and PPE recommendations.

6. Completing the Job

Remove PPE after completion of clean-up and exiting the spray area. Continue to wear PPE while cleaning MDI-contaminated equipment and while handling any containers with MDI (e.g., drums, buckets). Point 3 provides guidance on PPE during clean-up.

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It is good workplace practice to keep all work clothing at work. Any clothing contaminated with MDI should be removed and properly disposed of or cleaned. Leather items cannot be decontaminated. Any contaminated leather items including shoes, belts, and watch bands or clothing, which have been exposed to MDI, should be properly discarded. MDI is a reactive chemical; therefore, the MDI container should be kept sealed to reduce contamination. However, resealing MDI containers contaminated with water or polyol can cause a buildup of pressure in the container due to the generation of carbon dioxide. A pressurized container may rupture. MDI can self-react in a fire or at very high temperatures and release carbon dioxide. Carbon dioxide can build pressure in sealed containers sufficient to cause rupturing of the container.

Additional information to help protect you is available through the product's MSDS and in materials on the CPI web-site at www.americanchemistry.com/polyurethane.

7. Responding to Emergencies

Fires, spills, and other emergencies involving MDI require an immediate response by trained and knowledgeable personnel. **If you have not been trained to respond to an emergency, leave the area immediately and notify the appropriate emergency response personnel. If you need additional guidance, CHEMTREC®, the Chemical Transportation Emergency Center, is available to provide assistance by telephone 24-hours a day in the event of an emergency involving a fire, leak, spill or personnel exposure. CHEMTREC's emergency number is 1-800-424-9300.**

The seven important points in this guidance document are exhaustive and do not identify all the safety measures or legal requirements that may apply to your particular worksite. Consult the supplier's MSDS for additional information.

For more information, visit:

The American Chemistry Council's Center for the Polyurethanes Industry
www.americanchemistry.com/polyurethane or www.spraypolyurethane.com

Spray Polyurethane Foam Alliance
www.sprayfoam.org

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Appendix E-5: Marketing Claims

Guidance Document

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"Green" Marketing Claims and Spray Polyurethane Foam

Spray polyurethane foam (SPF) is an exciting insulation product that is exploding in popularity for many reasons. Among its many outstanding attributes are several that could be understood by consumers to be "green" attributes - for example, some SPF is made in part with natural oils, giving the foam some renewable content. And because SPF is an outstanding insulator, it can contribute significantly to home and building energy efficiency and energy savings.

When these "green" attributes are described as part of product marketing – whether advertisements, promotional materials, sales claims, or labels – they are considered "green" claims. Green claims are the marketing response to consumers' increasing interest in protecting the environment. They can help consumers better understand the environmental attributes of a product or service and help inform purchasing decisions.

Who is a "marketer?"
Marketers include anyone who is making a promotional claim to sell a product or service.

Who is responsible for marketing claims about a SPF product or service?
The product manufacturer is responsible for claims about the product. For SPF, a finished package of all the components needed to mix and make the foam is typically marketed as a kit or "system." The manufacturer of the SPF system is responsible for marketing claims about that system. If the SPF product is a product that is sold directly to consumers, such as a one component foam sold in a can, the manufacturer of that product is responsible for marketing claims about that product.

The provider of a service, such as a spray foam applicator, is responsible for claims about the service, such as claims that the application will be made in a timely way, or that the premises will be cleaned up after the application is completed.

Are there restrictions on the kinds of environmental marketing claims that can be made?
Yes. Federal law prohibits deceptive acts or practices, including deceptive representations in advertising, labeling, product inserts, catalogs, and sales presentations. Some deception cases have involved representations or practices likely to mislead consumers; others have involved omissions of information.

What is a deceptive claim?
It is usually easy to see how an express misrepresentation of fact can be considered a deceptive claim. But it is also important to understand that omissions of information, and implied claims, can both be considered deceptive claims in certain circumstances. The Federal Trade Commission's (FTC) Policy Statement on Deception says that deception occurs when (1) there is a representation, omission, or practice that is likely to mislead the consumer; (2) the consumer is acting reasonably under the circumstances; and (3) the representation, omission, or practice is material. While express claims tend to speak for themselves (the representation itself establishes the meaning), for implied claims, FTC will consider "the representation itself, including an evaluation of such factors as the entire document, the juxtaposition of various phrases in the document, the nature of the claim, and the nature of the transactions." FTC may also consider an omission deceptive if the representation creates "a reasonable expectation or belief among consumers which is misleading, absent the omitted disclosure."

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Is there guidance to help explain how to make a "green claim?"
Yes. The Federal Trade Commission (FTC), together with the Environmental Protection Agency (EPA), developed guidelines for advertisers to ensure that their environmental marketing claims don't mislead consumers. These are called the "Green Guides," and they explain how the FTC Act is enforced when it comes to environmental claims.

Analyzing any marketing claim is generally a two step process. First, ask what claims — express and implied — does the marketing or advertising convey to reasonable consumers? Second, ask whether there is "competent and reliable evidence" – which, depending on the claim, may require scientific evidence – to support each of the claims. The Green Guides helps marketers understand how to do this analysis.

What marketing claims do the Green Guides apply to?
The Green Guides apply to all forms of marketing for products and services: advertisements, labels, package inserts, promotional materials, words (including sales "pitches" at trade shows and conventions and one on one sales calls to buyers, consumers, or customers), symbols, logos, product brand names, and marketing through digital or electronic media (including Internet "YouTube" videos, blogs, web pages, social networking sites, Twitter, and email). They apply to any claim, express or implied, about the environmental attributes of a product, package or service in connection with the sale, offering for sale or marketing of the product, package or service for personal, family or household use, or for commercial, institutional or industrial use.

Is there difference between a green marketing claim and product use and application instructions?
Yes. A marketing claim often points out a particular product feature benefit; for example, a marketing claim may point out that a product is made using a renewable, plant-based resource. But a marketing claim should not be confused with instructions on how to safely use and apply the product. Application and Use Instructions should always be consulted, including the Material Safety Data Sheet (MSDS), manufacturer's instructions, and label instructions.

If I make an environmental marketing claim, do I have to be able to "back up" the claim?
Yes. This is called claims substantiation, and all marketers making express or implied claims about the attributes of their product, package or service must be able to substantiate the claim at the time they make it (in other words, that means there is a reasonable basis for making the claim). In the case of environmental marketing claims, such substantiation will often require competent and reliable scientific evidence, defined as tests, analyses, research, studies or other evidence based on the expertise of professionals in the relevant area, conducted and evaluated in an objective manner by persons qualified to do so, using procedures generally accepted in the profession to yield accurate and reliable results.

Example 1:
A spray polyurethane foam (SPF) product is advertised as containing "90% recycled content." The SPF kit is sold with chemical mixtures pre-packaged in two "sides," an "A" side and a "B" side, each side making up 50% of the kit. Twenty percent of the B side is made up of polyols, and the polyols have 90% recycled content. The A side and B side are mixed at the application site to create the finished foam. After the sides are mixed and the finished foam is produced, the ultimate recycled content in the SPF is only 9%. The "90% recycled content" claim for the finished foam is deceptive because consumers could reasonably believe that a majority of the finished spray polyurethane foam consists of recycled content. On the other hand, an appropriately qualified claim, e.g., "contains 9% recycled content in the finished foam," addresses this issue. In addition, the claim should be able to be adequately substantiated, so further qualifying the claim, "as measured using ASTM D6866," would be acceptable as it discloses the actual, substantiated percentage of recycled content in the finished foam.

Can I make a general claim that a product is "green"?
An unqualified general claim of environmental benefit may convey that the product has far-reaching environmental benefits, when it doesn't. The FTC may consider such an unqualified general claim to be

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deceptive. For example, a car manufacturer that made an unqualified general claim of a "green" car simply because it had eliminated VOCs in a paint formula (only one environmental attribute of many of the car) might be subject to challenge as making a deceptive claim.

Products generally advertised as "green" are likely to convey to consumers a broad range of environmental attributes. Under the Green Guides, such a claim would be less likely to be considered deceptive if it is accompanied by clear and prominent qualifying language that limits the green representation to the particular product attribute that can be substantiated, provided that the context doesn't create any other deceptive implications.

What about claims that a product is "non-toxic"?
Consumers understand claims that a product is "non-toxic," "essentially non-toxic," or "practically non-toxic" to mean that the toxicity claims apply not only to human health effects, but also to environmental effects. The manufacturer of the product will determine whether a product can be called "non-toxic" based on its judgment after reviewing animal / environmental data, or human experience. Such classification may be used on toxicity / hazard information contained in Material Safety Data Sheets (MSDS), toxicity studies, and / or opinion from certified toxicologists or industrial hygiene (IH) professionals. A properly qualified "green" marketing claim about a particular product attribute, such as renewable content in a product, should never be confused with the toxicity profile of a product and never be solely relied upon for purposes of making a claim that a product is "non-toxic."

Under the Federal Hazardous Substances Act (FHSA), a consumer product meeting the definition of hazardous household product ("hazardous substances"), must also bear cautionary labeling to alert consumers to the potential hazards that the product presents and to inform consumers of the measures they need to protect themselves from those hazards. Any consumer product that is toxic, corrosive, flammable or combustible, an irritant, a strong sensitizer, or that generates pressure through decomposition, heat, or other means requires labeling, if the product may cause substantial personal injury or substantial illness during or as a proximate result of any customary or reasonable foreseeable handling or use, including reasonable foreseeable ingestion by children.

Are there special rules for claims about the energy efficiency of SPF?
Yes. FTC has a regulation called the "R Value Rule," which applies to the labeling and advertising of home insulation products. 16 C.F.R. 460. http://www.ftc.gov/bcp/rulemaking/rvalue/16cfr460.shtm. The rule has very broad application, and applies not just to the manufacturers of insulation, but also to any member of the home insulation industry, including insulation installers and home builders. Any claims about the R-value (the measure of resistance to heat flow) or energy savings of SPF should be carefully scrutinized for compliance with the rule.

Can different claims be made about spray foam chemicals before they are mixed and applied, as opposed to the finished, cured foam?
The chemical hazard characteristics of the pre-mix, which has an "A" side and a "B" side of certain chemicals, are quite different than those of post-mix (reacted), finished and cured foam. Care should be taken to understand this distinction when making or interpreting marketing claims.

Example 2:
A spray polyurethane foam (SPF) brochure advertises the spray foam product as "safe and non-toxic." The SPF is produced by reacting hazardous liquid chemicals that have certain toxicity characteristics according to the material safety data sheets, and require personal protective equipment when being handled. However, the manufacturer has determined that after the SPF chemicals are mixed and installed, that the finished, cured, solid SPF product is non-toxic (using industry accepted tests) 24 hours after installation. The general, unqualified claim made in the advertising brochure may be deceptive if it is likely to be interpreted by consumers to mean that SPF in any form does not present any toxicity risks, and can be handled in any manner. A properly qualified claim that distinguishes between the characteristics of the pre-mix

For more Information: www.spraypolyurethane.com

Appendix E-5: Marketing Claims

Guidance Document

chemicals and the fully cured foam, however, is unlikely to be considered deceptive, e.g., that "Liquid SPF chemicals are hazardous and must be handled and installed using personal protective equipment. The fully cured solid SPF product may not be considered non-toxic until 24 hours after installation."

Sources of additional information:

FTC Act Section 5:
http://www.law.cornell.edu/uscode/15/usc_sec_15_0000045---000-.html

The Green Guides:
http://www.ftc.gov/bcp/grnrule/guides980427.htm

FTC Policy Statement on Deception:
http://www.ftc.gov/bcp/policystmt/ad-decept.htm

FTC Policy Statement on Unfairness:
http://www.ftc.gov/bcp/policystmt/ad-unfair.htm

FTC Policy on Ad Substantiation:
http://www.ftc.gov/bcp/guides/ad3subst.htm

Federal Hazardous Substances Act:
http://www.cpsc.gov/BUSINFO/fhsa.pdf

For more information, visit:

The American Chemistry Council's Center for the Polyurethanes Industry
www.americanchemistry.com/polyurethane or
www.spraypolyurethane.com

Spray Polyurethane Foam Alliance
www.sprayfoam.org

Published August, 2009 This document may be updated. For the most current version of this document, see www.americanchemistry.com/polyurethane, www. spraypolyurethane.com, or www.sprayfoam.org.

This document was prepared by the American Chemistry Council (ACC) Center for the Polyurethanes Industry (CPI) and the Spray Polyurethane Foam Alliance (SPFA). It is intended to provide general information to persons who may handle or apply spray polyurethane foam chemicals. It is not intended to serve as a substitute for in-depth training or specific handling or application requirements, nor is it designed or intended to define or create legal rights or obligations. It is not intended to be a "how-to" manual, nor is it a prescriptive guide. All persons involved in handling and applying spray polyurethane foam chemicals have an independent obligation to ascertain that their actions are in compliance with current federal, state and local laws and regulations and should consult with their employer concerning such matters. Any mention of specific products in this document is for illustration purposes only and is not intended as a recommendation or endorsement of such products.

American Chemistry Council
Center for the Polyurethanes Industry

SPRAY POLYURETHANE FOAM ALLIANCE
SPFA

For more Information: www.spraypolyurethane.com

Appendix F: Helpful Internet Resources

List of Helpful Internet Resources	
Center for the Polyurethanes Industry (CPI) of the American Chemistry Council	www.americanchemistry.com/polyurethane www.spraypolyurethane.com
Spray Polyurethane Foam Alliance	www.sprayfoam.org
OSHA homepage	www.osha.gov
NIOSH homepage	www.cdc.gov/niosh

Ventilation Considerations for Spray Polyurethane Foam

Guidance on Ventilation During Installation of Interior Applications of High-Pressure Spray Polyurethane Foam

Spray Foam Coalition
Center for the Polyurethanes Industry

American Chemistry Council | Spray Foam Coalition

This document is intended to provide general guidance on ventilation during installation of interior applications of spray polyurethane foam (SPF) in new residences and buildings and during renovation and weatherization projects in existing homes and buildings. SPF is a widely used and highly effective insulation and sealant material that is spray-applied to walls, ceilings, attics, basements, and crawl spaces.

SPF is a highly effective sealant, and its application could seal the building enclosure below the minimum ventilation rates required by building codes or recommended design requirements. *This document does not discuss permanent mechanical ventilation systems, but in certain cases the use of such systems may need to be considered.* Consult with a design professional to determine if it is appropriate.

Why use work zone mechanical ventilation during and shortly after SPF installation

Work zone mechanical ventilation during and after SPF installation is designed to prevent workers and others in the area from being exposed to SPF chemicals above recommended or permissible levels. Potential health effects from exposure above recommended levels can range from no effects to slight irritation of the eyes, skin or respiratory system to the development of chronic lung or pulmonary disease depending on the individual person and level and duration of overexposure.[1, 2]

SPF chemical components include isocyanates (A-side material), which are irritants (causing effects on eyes, skin, and respiratory system) and sensitizers that may produce an allergy-like response in some people after re-exposure. Exposure of a sensitized individual has the possibility to result in skin and/or respiratory reactions. Respiratory effects (asthma attacks) can be severe (or fatal) even at very low levels of exposure in sensitized individuals.

The B-side material (polyol or resin blend) used in SPF is a formulated product that contains polyols, blowing agents, catalysts, flame retardants, surfactants and other additives. These component materials could also result in irritation of eyes, skin and respiratory system from overexposure. A temporary condition referred to as “Blue Haze” or “Halovision” could also result from exposure to catalysts. For more information on chemical health and safety, see “Health and Safety Product Stewardship Workbook for High-Pressure Application of SPF.”[2] Important information concerning health and safety is available online for free, including the CPI Chemical Health and Safety Training for both high-pressure SPF and low-pressure SPF here: www.spraypolyurethane.org.

