



Center for the Polyurethanes Industry

**Health and Safety**  
**Product Stewardship Workbook**  
**for**  
**High-Pressure Application of**  
**Spray Polyurethane Foam (SPF)**

**March 15, 2010**

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## 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](http://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) 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 catalyst 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 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](http://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.

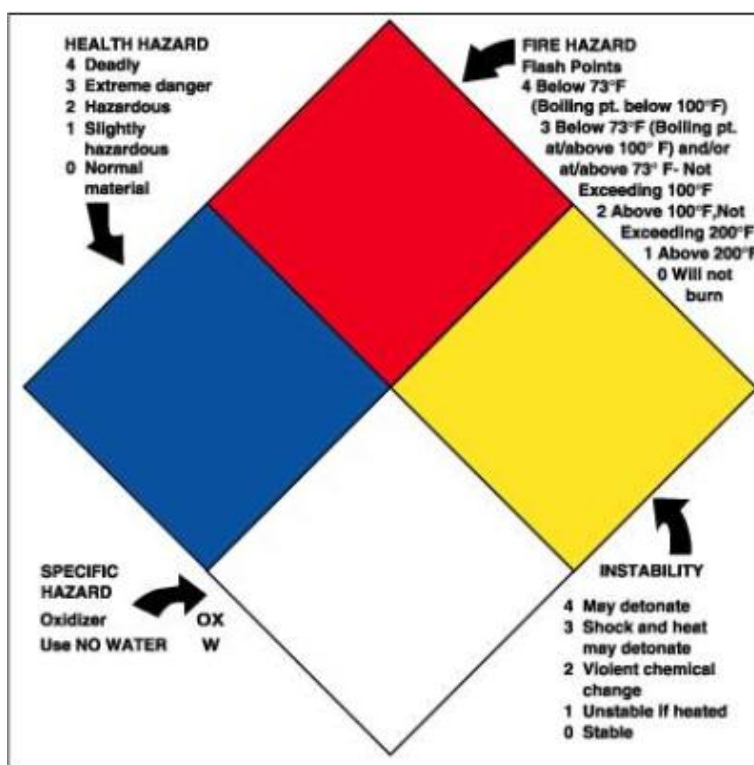
An example of a typical HMIS hazard-warning label is shown in Figure 2. It ranks the hazard the material poses from 0 to 4 in these categories: Health (blue), Flammability (red), and Physical Hazard (yellow). A rank of 0 indicates that the material presents a minimal hazard for that category. A rank 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 of 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**