When SPF is applied using high-pressure application equipment, some SPF component chemicals may be present in the form of aerosol mists and vapors over the occupational exposure level (OEL) or at levels that could be harmful to some individuals.[a] Engineering controls including containment and properly designed ventilation systems should be used *in tandem* with proper personal protective equipment (PPE).[3] These protective measures can help prevent SPF applicators, helpers, and others who may be working in adjacent areas from potential exposures. In addition, taking steps like access restrictions and evacuation of the home are important during and shortly after installation to minimize potential exposures.

[a] Not all SPF component chemicals have OELs.

Current studies show use of engineering controls alone (containment and ventilation systems) during high-pressure SPF application do not sufficiently reduce airborne chemicals to below levels needed to eliminate the use of recommended PPE for those in the work zone during and shortly after spraying.[4,5] Use engineering controls and proper PPE together when applying high-pressure SPF in interior applications.

When to consider using a mechanical ventilation system during installation

Airborne SPF chemicals can rapidly accumulate in enclosed interior spaces, depending on the ambient conditions, size of the work zone and the amount of SPF applied. Enclosed work zones include the interior space of buildings, especially in areas with minimal natural ventilation like attics and crawlspaces. Isolating and ventilating the areas of SPF application should be considered so that other trade workers and building occupants are not potentially exposed to SPF chemicals. The need for mechanical ventilation systems during application and shortly after should be reviewed in all applications of high-pressure SPF.

Who is responsible for constructing and using containment and mechanical ventilation systems

According to OSHA regulations,[6] SPF contractors have a legal responsibility to provide a safe workplace for all employees. In the case of high-pressure SPF application, use of engineering controls and proper PPE in the work zone during and after spraying is an important consideration to help achieve a safe workplace. In addition, it is a good practice for the SPF contractor to advise the building owner (homeowner or general contractor) of all hazards associated with SPF application. Conduct a meeting between the SPF contractor and the building owner before SPF application to discuss potential hazards, containment and ventilation methods, the importance of vacating, and when it is safe to reoccupy the building during and after SPF application.

What does a SPF contractor consider when designing and constructing a containment and mechanical ventilation system

Application of SPF to walls, ceilings, attics, and basements within buildings of varying size and geometry creates some challenges for designing containment and ventilation configurations because every job site will be different. Work zones vary in size, geometry and ambient conditions, and the delivery rate and position of the contaminant source (i.e. spray gun), as well as air flow, will change throughout the job as the applicator moves around the room.

Applicators, helpers, occupants, and adjacent workers should avoid inhalation of, and skin and eye contact with, SPF chemicals.[7] The following practices, including engineering controls, work practices, and PPE, are intended to reduce the potential for overexposure to SPF chemicals via inhalation, skin or eye contact. Consider a combination of engineering controls, work practices, and PPE for SPF applications. Individuals not involved in the application process vacate the area and return after informed that it is safe to do so.

Engineering Controls: Proper containment and ventilation techniques can help prevent workers and building occupants from potential exposure due to SPF application, particularly in interior applications when buildings cannot be vacated. This can occur in large, commercial buildings where vacating the entire building is not feasible. Containment creates

a restricted work zone while the ventilation system removes SPF chemicals from the work area by drawing the air out of the work zone through the use of a fan. In addition to the engineering controls, the use of PPE further reduces the potential for exposure.

- **Work Zone Containment:** Work zone containment is used in conjunction with ventilation to isolate and remove chemicals from the work area. Work zone containment is most effective when a space is as close to airtight as can practicably be achieved. If a work zone is contained, clearly mark the area externally, and take appropriate steps to restrict entry into the work zone to personnel wearing proper PPE.
- **Ventilation Design:** Ventilation used with work zone containment removes chemicals from the isolated area via negative pressure. Having negative pressure in a contained work zone will draw in air from small cracks and gaps around the work zone boundary and exhaust the work zone air. Active ventilation is achieved by using one or more fans to draw air from the work zone and create a negative pressure inside the work zone. Give careful consideration to the location of the exhaust. Release exhaust to an unoccupied space where it is not drawn through an air intake. This also helps protect occupants and workers in adjacent areas from potential exposure.

A. Work Zone Containment

Prior to application of high-pressure SPF within a building, construct a containment or enclosure system to isolate the work zone from other parts of the building. This containment system serves several important functions:

- Prevents airborne mists and particulates from migrating to other parts of the building. Minimizing air and particulate migration not only helps prevent unwanted deposits (i.e. overspray) on finished surfaces outside of the work zone, but also prevents the spread of contaminants to those areas. Containment can minimize the need for additional ventilation outside of the work zone.
- Minimizes the total volume of the work zone for ventilation, thus reducing the size and number of fans, and helps to direct airflow across the point of SPF application.
- Establishes a defined boundary between the work zone and other areas in the building, when properly marked with hazard signage at all entrance points, thus helping to prevent unwanted entry by persons not wearing PPE.

An example of a material used to build a containment area in SPF applications is 4-6 mil polyethylene sheeting. Sheeting can be purchased in roll widths corresponding to the interior wall height, usually 8-10 feet high. This sheeting should be installed to provide a negative pressure in the work zone.

In addition, all penetrations and openings to other parts of the building, including open areas between the ceiling joists above the interior walls, are temporarily blocked with faced fiberglass batts, plastic sheeting or other materials and tape to minimize air flow as shown in Figure 1. All finished surfaces, such as windows and immovable furnishings and appliances, are masked to prevent overspray.

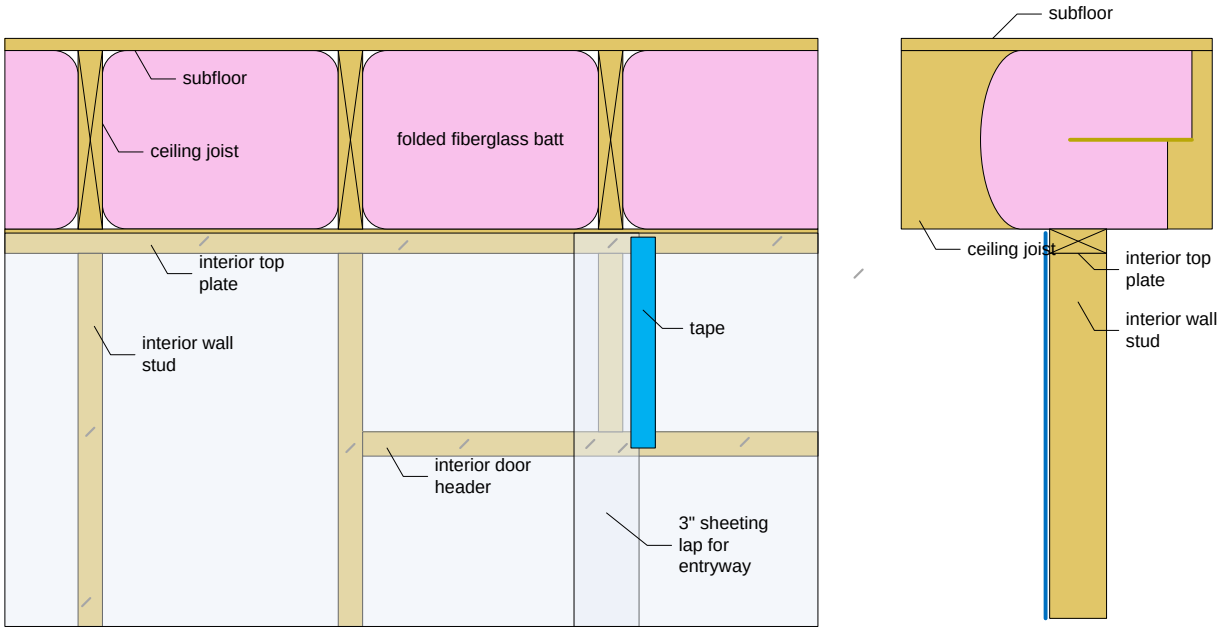

FIGURE 1 – Example of using batts to seal openings in ceiling joists

It is also important to deactivate the HVAC system and cover HVAC registers and grilles (see Figure 2) during installation and ventilation of the work zone. Use OSHA's lock-out/tag-out (LOTO) procedures to de-energize and secure the HVAC system breakers or sub-panel and/or use a sign/tape over the switch, as shown in Figure 3. Turn the HVAC system back on after ventilation is stopped and prior to re-occupancy.

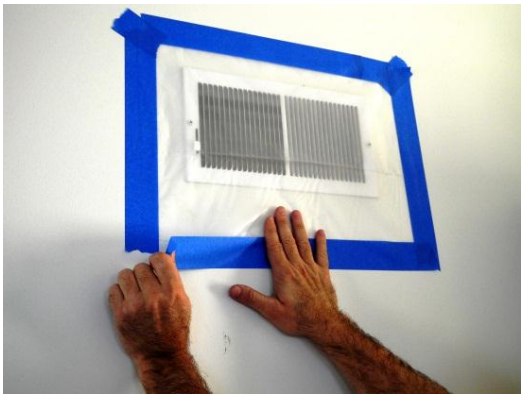

FIGURE 2 – Cover and taping all grille and register openings into containment

FIGURE 3 – Deactivate and mark HVAC system at electrical panel (use LOTO procedure and indicate date, time and name of person applying the tag)

An adequately-sealed containment system will provide a negative-pressure enclosure around the work zone when proper ventilation fans are used.

B. Ventilation Design

During SPF application, the main source of chemical vapor and particulate emissions is the spray gun. The location of this source (the spray gun) moves as the point of application progresses throughout the work zone. This moving of the source creates unique challenges in designing and implementing an effective containment zone and ventilation system. If a single, immobile fan is used, the system may resemble a simple exhaust-only system. To maximize the system's effectiveness, one must understand the following components and how they work together:

- **Contaminant Source:** In the case of SPF, this is the spray gun and curing foam.
- **Work Zone:** The space, room or enclosure to be ventilated, within the containment area.
- **Exhaust Air System:** The exhaust air system includes an exhaust point, ductwork and an exhaust fan that captures contaminates at the source and sends them to a location outside the building away from occupied areas and air inlets.
- **Supply Air System:** The supply air system provides a source of fresh outside air into the work zone that is needed to replace the air removed by the exhaust system. This make-up air can be provided passively through various penetrations in the containment (such as windows, doors, exterior vents and other openings) or through a dedicated active forced-air inlet system consisting of a supply point, ductwork and second supply fan. Supply air systems can be comprised of both passive and active systems.

One way to think about this is to consider the exhaust and supply air systems as a "push-pull" system. The supply air system pushes air into the contained space, delivering a positive pressure inside. The exhaust air system pulls the air from the containment, creating a negative pressure. To assure that a net negative pressure is created in the containment, the exhaust air pulled from the containment should always be more than the supply air pushed into it.

How one designs or places each of these components will determine the effectiveness of a ventilation system. One can employ a single-fan, exhaust-only system which, by default, generates a negative pressure in the work zone or containment. However, such systems may provide limited ventilation and air flow to some points in the work zone due to the source (spray gun) moving in the work zone. More importantly, exhaust-only ventilation may gradually become less effect as SPF is applied, as the foam seals sources of passive make-up air. Fixed, passive supply air sources such as open windows and doors are also problematic in that the ambient air temperature and humidity may be hard to control, and the fixed location may create dead air sites within the containment.

A ventilation system consisting of both active exhaust and supply air systems can address these issues. Figure 4 shows such a two-fan system. There are several key points to consider when designing this type of system:

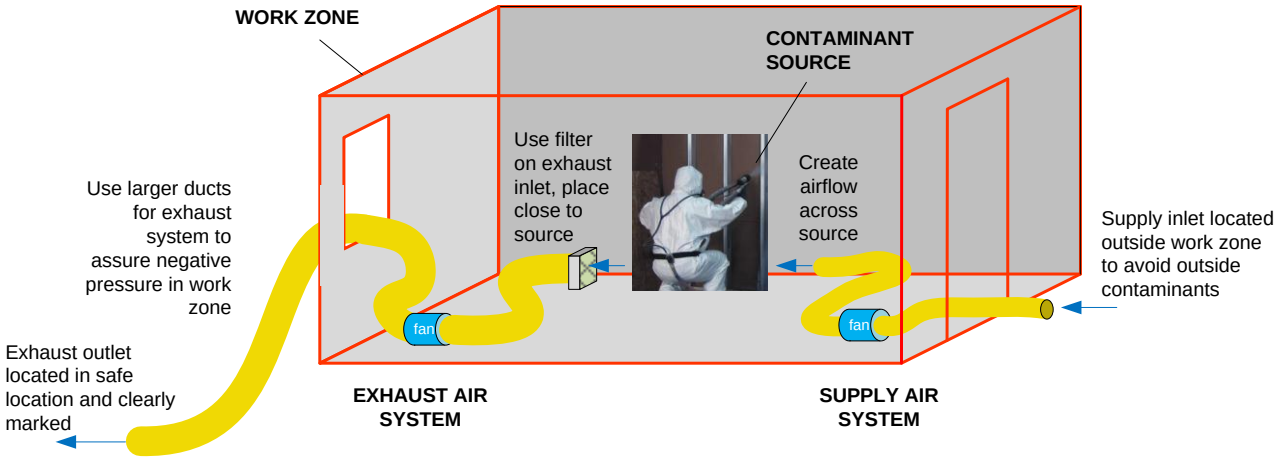

FIGURE 4 – Example of a Two-Fan Ventilation System (active exhaust and supply systems) for interior SPF Application

- **Maintain a negative pressure in the work containment zone.** A negative pressure within the containment zone assures that contaminants are not forced into other areas of the building. With a two-fan system, negative containment pressures can always be achieved when the exhaust fan capacity (e.g., CFM rating) is greater than the supply fan capacity. For most systems, it is suggested that the capacity of the exhaust fan exceeds the capacity of the supply fan. Use caution with multi-speed fans so that the supply fan rate does not exceed the exhaust fan rate. A smoke-pencil is often used to visually confirm that the containment is always under a state of negative pressure. Observing an inward billowing of the plastic film used for containment can also confirm a negative pressure in the containment area. If the plastic sheet billows outward, there is too much supply air or insufficient exhaust air. Remember, to create a net negative pressure the air pulled from the containment exceeds the air pushed into the containment.
- **Check placement and direction of fans.** Direct fans in the appropriate direction: use the larger-capacity exhaust fan for pulling air from the containment area to the outdoor and the smaller supply fan to bring air indoors.
- **Generate and maintain air flow across the spray area.** Position the inlet of the exhaust system and the outlet of the supply system at locations on both sides of the spray foam application site (contaminant source). This position helps to assure maximum airflow across the application site. Move the exhaust inlet along with the applicator as necessary as the job progresses to help move contaminants away from the applicator, and to help have the applicator (contaminant source) lined up on a straight line between the supply air outlet and the exhaust air inlet.
- **Avoid unwanted openings in the work zone.** Unwanted or unknown openings through the work containment zone can make the ventilation system less effective. If a negative pressure exists in the work zone, make-up air will enter the containment from these passive openings. If these openings are large enough, a direct flow of air between these openings and the exhaust air system will occur, which may create dead-air spaces in other parts of the containment zone. If the SPF application site is not between these openings and the exhaust system (e.g., if the spray gun is in a dead space), the ventilation system will not work efficiently.
- **Exhaust contaminants to a safe outside location.** Air from the outlet of the exhaust system may contain elevated levels of SPF component chemicals and

particulates. Direct the exhaust air outside, far away from the air inlet point and away from occupied areas. Cordon the outlet off with physical barriers to prevent access and mark it.

- **Use filtration on the inlet of the exhaust system.** During the ventilation process, mists and particulates are collected by the exhaust system. Over time, these materials can accumulate and reduce the effectiveness of the ductwork and fan of the exhaust system. To reduce this accumulation of particulates in the equipment and minimize the contaminants at the exhaust outlet, filtration is often used. A box with a replaceable filter can be used. Regularly inspect and replace the filter media for proper function of the exhaust system.

What to consider when selecting the fan size necessary for the exhaust and supply ventilation

The effectiveness of a ventilation system is determined by the design of the containment and the ventilation rate. The containment ventilation rate is measured by the number of air changes per hour (ACH). ACH is how many times per hour the volume of air within the containment area is completely replaced with fresh air.

Use the SPF manufacturer's recommended containment ventilation rate to determine the size of the ventilation system fans. Generally, consider the following:

1. Determine the total volume of the containment to be vented. This can be done by taking the floor area in square feet (length x width of the containment floor in feet) and multiplying it by the average height in feet of the containment. This provides the total volume of the containment in *cubic feet*.
2. Take the recommended ventilation rate in ACH (air changes per *hour*) and divide it by 60. This is the recommended air changes per *minute*.
3. Multiply the recommended containment ventilation rate in air changes per *minute* by the total volume of the containment in *cubic feet*. This number provides the minimum required capacity of the exhaust fan needed in cubic feet per minute (CFM).

Example:
An individual is applying SPF to create an unvented attic in a home, as shown in Figure 5. The floor space of the attic is a simple 30' wide by 40' rectangle. The peak of the roof is 6 feet above the attic floor. Assume a ventilation rate of 30 ACH is specified by the SPF manufacturer. What size fan is needed? Assume the entire attic defines the containment zone.

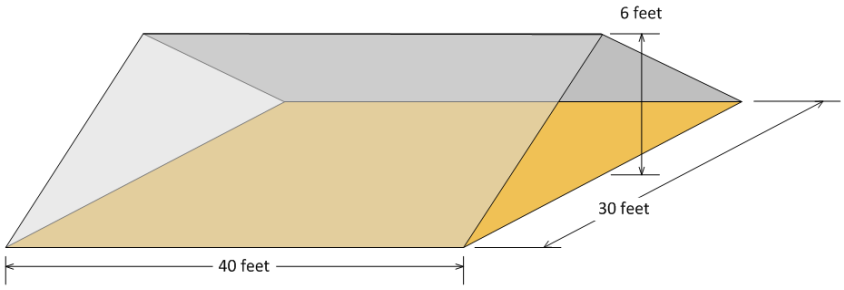

FIGURE 5 – Diagraph of Attic

1. *Determine the attic (containment zone) volume in cubic feet:*
   a. *Area of attic floor = 30' x 40' = 1200 sq. ft.*
   b. *Volume of attic = 1200 sq.ft. x (½) x 6' = 3600 cu.ft.*
2. *Convert the recommended ventilation rate to air changes per minute:*
   a. *30 ACH / 60 = 0.5 air changes per minute*

3. *Calculate the minimum fan size (larger is better):*
   a. *0.5 x 3600 = 1800 CFM*

This information is provided as an example only.

Remember the following:

1. Attachments and accessories such as ductwork, ductwork fittings and filters can substantially reduce the rated air flow performance of any fan system. Check with the fan manufacturers to confirm how to properly size the fan.
2. The size of the containment and the desired ventilation rate may exceed the rated performance of the fan systems. In this case, multiple exhaust and supply fans may prove necessary to achieve the required air flow (supply and exhaust) or the size of the containment may need to be reduced.

Contractors can purchase the necessary fans, ductwork and other equipment to create a complete ventilation system. For example, compact, portable and powerful fans are axial blower fans as shown in Figure 6. These fans, typically about 8-12" in diameter are easy to move around the jobsite, and provide a direct controllable air flow pattern. Axial fans of this size can provide unrestricted flow rates of over 2,000 CFM that may be adequate for small homes or partitioned containment areas in larger homes and buildings, but users need to review the manufacturer's recommendations.

FIGURE 6 – Flexible Duct Attached to Axial Fan

Portable axial blower fans can be connected to flame-resistant flexible ducts that can be easily positioned inside the containment area, as shown in Figure 8. Duct lengths of around 25 feet help to be able to reach more points within the containment area to reduce the number of stagnant air spaces.

If there is no easy access to fans with two different flow rates, one can use different size ducts to provide different fan flow rates for the same fan. For example, a 12" diameter fan may be rated at 2,200 CFM of free air flow (using a 12" duct with no 90 degree elbows). The same 12" diameter fan may have a reduced flow rate of 1,700 CFM when connected to an 8" hose with an adapter. For example, using a 12" duct for the exhaust system, and an 8" duct and adapter for the supply system could provide the necessary flow rate difference. Alternately, the same duct sizes can be used on both the exhaust and supply system when a damper or 'valve' is placed in the supply system to throttle the supply air flow. Observe the plastic film used to isolate a spray area to see if negative pressure is being created (film tends to move inward to the space being sprayed) or use a smoke stick to check proper air flow.

FIGURE 7 – Filtration Box for Exhaust System Inlet

Also, a good worksite hygiene practice is to consider using and labeling specific fans and ducts for supply or exhaust system use only.

Consider how to filter the exhaust air. For example, some fan manufacturers provide filter boxes as accessories as shown in Figure 7. Remember that the purpose of this filter is to protect the downstream equipment, not to remove allergens and dust.

The example provided about using separate supply and exhaust systems is representative. There are other ways to deliver sufficient ventilation rates and negative containment pressurization on a given SPF jobsite. Truck or rig mounted ventilation systems may be used. Another example is the use of an axial exhaust system with a blower-door fan to provide supply air.

What to consider when using an exhaust and supply ventilation system during installation

The setup of the ventilation system can be challenging, especially when working in the attic or crawlspace of an existing home. When applying SPF in a typical room, a configuration as shown in Figure 4 may be used.

When working in an attic or crawl space of an existing home, finding the needed openings for the supply and exhaust ducts can be difficult. Consider whether it is difficult or unsafe to run both the exhaust and supply ducts through a small scuttle hatch into the attic or crawl space. If the hatch is not used for both the exhaust and supply, consider connecting the supply duct to an existing external opening, such as a gable or soffit vent or an attic fan opening, and not foam over it initially. If this option is undertaken, consider spraying a piece of foam (or use boardstock foam) that can be cut to fit into the opening after the ventilation time period is completed. Consider using a low-pressure spray foam system to adhere the foam "patch" in place and caulk the crack between the patch and the remainder of the surface. An additional option is to create a supply duct opening in the ceiling of a concealed area like a closet (with the owner's permission). With any option chosen, direct the exhaust duct to a safe outside location. An example is provided in Figure 8.

Remember that the ducts in the work zone could create excessive trip hazards or limit emergency egress.

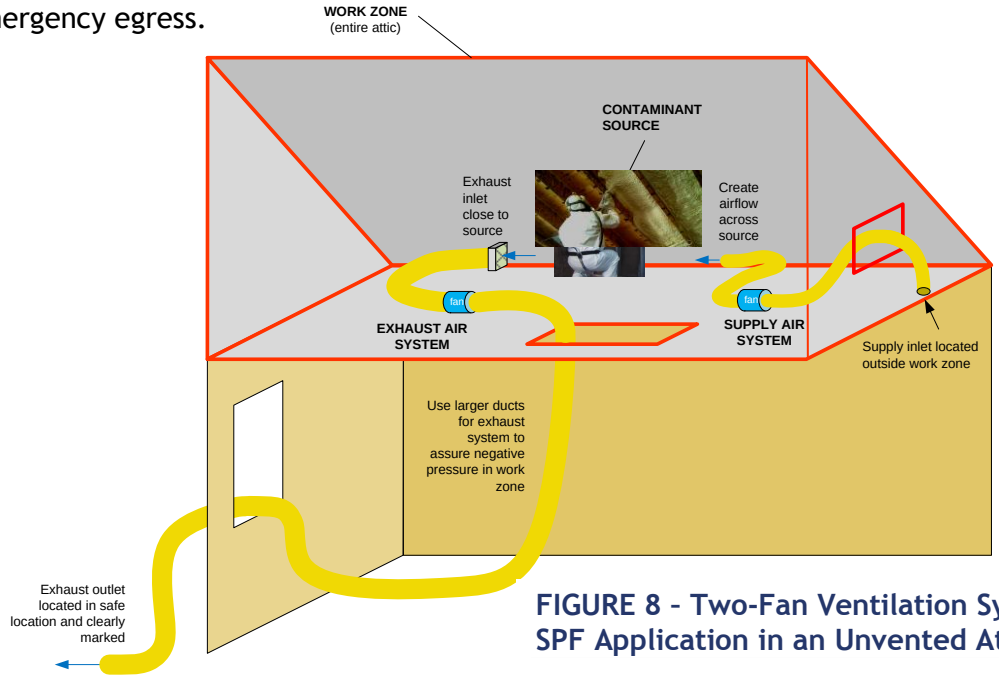

FIGURE 8 – Two-Fan Ventilation System for SPF Application in an Unvented Attic

What to consider when determining how long to continue ventilation after installation

After foam is applied, continue to follow the manufacturer's instructions regarding ventilation rate and duration to ventilate the work zone. Some of the factors affecting the ventilation period include specific foam formulations and cure times, ventilation rate and ambient temperature and humidity inside the containment. During this time, reentry includes only persons with appropriate PPE. Occupants can re-enter after the manufacturer's stated reentry time.

What to consider when thinking about extended ventilation

In some cases, extended ventilation may be helpful or desired. For example, older homes may have odors in the attic from mold, rodent and bat droppings and small animal carcasses. In these cases, extended ventilation may be helpful. Contractors may opt to leave the existing ventilation system in place, or may choose to use an alternate system such as an exhaust-only system. Check with the SPF manufacturers for extended ventilation rates, which may be much lower than the rate used during and shortly after SPF application.

For extended ventilation, a smaller exhaust-only system may be used where the outlet of the exhaust only system is positioned in a safe location. Another option is to use a heat recovery ventilator (HRV) or energy recovery ventilator (ERV) installed inside the containment area, which is an example of an energy-efficient means to provide extended ventilation (shown in Figure 9). If this option is utilized, the exhaust line is disconnected from the vent opening (A), a fire-damper grille is installed on the opening, and the exhaust line is positioned in the attic (B) far from the disconnected vent. Read and follow the HRV/ERV manufacturer's recommendations if this extended ventilation option is utilized. This configuration can provide extended ventilation for several days after which the contractor re-installs the exhaust duct when the extended ventilation is complete.

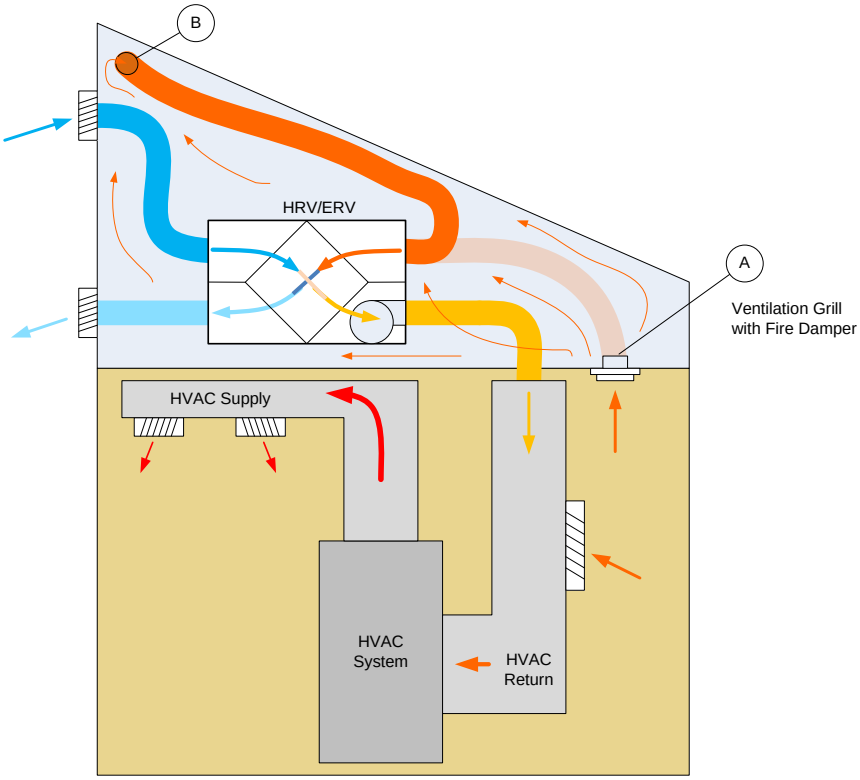

FIGURE 9 – Extended Ventilation using HRV/ERV System

In Summary:

- During and shortly after high pressure SPF installation in indoor applications aerosol mists and vapors can be generated at levels over the occupational exposure level (OEL) or at levels that could be harmful to some individuals.[b]
- To protect workers and others against exposure, the SPF contractor is required by OSHA to establish engineering controls and ensure proper personal protective equipment is utilized by their employees in the work zone.
- Engineering controls for high-pressure SPF application can include establishing a containment zone that is mechanically ventilated using adequately-sized exhaust and supply air systems.
- Ventilate the SPF work zone during application and after spraying based on SPF manufacturer's installation instructions.
- Consult with the SPF manufacturer to determine the recommended reentry and re-occupancy times for the particular job and SPF in use.
- Consider extended ventilation to remove odors.

How Can I Get More Information on SPF Ventilation

- Contact the SPF product manufacturer or supplier, or contact an industrial ventilation equipment supplier.
- Refer to information posted on CPI's SPF chemical health and safety website at www.spraypolyurethane.com.
- Consult the National Institute for Occupational Safety and Health (NIOSH) by either calling 1-800-CDC-INFO or by visiting the NIOSH website.
- Refer to EPA's Ventilation Guidance for Spray Polyurethane Foam Application[1]
- Guidance on Best Practices for the Installation of SPF[8]

Disclaimer: This guidance document was prepared by the Spray Foam Coalition of the American Chemistry Council's Center for the Polyurethanes Industry. It is intended to provide general information to professional persons who may be involved in installing spray polyurethane foam. It is not intended to serve as a substitute for in-depth training or specific construction requirements, nor is it designed or intended to define or create legal rights or obligations. It is not intended to be a "how-to" manual, nor is it a prescriptive guide. All persons involved in construction projects including spray polyurethane foam have an independent obligation to ascertain that their actions are in compliance with current federal, state and local laws, codes, and regulations and should consult with legal counsel concerning such matters. The guidance is necessarily general in nature and individuals may vary their approach with respect to particular practices based on specific factual circumstance, the practicality and effectiveness of particular actions and economic and technological feasibility. Neither the American Chemistry Council, nor the individual member companies of

[b] Not all SPF component chemicals have OELs.

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References

[1] "Ventilation Guidance for Spray Polyurethane Foam Application," published by the U.S. Environmental Protection Agency (EPA), online at www.epa.gov/dfe/pubs/projects/spf/ventilation-guidance.html

[2] "Health and Safety Product Stewardship Workbook for High-Pressure Application of SPF," published by the American Chemistry Council's Center for the Polyurethanes Industry, available online at www.spraypolyurethane.org/Workbook/

[3] "Personal Protective Equipment Sheet," published by the American Chemistry Council's Center for the Polyurethanes Industry, available online at http://www.spraypolyurethane.org/ppe_sheet

[4] Wood, Richard. "CPI Ventilation Project Phase 1 and Phase 2 Update." Presented at the CPI Technical Conference, September 2012.