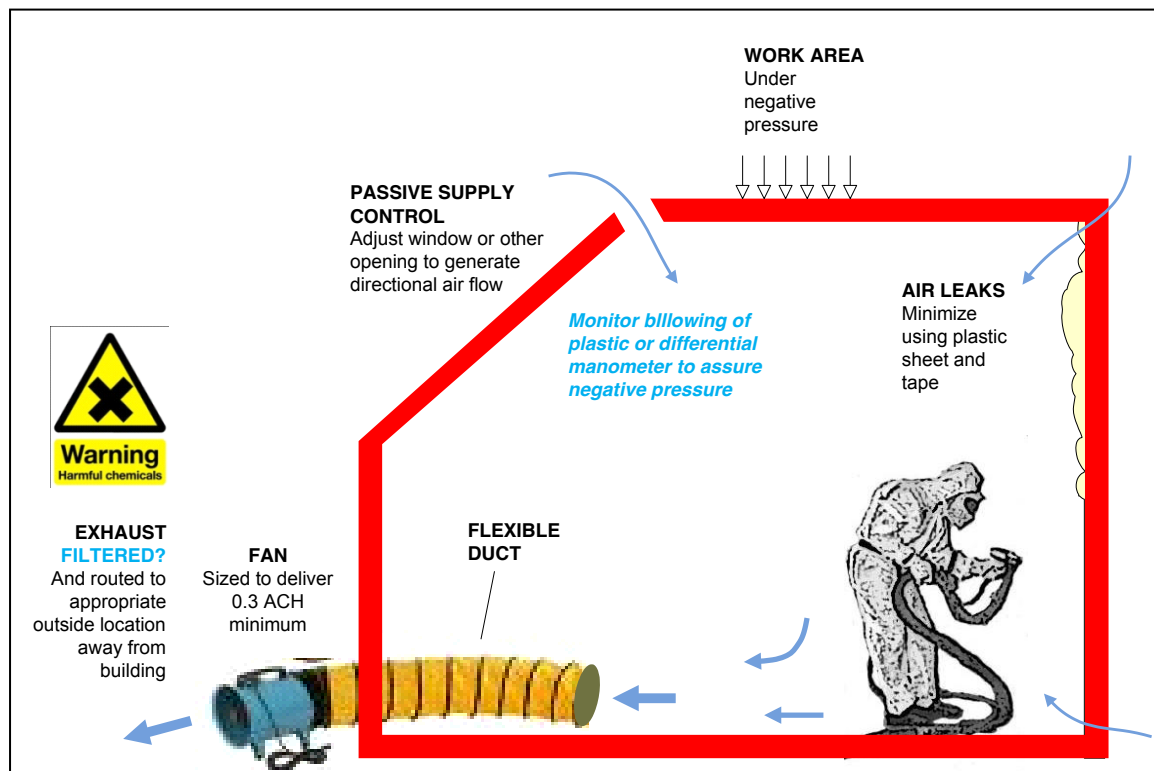


### 5.1.2 Ventilation Design

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°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.



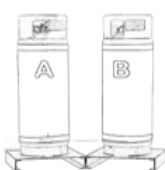






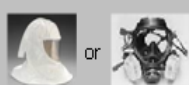
















Appropriate PPE is worn by personnel handling containers with A-side or B-side chemicals to minimize the potential risk of exposure to SPF chemicals via inhalation or skin or eye contact. Depending on the task, this may include chemical-resistant gloves, chemical-resistant clothing, and eye protection.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

	One-component Cans 	Low Pressure Two-Component Kits 	Refillable Systems 	High Pressure High Pressure Spray Systems 
Routes of Exposure	PPE	PPE	PPE	PPE
Eyes	Safety Glasses  Safety Glasses	Safety Glasses  or  Safety Glasses or Goggles	Safety Glasses  or  Safety Glasses or Goggles	 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  or  &  FF Mask/ Hood or FF Air Purifying Airline OV/Pre-filter Provide Good Ventilation
For more available information see the Spray Polyurethane Foam Health & Safety Website at <a href="http://www.spraypolyurethane.com">www.spraypolyurethane.com</a>				

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](http://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](http://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](http://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](http://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.

**Each 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](http://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.

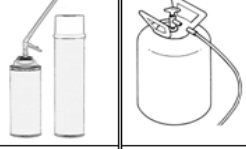

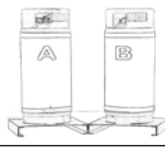

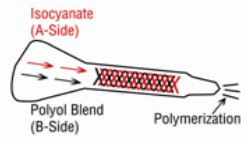
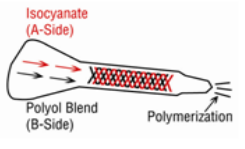
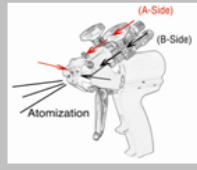

Copies of MSDSs or a list of the chemicals must be submitted to the Local Emergency Planning Commission (LEPC), the State Emergency Response Commission (SERC), and the local fire department within 90 days after storing 10,000 pounds or more of SPF chemicals at a facility or on-site.