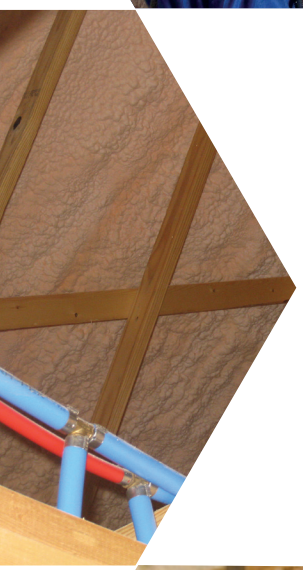
[5] Robert, William, James Andersen, Richard Wood, and Mary Bogdan. "Ventilation and Re-Occupancy of a Residential Home Sprayed with High Pressure Polyurethane Foam." Presented at the CPI Technical Conference, September 2012.

[6] Code of Federal Regulations Title 29 CFR §1926.20 Safety and Health Regulations for Construction: General Safety and Health Provisions available online at www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=STANDARDS&p_id=10606

[7] "Good Practices – Engineering Controls and Ventilation," published by the American Chemistry Council's Center for the Polyurethanes Industry, available online at: www.spraypolyurethane.org/GoodPractices#EngineeringControls

[8] http://polyurethane.americanchemistry.com/Spray-Foam-Coalition/Guidance-on-Best-Practices-for-the-Installation-of-Spray-Polyurethane-Foam.pdf

Guidance on Best Practices for the Installation of Spray Polyurethane Foam



Guidance for Residential Homes and Commercial Buildings

Spray Foam Coalition
of the ACC Center for the Polyurethanes Industry

American® Chemistry Council | Spray Foam Coalition

The Center for the Polyurethanes Industry (CPI) of the American Chemistry Council serves as the voice of the polyurethanes industry in North America and works with polyurethane trade associations across the globe. CPI members are companies that produce and sell the raw materials and additives that are used to make polyurethane products, equipment used in the manufacture of polyurethanes, and companies engaged in end-use applications and the manufacture of polyurethane products.

The Spray Foam Coalition (SFC) champions the use of spray polyurethane foam in U.S. building and construction applications and promotes its economic, environmental and societal benefits while supporting the safe manufacture, transport, and application of spray polyurethane foam. SFC consists of manufacturers of spray polyurethane foam systems as well as suppliers of raw materials and machinery used to apply the foam.

Introduction

In recent years, spray polyurethane foam (SPF) insulation has seen significant growth in both general interest and acceptance as a high-performance solution to seal and insulate the entire building envelope. SPF insulation is energy efficient, durable, and helps create a comfortable building environment by helping keep homes warm in the winter and cool in the summer. Because it is sprayed directly into the gaps, cracks, and other surfaces that contribute to heat loss, SPF both insulates and air seals, offering an easy and effective way of weatherizing existing buildings and new construction.

The Spray Polyurethane Foam Installation Guidance is intended to provide an overview of best practices to help professional installers use SPF effectively and efficiently to insulate homes and commercial buildings. It discusses considerations for the use and handling of materials as well as steps that help make the jobsite safe and secure. It also addresses health and safety hazards and offers steps to avoid potential issues. Steps and tips for installing, measuring, and inspecting SPF are included to supplement those offered by the manufacturer. Product-specific steps provided by the manufacturer and code requirements override the steps offered here, so always verify with your specific manufacturer what steps to take on a specific project. Finally, the document offers resources and references to help the installation proceed more smoothly. This document does not substitute for the extensive training provided by manufacturers and industry organizations associated with the manufacture and installation of SPF, nor does it provide detailed information on many of the areas covered in that training. It is designed to outline best practices and to provide helpful information to professional practitioners in the field and homeowners wanting to know what to expect from their spray foam contractor.

SPF insulation is created onsite using liquid components and equipment that could pose a potential hazard, especially to those having no experience or training in polyurethane chemistry and applications. Therefore, it is essential that SPF installers and SPF component suppliers work towards ensuring every SPF installation is done properly and with the utmost consideration for health and safety, both on the jobsite and the surrounding area.

This SPF Installation Guidance focuses on SPF application in residential and commercial buildings within the building envelope. While there are many similarities in requirements and procedures between high and low pressure SPF applications, there are some distinct differences. Where these occur, this guidance attempts to highlight the differences between the two products and their application, but always refer to the SPF manufacturer's instructions and Material Safety Data Sheets (MSDS) for more precise information.

The following pages will provide the reader with useful guidance and best practices related to:

1. **Training**
2. **Health and Safety**
3. **Jobsite Practices**
4. **SPF Application on the Jobsite**
5. **Post-Application Inspections**

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What is Spray Foam?

Spray polyurethane foam (SPF) is a spray-applied plastic that can form a continuous insulation and air sealing barrier on walls, roofs, around corners, and on all contoured surfaces. It is made by mixing and reacting unique liquid components at the job site to create foam. The liquids react very quickly when mixed, expanding on contact to create foam that insulates, seals gaps, and can form moisture and vapor barriers. SPF insulation is known to resist heat transfer extremely well, and it offers a highly effective solution in reducing unwanted air infiltration through cracks, seams, and joints.

Types of Spray Polyurethane Foam

There are three primary types of SPF that can be used for insulation and other specific purposes:

High Density: often used for exterior and roofing applications
Medium Density: often used for continuous insulation, interior cavity fill, and unvented attic applications
Low Density: often used for interior cavity fill and unvented attic applications

Medium and High Density SPF are frequently called "closed-cell foam" because they use an internal closed cell structure that improves thermal resistance and other properties. Low Density SPF is frequently called "open-cell foam" because the cell structure includes tiny holes in the cells to provide improved drying capability and flexibility.

Each product offers unique benefits that a professional SPF contractor can explain and help people determine which types of foam will be most appropriate for a specific building, climate, and project. Beyond the structure of the foam itself, the other significant difference relates to how it is created and installed. The main delivery systems include:

- **High-pressure, two-component foam**
- **Low-pressure, two-component foam SPF kits**

High-pressure, two-component foam is often used to insulate large areas on new construction or major renovations of walls and roofing systems. For a typical high-pressure SPF application, a spray rig (truck or trailer) that houses the spray foam ingredients, air supply and other items is parked near the building to be sprayed. Hoses up to about 300 feet in length deliver the liquid ingredients to the application area.

Low-pressure, two-component SPF kits or refillable cylinders are smaller, portable systems that can insulate and air-seal small to mid-sized areas. This type of foam is usually applied around duct work, electrical or piping penetrations, rim joists and roof repairs. Both high-pressure and low-pressure foams are applied by professional spray foam applicators.

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1) Training and Advanced Preparation Best Practices

Prior to working with spray polyurethane foam (SPF) component materials, process equipment, or performing actual SPF installations, employees of an SPF installation company should receive training. Proper initial training and regular "refresher" training of all those involved with SPF operations can help prevent poor installations, accidents, and overexposure to SPF chemicals to workers and bystanders.

Below is a list of some of the training programs that an SPF installation company can use to train employees involved with SPF operations.

Occupational Health & Safety Administration (OSHA)

Outreach Class for Construction: 10-hour version or 30-hour version – this course provides general training for workers and employers on the recognition, avoidance, abatement, and prevention of safety and health hazards in workplaces and is not specific for spray foam installation.
http://www.osha.gov/dte/outreach/index.html

SPF Manufacturers' Training

Several SPF component material suppliers offer training for handling and use of SPF component chemicals and the installation of SPF products.

Contact your SPF component material supplier directly for information regarding available training programs.

Center for the Polyurethanes Industry (CPI)

CPI Spray Polyurethane Foam Health and Safety Training
http://www.spraypolyurethane.org/SPF-Chemical-Health-and-Safety-Training

CPI Health and Safety Product Stewardship Presentation for High-Pressure Application of SPF
http://www.spraypolyurethane.org/Presentation

CPI Health and Safety Product Stewardship Workbook for High-Pressure Application of SPF
http://www.spraypolyurethane.org/Workbook

Spray Polyurethane Foam Alliance (SPFA)

SPF Accreditation Program
http://www.sprayfoam.org/index.php?page_id=372

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2) Health and Safety Best Practices

Introduction to Health and Safety Considerations when Working with SPF

During installation, health and safety are important considerations. However, once properly installed and allowed time to cure, SPF is considered to be relatively inert by the Environmental Protection Agency (EPA). This section will discuss the potential hazards during SPF application; proper handling of component chemicals; jobsite first aid and safety practices; and use of appropriate personal protective equipment while handling SPF chemicals.

The information presented here is in summary form. More in-depth information about the health and safety aspects of SPF is available at www.spraypolyurethane.org. There you will find information, guidance documents, health and safety training materials and more.

2.1) Chemicals

Overview of Spray Polyurethane Foam

Spray polyurethane foam is a thermoset cellular plastic insulating material formed by combining methylene diphenyl diisocyanate (MDI) and a polyol blend. The reaction between these two materials releases heat and within a few minutes foam is formed and is typically no longer tacky or sticky. In the United States, MDI is known as the A-Side and the polyol blend is known as the B-Side.

Figure 1: Drums strapped inside truck

Component Materials Health Risks
MDI (A-Side or Isocyanate Side):

MDI has a potential risk of irritation and sensitization through inhalation and skin contact. Exposure can affect skin, eyes, and lungs. Once sensitized, continuing exposure can cause persistent or progressive symptoms and even life-threatening asthmatic reactions, so remove sensitized people from potential exposure activities. Wear the proper personal protective equipment (PPE) when working with MDI (See section 2.3). See the manufacturer's Material Safety Data Sheet (MSDS) for more detailed information on potential health effects[1].

[1]OSHA is modifying their Hazard Communication Standard to adopt the Globally Harmonized System and the transition is scheduled to be complete by the end of 2015. MSDSs will be called Safety Data Sheets (SDS) under the new requirements, so while this document will use the term MSDS, SDS is equally applicable for companies that have transitioned to utilizing the new standard.

Polyol Blend (Resin or B-side):

The B-side formulations for SPF use five basic chemical classes: polyols, blowing agents, catalysts, flame retardants and surfactants. The polyol blend has a potential health risk of irritation to the respiratory system, skin, and eyes. Wear the proper PPE when working with polyol blends. See the manufacturer's MSDS for more detailed information on potential health effects.

Cured Foam:

The polyurethane foam that forms from the reaction of the A- and B-side chemicals is considered essentially inert and non-hazardous when properly installed and cured. Avoid exposing the polyurethane foam to extreme heat (→200°F) or open flame due to the possibility that such extreme heat can ignite the foam.

Material Safety Data Sheet (MSDS)

Before using any SPF product, read and understand the entire MSDS for the material. The MSDS contains very important information about the product, including the chemical constituents and the approximate concentrations; potential health effects; appropriate PPE for the job; first aid measures; information on how to handle accidental releases; and information on storage, handling, transportation, and disposal. It is an OSHA requirement to make MSDSs readily accessible at a jobsite. Keeping one clean copy of each current MSDS in a clearly marked binder is a good practice that helps keep the information readily accessible for employees and first responders. As noted above, OSHA is revising their Hazard Communication Standards and the term "Safety Data sheets" will replace MSDSs. *(http://www.spraypolyurethane.org/WorkerProtection#MSDS)*

Figure 2: MSDS

Handling and Storage Considerations for the Chemicals

It is important that SPF component chemicals are stored properly before and during use on the jobsite. Improper storage conditions can reduce shelf life and make the components unusable. It is also important to store incompatible materials separately. Storing drums in a secured, cool area away from direct sunlight, excessive heat, and general storage areas helps protect them. Consult the manufacturer's instructions for the recommended temperature at which to store drums. Ventilate the storage space as described by the manufacturer and locate the storage space away from possible sources of ignition.

Store MDI (A-side) drums in locations that limit the risk of contact with water, acids, caustics (such as lye), alcohols, and strong oxidizing and reducing agents. Oxidizing agents include oxygen and chlorine. Oxidizers can be recognized by a yellow diamond-shaped label marked "oxidizer." Most strong reducing agents also are corrosive. These can be identified by a half-black, half-white diamond-shaped label marked "corrosive." MDI contact with any of these materials could trigger a violent reaction that could cause significant damage or injury. In addition to storing containers away from incompatible materials, it is important to maintain a tight seal on MDI containers to protect against moisture or direct contact with water. Water reacts with MDI to release carbon dioxide gas. If high levels of carbon dioxide gas accumulate inside a sealed container, the drum can rupture or explode.

Figure 3:
Be sure to dispose of drums properly

When opening the "B-side" drums, slowly open the bung or stopper to help release any built-up pressures, allowing the drum to be opened safely. This is especially important when the B-side contains a physical blowing agent such as in closed cell SPF.

Disposal

Follow proper disposal procedures for all drums, cans, and cylinders in accordance with legal, federal, state, and local requirements. Consult the MSDS for information on proper disposal procedures. Note that in drum systems, small amounts of unused A-side chemicals can be reacted with small amounts of unused B-side chemicals to produce foam. Cured foam does not meet the criteria of a hazardous waste according to Resource Conservation and Recovery Act (RCRA) and can typically be disposed of as non-hazardous waste. Wear appropriate PPE at all times when handling SPF chemicals and the drums containing these materials. Consult the manufacturer's MSDS for specific information about PPE and for disposal guidance on unused chemicals and empty containers. The Reusable Industrial Packaging Association (RIPA) can assist in locating a qualified container reconditioner in your area.
(http://www.reusablepackaging.org/find-a-member)

2.2) Personnel

Hazard Communication

The OSHA Hazard Communication (HazCom) Standard was designed to provide employees with information on the identities and hazards of all hazardous chemicals used in the workplace and recommended protective measures. According to the OSHA Hazard Communication Standard (29 CFR 1910.1200), all employers are required to have a written hazard communication program. The OSHA standard includes requirements for container labels, MSDSs, and employee training.

Systems have been developed for labeling potentially hazardous chemicals. The two common examples are the Hazardous Material Identification System (HMIS) and the National Fire Protection Association (NFPA) system. The HMIS refers to hazards during anticipated use while the NFPA system describes hazards under fire conditions. Please note these two systems may have different hazard categories for the same material.

OSHA has revised its Hazard Communication Standard, aligning it with the United Nations' Globally Harmonized System (GHS) of classifying and labeling chemicals, and it will be fully implemented in the United States by 2016. During the transition period, chemical manufacturers, importers, distributors and employers may comply with the new standard, the current standard, or both. For more information, go to: *http://www.osha.gov/dsg/hazcom*.

Employee Training and Certification

Proper training before handling SPF chemicals is important. Contractors, applicators, and helpers can receive training from various sources, including manufacturers' programs, the Spray Polyurethane Foam Alliance (SPFA) Accreditation courses, and CPI SPF Chemical Health and Safety Online Training, among others. Please see Section 1 on Training and Advanced Preparation for more specifics.

Confined Spaces

Some attics and crawlspaces could fall within the OSHA definition of "confined spaces" in the code of federal regulations. Work in confined spaces should comply with the requirements specified in the OSHA Safety and Health Regulations for Construction, specifically 29 CFR 1926.21. OSHA requires that workers be instructed in the nature of the hazards involved, precautionary measures to be taken, personal protective equipment needed, and emergency procedures.