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

	One-Component		Low Pressure Two-Component Kits	Refillable Systems	High Pressure High Pressure Spray Systems
					
<b>Delivery Systems</b> Pressure	<150 psi	<250 psi	<250 psi	<250 psi	1000 psi-1300 psi
Contents	.5lbs - 2lbs	10lbs - 23lbs	2lbs - 110lbs <i>Combined</i>	250lbs - 1700lbs <i>Combined</i>	900lbs - 1000lbs <i>Combined</i>
Output	Full Trigger: up to 2-5 lbs per min		Full Trigger: up to 5-7 lbs per min <i>Standard fan or cone nozzle</i>	Full Trigger: up to 5-7 lbs per min <i>Standard fan or cone nozzle</i>	Full Trigger: up to 30 lbs per min
Mixing	Prepolymer	Prepolymer	Static Mixing 	Static Mixing 	Impingement Mixing 
Mixer			Static Mixer	Static Mixer	Chamber Mixing
Housing			Nozzle	Nozzle	Spray Gun
Container <i>Most Popular Size Sold</i>	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
<b>Product Temperature</b> Recommended Use	70°F-90°F (21°C-32°C)		70°F-90°F (21°C-32°C) <i>optimal temp for std systems</i>	70°F-90°F (21°C-32°C) <i>optimal temp for std systems</i>	120°F-150°F (49°C-65°C) <i>machine heater system</i>
<b>Foam Properties</b> Curing Tack-Free Time How it is used	Moisture Cure 3-20 minutes Bead Application		Chemical Cure < 1 minute Bead Application Spray Coating	Chemical Cure < 1 minute Bead Application Spray Coating	Chemical Cure < 15 seconds 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)
<i>Air Contaminants</i>	General	29 CFR 1910.1000
<i>Limits for Air Contaminants</i>	General	29 CFR 1910.1000 Table Z-1
<i>Hazardous Atmospheres and Substances</i>	Marine Terminals	29 CFR 1917.23
<i>Hazardous Atmospheres and Substances</i>	Longshoring	29 CFR 1918.93
<i>Gases, Vapors, Fumes, Dusts, and Mists</i>	Construction	29 CFR 1926.55
<i>Hazard Communication</i>	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
<i>Personal Protective Equipment</i>	General	29 CFR 1910, Subpart I
<i>Personal Protective Equipment</i>	Shipyard	29 CFR 1915, Subpart I
<i>Personal Protection</i>	Marine terminals	29 CFR 1917, Subpart E
<i>Personal Protective Equipment</i>	Longshoring	29 CFR 1918, Subpart J
<i>Personal Protective and Life Saving Equipment</i>	Construction	29 CFR 1926, Subpart E
<i>Respiratory Protection</i>	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
<i>Ventilation</i>	General	29 CFR 1910.94
<i>Ventilation and Atmospheric Conditions</i>	Longshoring	29 CFR 1918.94
<i>Ventilation</i>	Construction	29 CFR 1926.57
<i>The Control of Hazardous Equipment (Lockout/Tagout)</i>	General	29 CFR 1910.147
<i>Permit-Required Confined Spaces</i>	General Industry	29 CFR 1910.146
<i>Work in Confined or Isolated Spaced</i>	Shipyard	29 CFR 1915.94
<i>Confined and Enclosed Spaces and Other dangerous Atmospheres in Shipyard Employment</i>	Shipyard	29 CFR 1915, Subpart B
<i>(Proposed) Confined Space Standard for Construction</i>	Construction	29 CFR 1926.1200
<i>Walking and Working Surfaces</i>	General Industry	29 CFR 1910 Subpart D
<i>Scaffolds, Ladders, and Other Working Surfaces</i>	Shipyard	29 CFR 1915, Subpart F
<i>Working Surfaces</i>	Longshoring	29 CFR 1918, Subpart D
<i>Occupational Noise Exposure</i>	General Industry	29 CFR 1910.95
<i>Occupational Noise Exposure</i>	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) <sup>4</sup>	0.02 ppm (C)	NA NA	0.005 ppm (TWA) <sup>1</sup> 0.02 ppm (STEL) <sup>2</sup>
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) <sup>3</sup> 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) <sup>4</sup> 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 <sup>3</sup> (TWA) NA	0.1 mg/m <sup>3</sup> (TWA) NA	0.1 mg/m <sup>3</sup> (TWA) <sup>4</sup> NA

<sup>1</sup>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.

<sup>2</sup>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.

<sup>3</sup>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.

<sup>4</sup>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

center for the polyurethanes industry • spray polyurethane foam alliance

## 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 workplace. 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.



For more information: [www.spraypolyurethane.com](http://www.spraypolyurethane.com)

## 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

OSHA website:  
[www.osha.gov/SLTC/hazardcommunications/index.html](http://www.osha.gov/SLTC/hazardcommunications/index.html)

NIOSH website:  
[www.cdc.gov/niosh/homepage.html](http://www.cdc.gov/niosh/homepage.html)

NIOSH Pocket Guide:  
[www.cdc.gov/niosh/npg/](http://www.cdc.gov/niosh/npg/)

International Chemical Safety Cards:  
[www.cdc.gov/niosh/ipcs/niosstart.html](http://www.cdc.gov/niosh/ipcs/niosstart.html)

National Fire Protection Association:  
[www.nfpa.org](http://www.nfpa.org)

## For more information, visit:

The American Chemistry Council's Center for the Polyurethanes Industry  
[www.americanchemistry.com/polyurethane](http://www.americanchemistry.com/polyurethane) or  
[www.spraypolyurethane.com](http://www.spraypolyurethane.com)

Spray Polyurethane Foam Alliance  
[www.sprayfoam.org](http://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)**

<p>Sections 1, 2, 3*</p> <p><b>CHEMICAL IDENTIFICATION HAZARD WARNINGS COMPOSITION</b></p>	<p>Do you know the <b>hazards</b> of every chemical you are handling:</p> <ul style="list-style-type: none"> <li>• Component A (Isocyanate);</li> <li>• Component B (Resin, Polyol, Amine Catalyst, Blowing Agent, Fire Retardant);</li> <li>• Solvents;</li> <li>• Cleaning Solutions;</li> <li>• Coatings?</li> </ul>
<p>Section 8*</p> <p><b>PERSONAL PROTECTION</b></p>	<p>Are you using the correct <b>Personal Protection Equipment</b> for the job:</p> <ul style="list-style-type: none"> <li>• Supplied-Air Respirator,</li> <li>• Eye Protection,</li> <li>• Gloves,</li> <li>• Coveralls,</li> <li>• Boots?</li> </ul>
<p>Sections 6 &amp; 7*</p> <p><b>ACCIDENTAL RELEASES STORAGE AND HANDLING</b></p>	<p>Are you <b>storing</b> and <b>handling</b> the chemicals as directed?</p> <ul style="list-style-type: none"> <li>• Do you know how to properly contain and clean a <b>spill</b>?</li> </ul>
<p>Section 4*</p> <p><b>FIRST-AID</b></p>	<p>What should you do if there is an <b>accidental exposure</b>?</p> <ul style="list-style-type: none"> <li>• Do you know <b>first-aid</b> procedures?</li> <li>• Do you have first aid materials at the work site?</li> </ul>
<p>Sections 5, 9-16*</p> <p><b>OTHER INFORMATION “READ THE ENTIRE MSDS”</b></p>	<p>Did you know that other information is provided on an MSDS?</p> <ul style="list-style-type: none"> <li>• Fire-Fighting Measures;</li> <li>• Physical-Chemical Properties;</li> <li>• Stability and Reactivity;</li> <li>• Toxicology;</li> <li>• Disposal;</li> <li>• Transportation; and</li> <li>• Regulatory information?</li> </ul>

For more information, visit:  
The American Chemistry Council's Center for the Polyurethanes Industry  
[www.americanchemistry.com/polyurethane](http://www.americanchemistry.com/polyurethane) or [www.spraypolyurethane.com](http://www.spraypolyurethane.com)

Spray Polyurethane Foam Alliance  
[www.sprayfoam.org](http://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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SPRAY POLYURETHANE FOAM ALLIANCE

SPFA

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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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Dated: March 15, 2010

## 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.

1

For more Information: [www.spraypolyurethane.com](http://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.