Fall Protection

OSHA requires that employees receive training in the following areas prior to assignment to work projects (OSHA Standard 29 CFR 1926.503):

- Nature of fall hazards in the work environment
- Correct procedures for erecting, maintaining, disassembling, and inspecting fall protection systems
- Role of each employee in a safety monitoring system when the system is in use
- Correct procedures for handling and hoisting materials and equipment
- Correct procedures for working with ladders, scaffolding, and aerial lifts

Use guardrails, warning lines, safety monitoring, and personal fall arrest systems as described in applicable regulations. A fall protection plan is required by OSHA for each project if the worker is to be six feet off the ground or higher.

First Aid

Read the MSDS: It is critical to be familiar with the MSDS in advance to know the proper first aid procedures for the SPF component chemicals on the jobsite.

Figure 4: Safety data sheets or MSDS

Inhalation Exposure: Avoid breathing vapors or mists of A-side or B-side chemicals at all times to avoid potential exposure. The appropriate product safety information, such as the MSDS and the chemical manufacturer's documentation, will provide installers with more information. If someone is affected by inhalation of A-side or the B-side chemicals, move them to an area with fresh air immediately and seek medical attention. High concentrations of the blowing agent, typically included on the B-side, can reduce oxygen concentrations available for breathing. Inform individuals involved in incidents that the onset of symptoms may occur or become worse several hours after the exposure.

Skin Contact Exposure: If someone is exposed to SPF component chemicals through skin contact, shower or splash the affected area with large amounts of water to cleanse the skin and then wash with soap and water. Corn oil or propylene glycol can be more efficient than water at removing MDI from the skin. Review the MSDS for more information on skin contact exposures. Remove contaminated clothing and discard. Consider seeking medical attention if skin contact is extensive or if irritation develops or persists. If a cut or abrasion is received while handling pressurized fluid, seek emergency care immediately because the chemical may have entered the wound. Do not treat as a simple cut despite appearances and provide medical personnel with a copy of all relevant MSDS documents.

Eye Contact: For eye contact with SPF chemicals, flush the eye(s) immediately for at least 15 minutes with large amounts of lukewarm water. Seek professional medical attention as soon as possible. Review the MSDS for additional information.

Ingestion: If SPF chemicals are ingested, do not induce vomiting. Obtain professional medical attention as soon as possible and refer to the MSDS.

Respiratory Protection Considerations (High Pressure Products)

Properly designed ventilation can reduce airborne levels of aerosols, mists, and vapors generated during spray application and can help protect SPF applicators, helpers, and others who may be working in adjacent areas. During and after spray application, vapors and mists as well as particulates and dust from trimming or sanding the foam can linger until the area is ventilated and fully cleaned. Carefully schedule construction activities so that no other trades or occupants are in the area during SPF Installation.

Figure 5: Full-face Supplied Air Respirator (SAR) with portable breathing air compressor

During application, airborne levels may exceed the exposure guidelines; therefore, use proper PPE. OSHA's Respiratory Protection Standard (29 CFR 1910.134) sets forth the requirements for respiratory protection. Supplied air respirators (SAR) are typically used in interior applications. Air purifying respirators may be adequate in exterior (outdoor) applications. Refer to the NIOSH Respirator Decision Logic for more information regarding respirator selection at *www.cdc.gov/niosh/docs/2005-100/pdfs/05-100.pdf*. The OSHA Respiratory Protection Standard (29 CR 1910.134) requires employers to have a written respiratory protection program when employees are required to use respiratory protection. The Standard outlines requirements for respirator selection, respirator maintenance, annual fit testing, medical surveillance, and annual training.

Low Pressure Products: As for high-pressure products, during use of low-pressure products, airborne levels may exceed the exposure guidelines; therefore, use proper PPE. OSHA's Respiratory Protection Standard (29 CFR 1910.134) sets forth the requirements for respiratory protection. Use a NIOSH approved air purifying respirator equipped with an organic vapor cartridge and a particulate pre-filter. If airborne levels exceed 10 times the threshold limit value (TLV) or the permissible exposure limit (PEL) for which an air-purifying respirator is effective, use a powered air purifying respirator (PAPR). Additional information on low pressure products can be found here: *http://spraypolyurethane.org/Main-Menu-Category/Weatherization-Contractors/Installing-SPF*.

Eye Protection Considerations (High Pressure Products)

Figure 6: Chemical resistant safety goggles

Appropriate eye protection helps protect eyes from splashes of liquid SPF component chemicals; accidental sprays of reacting foam, aerosols, and particulates that are likely to be present during spraying; and airborne particulates associated with sanding and grinding operations. The type of eye protection needed depends on the nature of the activity. Persons handling liquid SPF chemicals in open containers can protect their eyes by wearing safety goggles or safety goggles in combination with face shields. During the application of SPF, eye protection may be provided by wearing a hooded or full-face respirator. In addition to proper eye protection, a portable eyewash station available in the rig/ truck or directly in the work area and properly covered can be helpful.

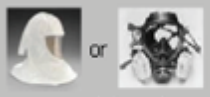
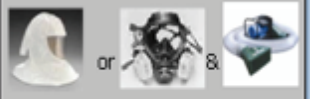
	Low Pressure			High Pressure
	One-component Cans	Two-Component Kits	Refillable Systems	High Pressure Spray Systems
				
Routes of Exposure	PPE	PPE	PPE	PPE
Eyes	Safety Glasses 	Safety Glasses  Goggles	Safety Glasses  Goggles	 FF Mask/ Hood
Skin	Long Sleeves 	Long Sleeves 	Long Sleeves 	Full Body Suits 
Hands	Gloves 	Gloves 	Gloves 	Gloves 
Lungs	Avoid Breathing Vapors  Provide Good Ventilation	Respirator  Air Purifying OV / Pre-filter Provide Good Ventilation	Respirator  Air Purifying OV / Pre-filter Provide Good Ventilation	Air Supply  FF Mask/ Hood *or* FF Air Purifying Airline OV/Pre-filter Provide Good Ventilation

Figure 7: PPE guidance for applicators and helpers

Low Pressure Products: Appropriate eye protection for low pressure application can include safety glasses with side shields or goggles. These can protect against accidental sprays of reacting foam, vapors that are present during spraying, and airborne particulates associated with trimming the cured foam.

Clothing

Wear appropriate protective clothing whenever there is a possibility of direct contact with SPF component chemicals. Appropriate protective clothing varies depending upon the potential and type of exposure, such as for liquid chemicals versus particulates. Applicators and helpers typically wear disposable coveralls to keep spray and mist from contacting skin and clothing. Launder non-disposable clothing that is exposed prior to wearing again. For proper skin protection, wear PPE in such a manner that no skin is exposed.

Gloves

Gloves made of nitrile, neoprene, butyl, or PVC generally can provide adequate protection against A-side materials. The same protection is generally considered adequate to provide B-side protection as well. Consult the manufacturer's MSDS for specific information about B-side protection. A range of glove sizes are available. Gloves which are too large or too small for the user may not provide proper protection. Fabric gloves, fully coated with nitrile, neoprene, butyl, or PVC typically can also provide good protection for SPF applicators.

2.3) Equipment

Potential Skin Injection Hazard

High-pressure fluid from leaks can potentially inject fluid into the body. High-pressure fluid from dispensing devices, hose leaks, or ruptured components could pierce skin. This may look like just a cut, but it can be a serious injury in need of immediate medical attention. The following safety tips can help avoid injury, including possible amputation.

- In case of skin injection, get immediate medical treatment.
- Inspect hose before each use for cuts, bulges, kinks, or any other damage. Replace damaged hose immediately.
- Check hoses and couplings daily. Replace worn or damaged parts immediately.
- Engage trigger lock when not dispensing.
- Do not point dispensing device at anyone or at any part of the body.
- Do not put your hand over the fluid outlet.
- Do not stop or deflect leaks with your hand, body, glove, or rag.
- Follow the Pressure Relief Procedure when you stop dispensing and before cleaning, checking, or servicing equipment.
- Tighten all fluid connections before operating the equipment.
- Keep clear of leaks.
- Follow hose maximum pressure or temperature ratings.
- Use chemicals that are compatible with the hose materials you are using.

Equipment (Low Pressure Products): When working with low pressure products, avoid kinking or folding the hoses and secure all fittings before use. Keep the outlet ports of the dispensing unit free from any dust, dirt, or chemical that can affect the proper sealing of the nozzles. Also, keep outlet ports pointed away from persons while opening outlet port valves and leave chemical in the hose for storage.

Electrical

Electric power lines near a worksite can be a source of ignition and other extreme hazards, including shock and electrocution. If you notice downed power lines in the area, secure all ignitable materials and evacuate personnel until the lines are repaired. Never let equipment touch or come close to overhead electric lines or other sources of electricity.

For work near energized equipment, follow the OSHA standards (29 CFR § 1926.417 or 1910.147) to properly lock out or tag out machines and equipment during repair or servicing activities.

Ground any electrical equipment used as part of the SPF application to prevent electrical shock or electrocution. This is especially important when working near water or on damp or wet floors and roofs. Ground or bond all process equipment and containers of flammable materials (e.g. cleaning solvents). Remember that plastic containers used to transport solvents cannot be grounded. Use non-sparking tools (such as those made of brass or aluminum) where flammability may be a concern. Employers on construction sites are required by OSHA to use either ground fault circuit interrupters (GFCI) or an Assured Equipment Grounding Conductor Program (AEGCP) to protect employees from the risk of electrocution or shock. There are several different means of employing a GFCI: (a) as an attachment to an appliance cord, (b) installed at the breaker panel, or (c) provided at the receptacle.

Extension cords are considered to be temporary wiring; therefore, consider using ground fault protection with all extension cords on construction sites. All 120-volt, single-phase 15-ampere and 20-ampere receptacle outlets on construction sites that are not a part of the permanent wiring of the building or structure and which are in use by employees need to have approved GFCIs for personnel protection. Your local electrical code will have detailed grounding and bonding instructions for your area and type of equipment. Consult the equipment manufacturer's instructions for specific instructions.

2.4) Fire

Install SPF in accordance with the chemical component manufacturer's recommendations. Do not use open flames, cutting and welding torches, and lighted pipes, cigars, and cigarettes in and adjacent to chemical storage and installation areas. Post clearly visible warning signs in all sprayed areas and do not expose SPF to flames or to the sources of intense heat (→200°F). Provide fire extinguishing equipment at both storage and installation sites. As described in more detail in Section 4, applying too much SPF per pass, without allowing appropriate time for the foam to cool, can also create a fire hazard resulting from too much heat from the reaction and spontaneous combustion. Following the manufacturer's guidance is important. Consider disposing of waste insulation daily in a designated location with due regard for its combustible characteristics. Since large buns of waste insulation can create internal temperatures high enough to cause smoldering or fire, cut open the buns, douse with water, and allow adequate time to cool prior to disposal to minimize the risk of a fire.

CPI has created a fire safety guidance document for working with polyurethane foam products: *http://polyurethane.americanchemistry.com/Resources-and-Document-Library/11365.pdf.*

Figure 8: Provide fire extinguishing equipment

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3) Jobsite Safety & Preparation Best Practices

Introduction to Jobsite Safety when working with SPF

Jobsite safety is always an important consideration when working with SPF. This section goes into greater detail about what to consider when preparing and maintaining a safe jobsite, including documentation, inspections, and guidance for helping keep workers and others from harm.

3.1) Jobsite Safety

Jobsite safety begins long before a crew arrives onsite. A safe jobsite begins with education and training that occurs on a continual basis, not just one time. Know and understand the health and safety best practices outlined in Section 2 of this Installation Guidance and effectively communicate these to all applicable personnel. When employees receive work instructions in languages other than English, employers are required by OSHA regulations to provide training in that language as well.

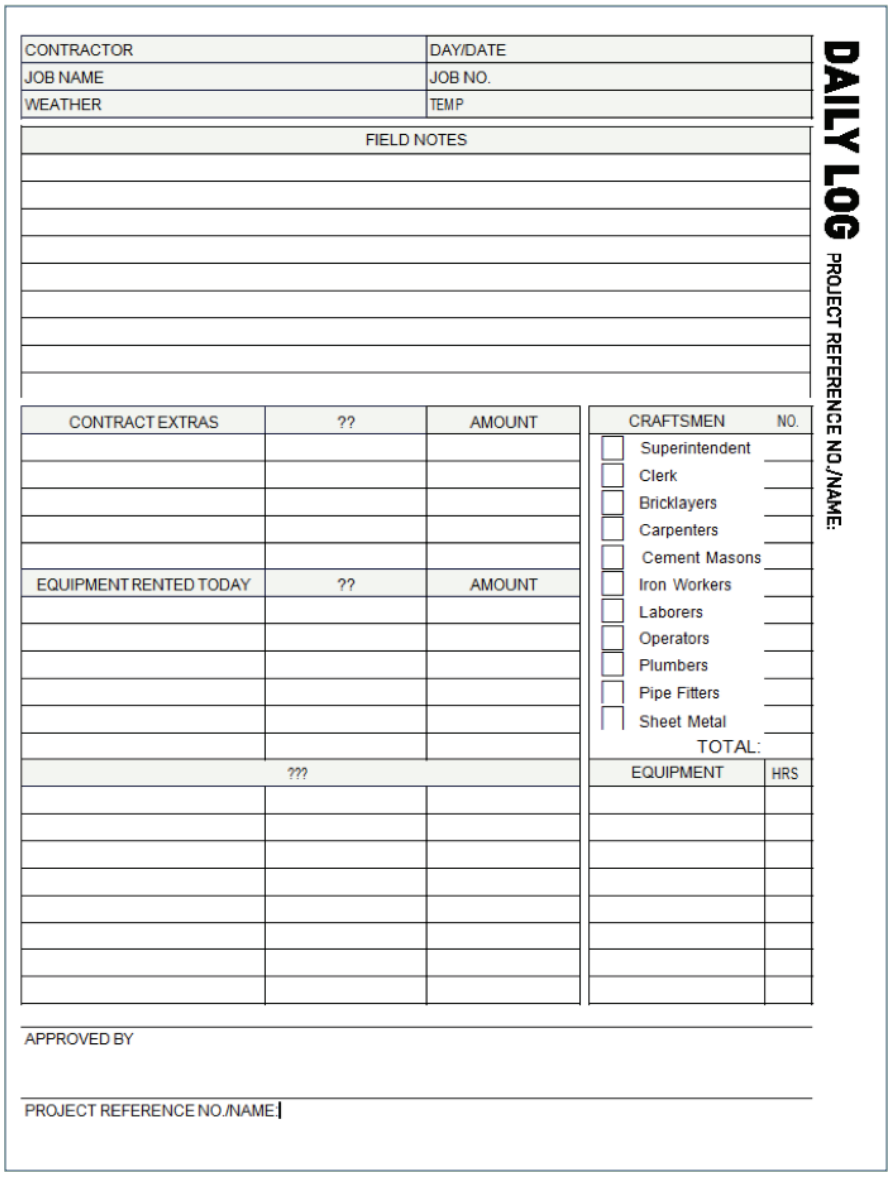
Written Jobsite Safety Plan

A Jobsite Safety Plan can include the following items (a printable version of this sample checklist is available at the end of the document in the Resource section). The checklist below is meant as an example only. Each jobsite may have unique needs to consider and include in the Jobsite Safety Plan.

✔	
	Verification that all personnel read and understand the MSDS for each material involved with the spray polyurethane foam application process.
	A copy of the most current MSDS should be available at all times (i.e. cab of the truck or in the trailer that is transporting the spray equipment).
	Communication procedures between the crew and customer.
	Overspray mitigation plan.
	Proper start-up and shut-down procedures for both SPF process equipment and the customer's equipment (i.e. HVAC system) when applicable.
	Review of Manufacturers Technical Data sheets that detail proper application procedures.
	Onsite review of the jobsite; note any potential safety hazards and special needs.
	Controlling access to the spray area.
	Proper set up for all equipment with particular emphasis on ladders or scaffolding which could present fall hazards.
	Proper set up for establishing the work area and restricting access by posting warning signs.
	Emergency procedures with notification procedures.
	Chemical spillage with current remediation procedures and notification procedures.
	Jobsite location and directions to the jobsite from the nearest major intersection.

Personnel

Daily Work Log: Establish a company daily work log that is for internal use. A daily work log can provide the framework for a company to support safe and consistent operation. The historical data accumulated in a work log can prove invaluable when documenting a work place incident. It is also a good way for a business to monitor equipment, material usage, and quality control. The following is an example of a daily work log (Appendix 8.3):



DAILY LOG

PROJECT REFERENCE NO./NAME:

CONTRACTOR	DAY/DATE
JOB NAME	JOB NO.
WEATHER	TEMP

FIELD NOTES

CONTRACT EXTRAS	??	AMOUNT

EQUIPMENT RENTED TODAY	??	AMOUNT

???		

CRAFTSMEN	NO.
☐ Superintendent	
☐ Clerk	
☐ Bricklayers	
☐ Carpenters	
☐ Cement Masons	
☐ Iron Workers	
☐ Laborers	
☐ Operators	
☐ Plumbers	
☐ Pipe Fitters	
☐ Sheet Metal	
TOTAL:	

EQUIPMENT	HRS

APPROVED BY

PROJECT REFERENCE NO./NAME:

Personal Protection Equipment (PPE): Section 2 on Health and Safety of this Installation Guidance briefly summarizes the OSHA PPE requirements and best practices involved with a spray polyurethane foam application. The OSHA Respiratory Protection Standard (29 CR 1910.134) requires employers to have a written respiratory protection program when employees are required to use respiratory protection.

Additional details regarding several aspects of PPE can be found at the CPI Health and Safety website: *www.spraypolyurethane.org*.

Equipment

Equipment Inspection (Safety) Checklist: Proper equipment care and maintenance is important and a regular focus on the jobsite. A simple equipment inspection checklist that contains a schedule of routine preventative maintenance helps with a long-term, safe, and efficient operation.

Consider a systematic approach that includes routine inspections and daily start-up and shut-down procedures that identify potential safety issues before they occur and reduce the possibility of failing to comply with OSHA requirements.

Figure 9: Routine inspections can prevent safety issues

Items included as part of the inspection routine could include, but are not limited to:

✔ Air and chemical leaks

	Inspect air and chemical lines for signs of wear or fatigue.
	Ensure the compressed air system has the proper OSHA-compliant disconnects.

✔ Proper ventilation of engine exhausts

	Verify adequate ventilation. The buildup of carbon monoxide from engine exhausts can be deadly.

✔ Ladders, scaffolding, and aerial lifts

	Improper use of ladders, scaffolding, and aerial lifts can be a source of jobsite injuries or deaths. **Proper use of ladders, scaffolding and aerial lifts is a major point of emphasis in the overall jobsite safety plan.**
	Consult the OSHA website along with the manufacturers care and use specifications for this equipment.

✔ Hoses, electrical cords and lights

	Use properly rated electrical cords and lights.
	Remove from service cords that are damaged, frayed or spliced.
	Properly ground/bond plugs and receptacles, including ground wire.

✔ Ventilation fans and ducts

	Clean fans and check if fully operational.
	Clean ducts and seal to eliminate leakage.

✔ Chemical storage and handling

	Proper environmental controls to ensure proper storage conditions.
	Proper restraining devices to secure chemicals during transportation.
	Spill control equipment.
	Decontamination solution.

✔ Emergency equipment

	A fully stocked and OSHA-compliant first aid kit.
	Eye wash station.

✔ Fire Prevention

	Fire extinguisher(s) fully charged and accessible.

✔ Other

	Tools, spare parts, and equipment manuals.
	Jobsite Safety Plan.

Material (components of SPF and the final product)

Material Safety Data Sheet (MSDS): Employers are required by OSHA to provide training on MSDSs and employees need to have a full understanding of the contents of an MSDS. Employers are also required by OSHA to have MSDSs readily available on jobsites. Here is an overview of the key sections of most MSDSs for SPF-related chemicals:

Name of Product or Chemical:

- Component A (isocyanate)
- Component B
  (typically includes: polyol, amine catalyst, blowing agent, fire retardant, surfactant)
- Solvents
- Cleaning solutions
- Coatings

Potential hazards:

- Acute and chronic toxicity
- Irritation
- Sensitization

Personal protection equipment (PPE):

- Respiratory protection
- Eye protection
- Gloves
- Disposable coveralls or clothing that protects against exposure
- Boot covers (resistant to wear)

Storage and handling of the chemicals:

- Proper storage conditions for the materials
- Procedure and equipment/supplies to properly contain and clean a spill

Procedures in case of an accidental exposure or overexposure:

- First-aid procedures
- First aid materials to keep on the jobsite

Other information that is provided in an MSDS:

- Fire-fighting measures
- Physical and chemical properties
- Stability and reactivity
- Toxicology
- Disposal
- Transportation
- Regulatory information

Product Technical Data Sheet(s): It is important to have a thorough understanding of the Technical Data provided by the manufacturer of the product. Provide this information to personnel working with the material.

Regulatory Postings Related to the Material Used: Proper regulatory postings are critical from both a safety and legal standpoint. OSHA requires employers to post certain information as outlined in their compliance notifications. Locations can include:

- Company office/warehouse
- Chemical storage area
- Work truck or trailer and the jobsite itself

Consult the OSHA website at *http://www.osha.gov/Publications/poster.html* for a current list of required compliance notifications.

Applicable Safety Standards

When establishing jobsite safety standards, a company needs to refer to the applicable safety standards. These can include, but are not limited to, the following OSHA standards:

- Hazard Communication: 29 CFR 1910.1200 and 1926.59
- Respiratory Protection: 29 CFR 1910 Part 134
- Personal Protective Equipment: 29 CFR 1910 Part 132-138 and 1926.95
- Ventilation: 29 CFR 1910.94 and 1926.57

3.2) Jobsite Preparation

There are many factors to consider when planning any SPF installation, such as the place of work, area of building occupancy, size of work area, and many others. Assess any special requirements or risks before the job starts and develop a plan to address them.

Figure 10: Sealing the windows

Understanding ventilation requirements is essential. For example, shut down HVAC systems during a SPF application. System shut-down stops dust, aerosol and vapors from being drawn into the HVAC system. For interior applications, this can help prevent airborne materials from being distributed from one part of a building to another. Once the HVAC system is shut down, seal the air intakes with plastic sheeting and tape to prevent dust and spray from entering the system. Some SPF manufacturers recommend that the HVAC system stay sealed and inoperable for up to 24 hours after the SPF application. Individual SPF manufacturer's recommendations concerning re-occupancy supersede any general recommendation.

Once you determine when an appropriate time has elapsed, based on the manufacturer's recommendation, remove the plastic sheeting and tape.

General Preparation Steps

There are several steps to consider prior to the actual application of the foam insulation. Examples of steps to consider include:

1. Provide a briefing for the general contractor and/or owner of the building so they can better understand the scope of the work and the safety procedures to utilize during the application process.
2. Confirm necessary inspections associated with the other trades have been completed and approved prior to the installation of the insulation.
3. Confirm all permits are in place prior to the spraying operation.
4. Complete other trade work to avoid later disturbance of insulation.
5. Install warning signs and caution tapes.
6. Clear building occupants and non-SPF personnel from building. Consider utilizing the best practices for the use of containment and ventilation techniques detailed in the U.S. Environmental Protection Agency's "Ventilation Guidance for Spray Polyurethane Foam Application": *http://www.epa.gov/dfe/pubs/projects/spf/ventilation-guidance.html*
7. Designate an area for putting on and removing PPE.

Jobsite Crews and Safety Briefings

Many commercial jobsites may require contractors to conduct safety briefings with the jobsite crews. They may require that documentation of meetings be submitted to the general contractor for the project. As a good safety practice, companies may consider implementing this policy regardless of whether the job is residential or commercial in nature.

The Daily Work Log outlined in the previous section (3.1) can provide a helpful structure for developing your own work log. Daily Work Logs are also a method for improving record keeping.

Notice to Other Trades and Occupants

Vacate building occupants and non-SPF personnel from the building during the application of SPF and for a period of time following the completion of spraying. Where this is not possible or practical for large commercial buildings, the use of containment and ventilation techniques can be utilized. For residential applications, the homeowner needs to vacate the home and return only after the specified re-occupancy time. Communicate with other trades working in proximity to the spray application area. Giving notice to other trades is an important aspect on larger commercial projects due to the number and kinds of workers in and around the jobsite.

Figure 11: Provide notice to trades and occupants

The focal points for this communication are the general contractor, building owner, home owner, or other responsible personnel for the project. Educate the onsite supervisor or project manager at the start of the project long before the actual spray application starts so that they have a complete understanding of the jobsite safety requirements before the beginning of the spray application process. Critical jobsite safety concerns include proximity of open flame sources and personnel to the spray application area.

General Safety Considerations

After the spray application area is secured, check the overall area and extinguish all sources of flame (e.g. pilot lights). Also, check for flue piping, lighting fixtures, and other heat producing devices.

Set up and prepare the necessary ladders, scaffolding, aerial lifts, and rigging. Once set up, perform a safety check of all the equipment to check that it is properly assembled, nothing is broken or missing, and that all safety devices are operational and in place. Check walking and work surfaces and the routing and location of process equipment hoses and electrical cords as they can present a trip hazard. If gas powered equipment is in use, vent the exhaust fumes to an open environment in order to limit the risk of a buildup of carbon monoxide in the work area.

Lockout/Tagout

Some projects may present instances where you want to consider locking out/tagging out of equipment. Lockout/tagout includes practices and procedures to safeguard employees from the unexpected energizing or startup of machinery and equipment, or the release of hazardous energy during service or maintenance activities. For work near energized equipment, contractors should follow the OSHA standards (29 CFR § 1926.417 or 1910.147). The SPF contractor coordinates with the appropriate facility personnel for locking/tagging out equipment.

Ventilation Considerations

Another jobsite consideration is ventilation. Turn off HVAC duct system fans and seal them so overspray does not enter the duct system. If gas powered equipment is used, direct the exhaust fumes to an open environment to prevent a buildup of carbon monoxide in the work area.

If evacuating an entire commercial building is not practical or possible, consider the potential for SPF chemicals to migrate to other floors. Containment and ventilation methods help prevent migration of chemicals and particulates. Discussing the project and application with property management and other contractors in areas or floors that will remain occupied during the period of SPF application is an important consideration.

Figure 12: Provide adequate ventilation

Set up and check portable ventilation equipment to provide fresh air into the immediate spray application area and exhaust humidity, vapors, and odors. Exercise care so that portable exhaust ducts do not introduce the exhausted air into occupied, unprotected areas. Consider utilizing the best practices for the use of containment and ventilation techniques detailed in the U.S. Environmental Protection Agency's "Ventilation Guidance for Spray Polyurethane Foam Application": *http://www.epa.gov/dfe/pubs/projects/spf/ventilation-guidance.html*.

One possible consequence of inadequate ventilation during the spray application is the absorption of vapors and odors by adjacent materials or surfaces (e.g. furniture). Vapor/odor absorption can be amplified by the presence of wet or dusty materials such as fiberglass duct insulation and ceiling tiles. Cover materials that cannot be removed during the spray and ventilation operation.

Overspray

Overspray is when the SPF application goes beyond the intended area. Train employees in overspray prevention and determine in advance the overspray risk posed by the job. Having a plan in place to address overspray incidents in the event that an issue arises is a good practice. Identify and protect surfaces that could be affected (e.g., windows, doors, equipment, or building exterior and automobiles) in advance of the spray application. When in doubt about covering a surface, it is a best practice to cover it.

For work outdoors, take wind direction into account for all spraying operations. Note that for a job that takes place over several days, the wind direction may change and the work area may need to be adjusted accordingly. In slightly windy conditions, use windscreens. Tenting is also an option to address wind and overspray issues. Adjust your plans for PPE if considering the use of any type of containment area outdoors.

Avoid spraying foam or coatings in excessively windy conditions for exterior applications. Avoid spraying during sustained wind speeds or gusts exceeding 15 miles per hour.

Substrate Considerations

Prepare the surface that the SPF will be applied to prior to the application to help minimize future problems. Before application, check the following substrate characteristics:

- Substrate temperature is within the parameters established in the manufacturer's specifications.
- Substrate moisture level is within the parameters established in the manufacturer's specifications using a moisture meter.
- Surfaces are clean, free of contaminates, and dry.
- Flashings and attachments are clean and/or primed.
- Substrate and any associated flashing materials are secured, specifically around windows and doors, so the SPF does not pull the flashing away from the substrate.

3.3) Jobsite Retrofit Applications

Retrofit applications also have a number of additional considerations. In addition to considerations discussed in Sections 3.1 and 3.2, retrofit applications may impact building occupants differently than in new construction applications. For example, SPF manufacturers generally recommend that building or home occupants and non-SPF personnel vacate the structure during the spray application process and for a period of time after completion. Specific SPF manufacturer's recommendations concerning re-occupancy supersede any general recommendation. Where large commercial buildings cannot be vacated, use containment and ventilation techniques. For residential applications, vacate the home.

Use PPE as set forth by OSHA. SPF installers typically work with an assistant wearing the same PPE as the installer.

Buildings are complex systems with all major components contributing to overall performance. A change to one component can impact the other components of a system that can influence the performance, indoor air quality, moisture level, and energy consumption of the structure. Moving the thermal envelope from one area of the structure (the ceiling or attic floor) to another area (under the roof deck or roofline) could significantly impact other systems and cause needed alterations so that the structure continues to perform in a safe, healthy, and efficient manner. Understanding the building science involved with changes to the building (e.g. the unvented attic assembly) is important so all aspects of the job can be explained to the home or building owner. This helps the home or building owner understand what is required on their part as well as the reasons for the various steps involved in the preparation and spray operation. SPF applications typically improve air sealing of the structure and it is important for building owners to understand how this impacts the overall building and the potential need for new or additional ventilation.

Being familiar with the building structure and systems prior to submitting a bid for the work is part of a retrofit application. This is the time to ask about the history of the structure, its use, and the purpose it will serve after the retrofit. These and other questions can help to prevent any potential complications associated with the retrofit process, both during spray application and after the job is completed.

Odors and Smells for Retrofit Applications

Any existing problems prior to the installation of SPF, such as moldy or mildewed carpets, wet ducts, or existing insulation, may be accentuated by the tighter building envelope that results from installing SPF. Identify, document, and rectify any of these existing conditions before the spray application and discuss them with the homeowner. Make the building owner aware of this possibility as odors may emanate from pre-existing sources and may only become noticeable once the SPF is installed. Additionally, new materials installed by other trades (such as carpeting, flooring, cabinets) as part of an overall retrofit project may release odors that could dissipate more slowly due to the tighter and more energy efficient building envelope. Give homeowners guidance regarding ventilation practices during a retrofit to avoid SPF being inaccurately identified as the source of odors.

Retrofitting Attics

General Safety Considerations (Attics)

Attics can be especially challenging places to work.

Walk only on the joists when moving in an attic. The space between the joists may not hold the weight of a worker. The use of walk boards may be utilized to more easily maneuver around the attic. Look for electrical wires and junction boxes and avoid stepping on these as well to avoid injury or damage to the home. Additionally, be especially careful of nails protruding down from the roof to avoid puncture wounds. Wearing some sort of head covering such as a hard hat, in addition to proper PPE, can help maintain worker safety.

When installing SPF in an existing attic within a home or building, as with other indoor applications, vacate the building during and after application and for a period of time afterward. Check the manufacturer's production information for specific recommendations. See section below on "Ventilation During and After Application of SPF."

Applicators and helpers must wear PPE appropriate for the job as set forth by OSHA (See Section 2.3). If the attic space is tight, refer to the information presented earlier on "Confined Spaces."

Figure 13: Attic retrofit

HVAC Systems (Attics)

The contractor and the homeowner should be aware that retrofitting an existing attic by employing an unvented attic assembly technique can result in the existing HVAC system becoming "oversized" in relation to the new demand. This situation is of special concern in the southern and coastal climate zones where the HVAC also serves to reduce or otherwise manage moisture levels of buildings in order to improve comfort and prevent moisture related problems, such as mold and mildew. If an existing HVAC becomes "oversized" due to the increased thermal efficiency of the unvented attic assembly, the HVAC system may begin to short cycle, or to quickly turn on and off, as it works to manage temperature. This short cycling of the HVAC system may have negative impacts on the comfort and efficiency of the building and possibly on the lifespan of the system. Involve an HVAC consultant to adapt the system to the new, more efficient building envelope associated with the spray foam retrofit.

Open Combustion Appliances (Attics)

Open combustion heating systems and hot water tanks are routinely installed in conventional attics. Moving the thermal envelope to the roofline places the open flame inside the envelope and could create the possibility of carbon monoxide and other combustion by-products from the appliances entering into the occupied area. In the event that open-combustion, gas-fired appliances are present in the existing attic, constructing a sealed equipment room with combustion air supplied from the exterior is one option. An additional option is installing high-efficiency, closed-combustion appliances with the combustion air ducted directly to the units from the exterior of the building. Involve a professional HVAC consultant or plumber.

Duct Systems (Attics)

Check that duct systems are in good condition and securely connected to the register boots and plenums. Be careful when dragging hoses, electrical cords, and lines over the ducts to avoid damaging them.

Soffit and Ridge Vents (Attics)

Ventilation for conventional attic designs is typically achieved through soffit vents, ridge vents, and passive or powered vents. When converting an existing, conventional attic to an unvented attic assembly, the existing attic ventilation is closed off. Appropriate methods to close off existing attic ventilation will vary depending on the layout of the existing structure.

Sewer and Exhaust Fan Vents (Attics)

In some homes, builders and plumbers terminate sewer system vents within vented attics. If sewer vents are found, extend them outside the building envelope. Check for damage, cracks, or improper connection of the sewer vents and repair as needed. Failure to conduct these inspection and repairs could lead to the buildup of odors that owners will mistakenly attribute to SPF and result in callbacks for odor concerns. It is also not uncommon to find ventilation fans from kitchens and bathrooms vented directly into the attic as well. Route the ducts outside the thermal envelope to help avoid an increase in moisture levels and possible condensation problems.

Dividing Walls (Attics)

Dividing walls can be made of various materials such as gypsum board, oriented strand board, or other materials. Dividing walls may need to be built in an unvented attic in order to separate the unvented space from conventionally vented areas. Once the dividing wall is constructed, apply the spray foam directly to it. By applying spray foam directly on these dividing walls, an air boundary will be established between the new unvented attic and existing vented portion of the attic.

Existing Insulation in Unvented Attic (Attics)

Remove the existing insulation in an unvented attic, such as blown-in fiberglass, from the attic floor prior to the installation of SPF. Failure to remove existing insulation could leave an unconditioned "dead" zone within the structure where temperature and humidity are not actively controlled by either the conditioned space below the floor or the exterior environment. This could result in decreased energy efficiency and potentially damaging humidity conditions. Insulation for sound abatement may be used on the attic floor (not over top plates of exterior walls) assuming it is not sufficiently thick enough to serve as a thermal insulation or an air barrier.

Ventilation During and After Application of SPF (Attics)

Vacate building occupants and non-SPF personnel from the structure during the spray application process and for a period of time after completion. Refer to the SPF manufacturer's recommendations concerning re-occupancy time. Where it is not practical or possible for the building to be vacated, such as in large commercial buildings, the use of containment and ventilation techniques can be utilized. For residential applications, the homeowner needs to vacate the home and return only after a specified re-occupancy time. Allow time for the foam to cure and ventilation fans to evacuate residual vapors from the attic. Place the attic under negative pressure and a cross ventilation set up utilized. Consider using a ducted fan supplying air into the closed

space (or an appropriately located opening that can serve as a passive supply) and use a separate fan to exhaust air out of the space. Place the exhaust duct in a location so the exhausted air does not return into the structure. Air filters can be used in conjunction with exhaust fans or ducts to prevent overspray material from potentially damaging areas near the exhaust. See the U.S. Environmental Protection Agency "Ventilation Guidance for Spray Polyurethane Foam Application" for additional information: *http://www.epa.gov/dfe/pubs/projects/spf/ventilation-guidance.html*

Odors and Smells (Attics)

As stated above for general retrofit applications, existing problems prior to the installation of SPF, such as moldy or mildewed carpets, wet ducts, or existing insulation, may be accentuated by the tighter building envelope that results from an unvented attic assembly. Identify, document, and rectify any of these existing conditions before the spray application and discuss them with the homeowner.

The contractor and the homeowner need to be aware that odors will exist in a conventional attic and normally escape to the exterior through the natural ventilation out of soffit, gable end, or ridge vents. Sealing the attic as part of the unvented attic technique stops this natural ventilation. Consequently, pre-existing odors may potentially accumulate or become more pronounced. Make the owner aware of this possibility as odors that emanate from pre-existing sources and may only become noticeable once the SPF is installed. Additionally, new materials installed by other trades (such as carpeting, flooring, cabinets) as part of an overall retrofit project may release odors that could dissipate more slowly due to the tighter and more energy efficient building envelope. Give homeowners guidance regarding ventilation practices during application in attics to avoid SPF being inaccurately identified as the source of the odors.

4) SPF Application Best Practices on the Jobsite

Introduction SPF Application Best Practices

Once the jobsite is set up, health and safety concerns addressed, and products secured, the next step is to apply the SPF. This section will discuss, in general, the steps and conditions to consider when applying SPF. Many of these topics are covered in more detail in training courses provided by SPF manufacturers and other organizations. Questions about how to apply a certain product, or what conditions are optimal for a successful implementation, should be directed to the SPF supplier's customer support or technical support contacts.

4.1) Applying and Processing Spray Foam on the Jobsite

Verify the Jobsite: On the day of application, verify and review all the items discussed in Section 3.

Ambient and Substrate conditions: Prior to actual application, review the ambient/atmospheric and substrate conditions for the parameters recommended by the SPF manufacturer. The manufacturer's technical data sheet or guidelines have the parameters associated with the ambient conditions.

Temperature and Recirculation of Material: Comply with the manufacturer's guidelines for the preparation and processing of the SPF component materials. Manufacturers may recommend recirculation of the polyol material and some may recommend recirculation with heating. Follow the manufacturer's instructions closely.

Figure 14:
Check ambient conditions

SPF Quality Testing: Prior to starting the day's spraying operations, spray out a small amount of material to verify the quality of the SPF produced. Use caution when spraying test buns and allow the buns to have an opportunity to properly cool before disposing of them. Use extra caution if spraying SPF test buns into plastic bags because it can reach the point of spontaneous combustion and could cause a fire. Disposal is also important and lack of attention to the disposal of scrap SPF can cause a fire.

Thickness of Application: Follow the SPF manufacturer's recommendations concerning the thickness of individual passes (lifts) and the cooling time between passes. Applying too much SPF per pass, without allowing time for the foam to cool, could cause poor foam quality and create a fire hazard resulting from too much heat from the reaction and spontaneous combustion. Closed cell SPF retains the heat from the reaction more than open cell SPF and can achieve higher temperatures for a longer period of time.

Refer to the manufacturer's guidance for both open and closed cell SPF.

It is important to note that the surface temperature of the SPF will be near ambient temperature while the internal temperature can remain much higher. Installing additional layers of SPF without allowing sufficient time for the previous layer to cool can cause the temperature to continue

rising. Such internal temperatures could cause damage to the cells and lead to poor quality SPF. Consider using a stick-probe type thermometer, typically used by HVAC technicians, for checking the internal temperature of the SPF.

In contrast to SPF applied too thick, if the SPF is applied too thin, especially in the case of open cell SPF, then not enough heat is generated, which can result in poor quality SPF. Knowledge of the characteristics of the SPF products and following the guidance provided in the manufacturer's technical literature will facilitate the application of SPF and obtain maximum yield from the material components.

Total Thickness: Refer to the manufacturer's recommendations, code requirements, and project specifications for total thickness. Monitor the thickness of SPF by periodically measuring it with a thin wire probe or depth gage, which can help manage the spray pattern to obtain an even and consistent thickness as close to the recommended thickness as possible without over spraying the foam and wasting materials.

Trimming the foam: Trimming is a subject of particular importance for open cell SPF installations. There are a variety of methods for trimming the foam in order to obtain a smooth or consistent surface. Follow the SPF manufacturer's recommended methods for trimming the foam. Clean up the trimmings and dust after the job is completed and wear PPE appropriate for this phase of the job. Consider using a vacuum cleaner, which may assist in a thorough cleaning.

Figure 15: Contractor trimming foam

Repairs: Often during the trimming process, areas needing repair are discovered. These repairs may be made with the SPF that was initially installed or with sealant foams. Keep protective materials such as plastic sheeting, ventilation equipment, and others in place until all repairs are made and the foam and subsequent coating/covering is inspected for completeness and compliance with the work order and contract.

Application of Coatings/Coverings: To conform to building codes, a protective coating or covering may be required. Follow the SPF manufacturer's technical information for what coating or covering is approved with the specific SPF, the required thickness, surface profile, and parameters for application. Prior to starting, review the manufacturer's recommended method for measuring installed coating thickness as well as documentation required by the authority having jurisdiction (AHJ). As with the rest of the installation process, wear appropriate PPE during the spraying of the coating/covering.

Cleanup: Once the SPF and coating application is complete, clean up the work area and remove and discard the protective materials in compliance with all federal, state, and local regulations.

Disposal of Waste Material: Dispose of all scrap SPF foam, liquid SPF component chemicals and empty drums in compliance with all federal, state and local waste disposal guidelines. Follow the SPF manufacturer's guidance on how to dispose of waste. Cut open large buns of waste insulation, douse with water, and allow an adequate time to cool prior to disposal to minimize the risk of a fire. CPI has a guidance document with more information regarding responsible disposal of wastes and containers from polyurethane processing: *http://polyurethane.americanchemistry.com/Resources-and-Document-Library/10311.pdf*.

Drum Disposal: Empty drums can pose a hazard. As with waste material, dispose of all drums according to procedures in the manufacturer's MSDS and all federal, state, and local requirements. Additional information regarding disposal of drums is available in Section 2 on Health and Safety. The Reusable Industrial Packaging Association (RIPA) can assist in locating a qualified container reconditioner in your area *(http://www.reusablepackaging.org/find-a-member).*

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5) Post-Application Best Practices

Introduction to Post-Application Best Practices

After the preparations are completed and the application is finished, it is time to inspect the SPF. This section describes what to consider when inspecting SPF and various additional items to consider recording on the inspection report. Examples of performance testing, including blower-door air leakage tests, carbon-monoxide testing, and thermographic imaging are described, along with the documentation for the building owner.

This Section on Post-Application is largely based on the Spray Polyurethane Foam Alliance's Building Envelop (BE) Inspector Manual.

5.1) Frequency of Post-Application Inspection

Inspect SPF installations daily, after completion, or both as part of an internal quality control process. Consider hiring an independent, third-party expert to perform some or all of the inspections. If the inspection takes place immediately after installation, wear full PPE.

5.2) Visual Inspection

Scope of Visual Inspection: In general, a visual inspection can help identify the following examples:

- Specific assemblies are insulated to sufficient levels in accordance with the project scope and specifications
- SPF is installed to provide a continuous air barrier, if that is in the scope of work
- SPF is fully adhered to the substrates and is well bonded to cavity framing members
- Surface profile is satisfactory
- Color is uniform and consistent
- SPF is free of cracks, blisters, and delamination
- Thermal barriers, ignition barriers, and coatings/coverings are installed as required by codes

The above list is an example of items to consider when doing a visual inspection. There may be other items that you want to include in a visual inspection.

Reporting of Visual Inspection Results: An SPF Insulation Inspection Report can be used to record visual inspection results and commentary. Including photographic documentation along with the visual observations is a good practice.

5.3) Thickness Measurement

Insulation thickness is typically a fundamental part of an insulation project specification. Thickness can vary depending on several factors, which may include the following:

- **Specification:** The specified thickness is typically related to R-value. Some specifications may require a minimum thickness or R-value while others may require an average thickness or R-value. Often these requirements correspond, at a minimum, to R-values prescribed by the applicable building codes. Refer to the applicable building cowde for more information.

- **Application Technique within Assembly Cavities:** Many applicators, especially for closed-cell foam, use a "picture framing" technique where the edges of the cavity are sprayed first (referred to as forming a cant), and then the middle is filled in with an up-and-down or side-to-side motion. This can leave the middle section thinner than the edges. Maintain specified minimums or averages in the middle of the cavity.

- **Surface Profile:** Spray foam surface profiles are rarely, if ever, completely flat. Variations occur for a number of reasons and leave a characteristic profile variation. Open-cell SPF exhibits greater profile variations than closed-cell SPF. In spite of profile variations, maintain specified minimums or averages set forth in the applicable building codes.

Figure 16: Maintain average thickness throughout

Thickness Measurement Method, Frequency, and Reporting: Thickness measurements can be obtained through nondestructive means by using a reference to measure the foam thickness. The reference can be the framing member or other objects of known measurements. Foam thickness measurements can also be made directly using a calibrated probe gauge or a probe and ruler. Take representative thickness measurements at regular intervals.

Note any areas where thickness measurements fall below minimum or average thickness requirements set by the project and building codes. Clearly mark and repair holes left by thickness measurement probes, as appropriate. If independent inspectors perform the foam thickness measurements, they typically will limit any puncturing of the foam membrane. In addition, it is typically the inspector's responsibility to repair holes or damage made during the inspection process. A low-pressure SPF product can be used to fix holes created during inspections. Small pin holes may not need to be repaired.

5.4) Physical Sampling and Testing Best Practices

Purpose and Procedure for Physical Sampling (Optional): Physical sampling involves destructive investigation, but can help verify the quality of the installed SPF. Visual inspections and touching the foam (proper PPE is required and can vary depending on amount of time after application) may be sufficient; however, core sampling can be helpful, especially if a concern about quality is suspected. Core sampling involves removing a full thickness sample of SPF from the finished assembly, such as from the wall stud cavity. This may be accomplished using a foam coring tool. Alternatively, a rectangular core may be removed using various cutting tools (e.g., a sharp knife for open-cell SPF or a saw for closed-cell SPF). The core holes can be visually inspected for consistent color, density, and limited cracks and blisters. A low-pressure SPF product along with other options can be used to repair core holes.

5.5) Performance Testing Best Practices

One prominent attribute of SPF is its ability to expand in place and seal cracks, gaps, and penetrations. SPF can function as an integral component of an air barrier system throughout the entire building envelope. SPF, used in conjunction with compatible accessories such as caulks and sealants around framing, windows, and doors can allow for significant reductions in building air leakage and increased energy savings.

Blower Door Testing: Blower door testing is used to verify the air tightness of single-family residential homes and small commercial buildings. The details of this test procedure are described in ASTM E779. Blower-door testing is required by the 2012 International Residential Code (IRC) and all new residential construction receiving ENERGY STAR certification. Blower door testing is also an integral part of many home performance contracting or rating services where the test is performed before and after the energy efficiency improvements are made. Consider measuring air leakage rates via a blower door test after retrofit work and check minimum ventilation requirements to help achieve adequate indoor air quality. Performing a blower-door test after a SPF installation but prior to drywall installation helps the SPF contractor verify a quality installation. During the blower-door test, air leakage locations can be identified and addressed by the SPF contractor.

Figure 17: Blower door testing

Carbon Monoxide Monitoring: Due to the tighter building envelope after SPF applications, undertake carbon monoxide (CO) monitoring and check for safe levels of CO inside the building when combustion appliances, such as ranges, furnaces, and fireplaces, are present. More information about CO in buildings can be found at *www.epa.gov/iaq/co.html#MeasurementMethods*.

Blower door testing and CO monitoring requires specialized equipment and training. Organizations like Residential Energy Services Network (RESNET) and the Building Performance Institute (BPI) maintain lists of companies and organizations that provide this training. SPF installers that do not have the proper equipment and training to perform the testing can refer to these lists for information on experienced professionals to perform blower door testing and CO monitoring.

Thermographic Imaging (Optional): Thermographic imaging (TGI), or infrared photography, is a non-destructive means to evaluate the quality of an SPF installation. It is often difficult to apply SPF in every cavity and location in a building; however, TGI can detect areas of the building envelope with missing insulation or where excessive air leakage is present. If used after the initial SPF application and prior to drywall installation, TGI enables the SPF contractor to more easily identify and address deficiencies in the initial installation. TGI works best with a relatively large temperature differential, typically 20 to 30 degrees Fahrenheit, between the inside and outside of the building.

As with blower-door testing and CO monitoring, TGI requires training and experience to effectively use this equipment and properly interpret results. Many home performance contractors and home inspection services use TGI.

5.6) Posting of Code Compliance Material Documentation

As part of the post-installation inspection report, the SPF contractor typically provides certain documentation to the building owner. Some of the documentation is required by federal, state, or local ordinances or codes. Consult the local authority having jurisdiction (AHJ) to determine the specific requirements for any given location. Requirements can differ between retrofit and new construction applications in some jurisdictions.

In addition to jurisdictional requirements, it is good practice to include the following documents:

- Manufacturer's Product Data Sheets.
- MSDS documents for finished foam material and coatings.
- Evaluation Reports (as applicable) or test data to support code compliance can be included in lieu of an Evaluation Report.
- Lot/batch numbers of all materials used.
- Location and installed thickness (R-value) of SPF.

5.7) Posting of Use/Occupancy Statements

Current model building codes also require an Installation Certificate. Typically a copy of this certificate is provided to the building owner or general contractor/builder, and a copy is left in a conspicuous location in the building (e.g., near the main electrical panel or in the utility room). The building owner may need to provide this to code officials, energy raters, or home performance contractors for verification of the work done.

6) Emergency Procedures

Introduction to Emergency Procedures

If something does go wrong during the application, knowing what to do and who to contact can help limit the damage and hazards posed to the crew and the environment. This section discusses emergency procedures to consider, including whom to contact, how to handle spills to minimize contamination to the environment, and information on fire safety and first aid. These are some, but not all, of the many items to consider when an emergency occurs.

6.1) Emergency Contact Numbers

Access to emergency services is essential for the safety and welfare of the application crew. On larger projects, the general contractor normally has standard procedures to follow in an emergency situation. Post emergency contact information so it is readily available to all personnel. Inform crew members on where to find emergency information, including phone numbers, address or location of the jobsite and/or directions to the jobsite for emergency personnel, MSDSs, and emergency equipment on the spray rig. Contact information for the following are commonly provided to crews:

- Local fire department
- Local emergency medical services
- Local emergency management organization
- Local environmental management agency
- General contractor/owner emergency contact numbers
- CHEMTREC: 1-800-424-9300 and *www.chemtrec.com*

6.2) Spill Response Considerations

A spill or release is the unplanned discharge of a material to the ground, water, or air. If this happens, take action to minimize environmental contamination. Comply with federal, state, and local laws and ordinances for spills and responses to spills. Refer to the MSDS for more information. More details on spill response can be found in the CPI Health and Safety Workbook: *http://www.spraypolyurethane.org/Workbook*.

Isocyanate (A-Side Product) Spill: In the event of a large isocyanate (A-side) spill or release, contact an accredited and trained hazardous material spill response team to address the spill. If the SPF crew has appropriate training and equipment, small spills can be handled by following the company's procedure.

Figure 18: Spill kit

General procedures to follow during an A-side spill can include, but are not limited to, the following:

- Direct all personnel away from the immediate area to avoid unnecessary exposure
- Provide appropriate PPE in accordance with OSHA regulation.
- Absorb the MDI with such substances as sand, wet earth, or absorbent clays (e.g., vermiculite)
- Place the absorbed material in drums and neutralize, as described in the MSDS. It is typically recommended to not seal the drums for at least 48 hours
- If you have exceeded the reportable quantity (RQ) (RQ for MDI is 5,000 lbs), call the EPA's Superfund Call Center 1-800-424-9346 or consult 40 CFR §302.4 to determine if the RQ has been exceeded
- If you determine that you have exceeded this amount, the EPA requires that the spill be reported to various government agencies
- Characterize waste (i.e., hazardous or nonhazardous waste) and dispose of waste in accordance with all applicable regulations. Report sizable isocyanate or solvent spills or releases to a Local Emergency Planning Committee (LEPC), State Emergency Response Commission (SERC), and the National Response Center (NRC). There are legal penalties associated with not reporting

Polyol Spill (B-Side or Resin): If B-side product is released or spilled, evacuate personnel not involved with the clean-up and refer to the MSDS for recommended actions. Wear appropriate PPE as set forth by the MSDS and OSHA. Consider steps like damming up or containing the spill in other ways to prevent spreading and possible environmental contamination. Cover the spilled material with absorbent material (e.g. sawdust, clay absorbent, dry sand, or earth). Consider shoveling the material into suitable containers for waste disposal. Wash the spill area with soap and water to dilute and remove remaining traces of the material. Ventilate the area to remove any remaining vapors. Contact the appropriate authorities.

Consult the MSDS for specific disposal and response information for both A-side and B-side spills.

Cured polyurethane foam typically does not meet the criteria of a hazardous waste, according to the Resource Conservation and Recovery Act (RCRA) guidelines, and can be acceptable for landfill disposal. However, consider contacting the disposal facility in advance. Some landfill facilities may ask for an MSDS for cured polyurethane foam before allowing disposal.

6.3) Fire Considerations

There are type A, B, and C fire extinguishers (typically dry chemical extinguishers) and professional fire fighting foams that may be used when there is a small fire. Water may also be used in large quantities. SPF is a combustible material similar to many other components in a building. SPF fires can grow very quickly and beyond the point of control of normal extinguishing practices. Evacuate all unnecessary personnel from the affected area during a fire as soon as possible and immediately contact the local fire authorities.

6.4) First Aid Considerations

Applicators are required by OSHA standard 29 CFR 1910.151 to have a person or persons adequately trained to render first aid for worksites that are not in proximity to an infirmary, clinic, or hospital. Design a first aid program to reflect the known and anticipated hazards of spray foam application, which could include general first aid issues and chemical exposure issues. Consult with local emergency medical experts and providers of first-aid training when developing a first-aid program. The program is required to comply with applicable OSHA standards and regulations.

Figure 19: Develop a first aid program

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7) List of Additional Sources and References

Below is a list of some of the training programs that an SPF installation company can utilize for the training of employees, including SPF installers (Section 1 of this Guidance):

- **Center for the Polyurethanes Industry (CPI)**
  Spray Polyurethane Foam Health and Safety Training
  www.spraypolyurethane.org/SPF-Chemical-Health-and-Safety-Training

- **Occupational Health & Safety Administration (OSHA)**
  Outreach Class for Construction: 10-hour version or 30-hour version
  www.osha.gov/dte/outreach/index.html

- **Spray Polyurethane Foam Alliance (SPFA)**
  SPF Accreditation Program
  www.sprayfoam.org/index.php?page_id=372

The following are some of the safety references, discussed in Section 2, for handling fire safety issues when working with SPF:

- **U.S. Model Building Code Fire Performance Requirements**
  http://polyurethane.americanchemistry.com/Resources-and-Document-Library/11361.pdf

- **Fire safety guidance when working with polyurethane foam products during new construction, retrofit and repair**
  http://polyurethane.americanchemistry.com/Resources-and-Document-Library/11365.pdf

Organizations Having Helpful Information or Training Materials on the Use and Handling of Spray Polyurethane Foam:

- ACC Center for the Polyurethanes Industry (CPI)
  www.spraypolyurethane.org *www.polyurethane.americanchemistry.com*
- Spray Polyurethane Foam Alliance (SPFA) *www.sprayfoam.org*
- Insulation Contractors Association of America (ICAA) *www.insulate.org*
- Sustainable Workplace Alliance *www.sustainablewp.org*
- U.S. Government Agencies
  - — Environmental Protection Agency
    http://www.epa.gov/dfe/pubs/projects/spf/spray_polyurethane_foam.html
  - — National Institute for Occupational Safety and Health *www.niosh.gov*
  - — Occupational Safety & Health Administration (OSHA)
    www.osha.gov *www.osha.gov/dep/greenjobs*

Additional Resources on First Aid and Cardiopulmonary Resuscitation (CPR)

- American Association of Occupational Health Nursing *www.aaohn.org*
- National Safety Council *www.nsc.org*
- American Red Cross *www.redcross.org*
- Center for the Polyurethanes Industry's Health and Safety Product Stewardship Workbook for High-Pressure Application of Spray Polyurethane Foam (SPF) *http://www.spraypolyurethane.org/Workbook*

Table of some OSHA Standards Related to SPF Application. Please go to the code of federal regulations online (*www.gpoaccess.gov/cfr/*) for the most updated information.

Title	Industry	Reference
General Duty Clause	All	29 CFR 5 (a)(1)
Air Contaminants *Limits for Air Contaminants* *Hazardous Atmospheres and Substances* *Hazardous Atmospheres and Substances* *Gases, Vapors, Fumes, Dusts, and Mists*	General General Marine Terminals Longshoring Construction	29 CFR 1910.1000 29 CFR 1910.1000 Table Z-1 29 CFR 1917.23 29 CFR 1918.93 29 CFR 1926.55
Hazard Communication	General Shipyard Marine Terminals Longshoring Construction	29 CFR 1910.1200 29 CFR 1915.1200 29 CFR 1917.28 29 CF. 1918.90 29 CFR 1926.59
Personal Protective Equipment *Personal Protective Equipment* *Personal Protection* *Personal Protective Equipment* *Personal Protective and Life Saving Equipment*	General Shipyard Marine Terminals Longshoring Construction	29 CFR 1910, Subpart I 29 CFR 1915, Subpart I 29 CFR 1917, Subpart E 29 CFR 1918, Subpart J 29 CFR 1926, Subpart E
Respiratory Protection	General Shipyard Marine Terminals Longshoring Construction	29 CFR 1910.134 29 CFR 1915.154 29 CFR 1917.92 29 CFR 1918.102 29 CFR 1926.103
Ventilation *Ventilation and Atmospheric Conditions* *Ventilation*	General Longshoring Construction	29 CFR 1910.94 29 CFR 1918.94 29 CFR 1926.57
The Control of Hazardous Equipment (Lockout/ Tagout)	General	29 CFR 1910.147
Confined Spaces *Work in Confined or Isolated Spaced* *Confined and Enclosed Spaces and Other dangerous Atmospheres in Shipyard Employment*	General Industry Construction Shipyard	29 CFR 1910.146 29 CFR 1926.21 29 CFR 1915.94, 29 CFR 1915, Subpart B
Walking and Working Surfaces *Scaffolds, Ladders, and Other Working Surfaces* *Working Surfaces*	General Industry Shipyard Longshoring	29 CFR 1910 Subpart D 29 CFR 1915, Subpart F 29 CFR 1918, Subpart D
Occupational Noise Exposure	General Industry Construction	29 CFR 1910.95 29 CFR 1926.52

8) Appendices

The following pages contain checklists and printable resources for your use during the installation process.

8.1) Jobsite Safety Plan

You may have different components to your plan due to your jobsite.

✔	
	Verification that all personnel read and understand the MSDS for each material involved with the spray polyurethane foam application process.
	A copy of the most current MSDS should be available at all times (i.e. cab of the truck or in the trailer that is transporting the spray equipment).
	Communication procedures between the crew and customer.
	Overspray mitigation plan.
	Proper start-up and shut-down procedures for both SPF process equipment and the customer's equipment (i.e. HVAC system) when applicable.
	Review of Manufacturers Technical Data sheets that detail proper application procedures.
	Onsite review of the jobsite; note any potential safety hazards and special needs.
	Controlling access to the spray area.
	Proper set up for all equipment with particular emphasis on ladders or scaffolding which could present fall hazards.
	Proper set up for establishing the work area and restricting access by posting warning signs.
	Emergency procedures with notification procedures.
	Chemical spillage with current remediation procedures and notification procedures.
	Jobsite location and directions to the jobsite from the nearest major intersection.

8.2) Equipment Inspection (Safety) Checklist

Each jobsite may have unique needs to consider and include in its Jobsite Safety Plan.

✔ Air and chemical leaks

	Inspect air and chemical lines for signs of wear or fatigue.
	Ensure the compressed air system has the proper OSHA-compliant disconnects.

✔ Proper ventilation of engine exhausts

	Verify adequate ventilation. The buildup of carbon monoxide from engine exhausts can be deadly.

✔ Ladders, scaffolding, and aerial lifts

	Improper use of ladders, scaffolding, and aerial lifts can be a source of jobsite injuries or deaths. **Proper use of ladders, scaffolding and aerial lifts is a major point of emphasis in the overall jobsite safety plan.**
	Consult the OSHA website along with the manufacturers care and use specifications for this equipment.

✔ Hoses, electrical cords and lights

	Use properly rated electrical cords and lights.
	Remove from service cords that are damaged, frayed or spliced.
	Properly ground/bond plugs and receptacles, including ground wire.

✔ Ventilation fans and ducts

	Clean fans and check if fully operational.
	Clean ducts and seal to eliminate leakage.

✔ Chemical storage and handling

	Proper environmental controls to ensure proper storage conditions.
	Proper restraining devices to secure chemicals during transportation.
	Spill control equipment.
	Decontamination solution.

✔ Emergency equipment

	A fully stocked and OSHA-compliant first aid kit.
	Eye wash station.

✔ Fire Prevention

	Fire extinguisher(s) fully charged and accessible.

✔ Other

	Tools, spare parts, and equipment manuals.
	Jobsite Safety Plan.

8.3) Example of a Daily Log

DAILY LOG PROJECT REFERENCE NO./NAME:

CONTRACTOR	DAY/DATE
JOB NAME	JOB NO.
WEATHER	TEMP

FIELD NOTES

CONTRACT EXTRAS		AMOUNT
EQUIPMENT RENTED TODAY		AMOUNT

CRAFTSMEN	NO.
☐ Superintendent	
☐ Clerk	
☐ Bricklayers	
☐ Carpenters	
☐ Cement Masons	
☐ Iron Workers	
☐ Laborers	
☐ Operators	
☐ Plumbers	
☐ Pipe Fitters	
☐ Sheet Metal	
TOTAL:	

EQUIPMENT	HRS

APPROVED BY

PROJECT REFERENCE NO./NAME:

American® Chemistry Council

Spray Foam Coalition