## Appendix E-3: Interior Spray Polyurethane Foam Applications

# Guidance Document

## 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.

## Appendix E-3: Interior Spray Polyurethane Foam Applications

# Guidance Document

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](http://www.americanchemistry.com/polyurethane) - Select "Safety" or "Health"
    - [www.americanchemistry.com/spf](http://www.americanchemistry.com/spf) or [www.spraypolyurethane.com](http://www.spraypolyurethane.com)
    - "Health & Safety Aspects of SPF Applications" DVD - 2002. [www.americanchemistry.com/polyurethane](http://www.americanchemistry.com/polyurethane) - Select "Order Publications".
    - "Safe Handling of Diphenylmethane Diisocyanate (MDI)" - 2007. [www.spraypolyurethane.com](http://www.spraypolyurethane.com).
  - ACC Diisocyanates Panel (DII):
    - [http://www.americanchemistry.com/s\\_acc/sec\\_iso.asp?CID=1547&DID=5866](http://www.americanchemistry.com/s_acc/sec_iso.asp?CID=1547&DID=5866)
- Spray Polyurethane Foam Alliance (SPFA)
  - [www.sprayfoam.org](http://www.sprayfoam.org) - Select "Health & Safety"
- U.S. National Institute of Occupational Safety and Health (NIOSH)
  - [www.cdc.gov/niosh/topics/isocyanates](http://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.

## Appendix E-3: Interior Spray Polyurethane Foam Applications

# Guidance Document

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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-3: Interior Spray Polyurethane Foam Applications

## 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	Equipment Maintenance	Gas and Aerosol Application	Interior SPF Application	Hoisting and Clamping
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](http://www.sprayfoam.org)



## Appendix E-3: Interior Spray Polyurethane Foam Applications

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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](http://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](http://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](http://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](http://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](http://www.americanchemistry.com/polyurethane) or  
[www.spraypolyurethane.com](http://www.spraypolyurethane.com)

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## Appendix E-4: Exterior Spray Polyurethane Foam Applications

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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.

For more Information: [www.spraypolyurethane.com](http://www.spraypolyurethane.com)

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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 disposable 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 days (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.

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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](http://www.americanchemistry.com/polyurethane) - Select "Safety" or "Health"
    - [www.americanchemistry.com/spf](http://www.americanchemistry.com/spf) or [www.spraypolyurethane.com](http://www.spraypolyurethane.com)
    - "Health & Safety Aspects of SPF Applications" DVD - 2002. [www.americanchemistry.com/polyurethane](http://www.americanchemistry.com/polyurethane) - Select "Order Publications".
    - "Safe Handling of Diphenylmethane Diisocyanate (MDI)" - 2007. [www.americanchemistry.com/spf](http://www.americanchemistry.com/spf) or [www.spraypolyurethane.com](http://www.spraypolyurethane.com).
  - ACC Diisocyanates Panel (DII):
    - [http://www.americanchemistry.com/s\\_acc/sec\\_iso.asp?CID=1547&DID=5866](http://www.americanchemistry.com/s_acc/sec_iso.asp?CID=1547&DID=5866)
- Spray Polyurethane Foam Alliance (SPFA)
  - [www.sprayfoam.org](http://www.sprayfoam.org) - Select "Health & Safety"
- U.S. National Institute of Occupational Safety and Health (NIOSH)
  - [www.cdc.gov/niosh/topics/isocyanates](http://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 Sensitivity	Other and Alternative Methods	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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## Appendix E-4: Exterior Spray Polyurethane Foam Applications

# Guidance Document

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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](http://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](http://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 website at [www.americanchemistry.com/polyurethane](http://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:

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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

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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.lawcornell.edu/uscode/15/uscode\\_15\\_00000045-000-.html](http://www.lawcornell.edu/uscode/15/uscode_15_00000045-000-.html)

The Green Guides:

<http://www.ftc.gov/bcp/ftnrules/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.epsc.gov/BUSINFO/ftsa.pdf>

#### For more information, visit:

The American Chemistry Council's Center for the Polyurethanes Industry

[www.americanchemistry.com/polyurethane-of](http://www.americanchemistry.com/polyurethane-of)

[www.spraypolyurethane.com](http://www.spraypolyurethane.com)

Spray Polyurethane Foam Alliance

[www.sprayfoam.org](http://www.sprayfoam.org)

Published August, 2009. This document may be updated. For the most current version of this document, see [www.americanchemistry.com/polyurethane](http://www.americanchemistry.com/polyurethane), [www.spraypolyurethane.com](http://www.spraypolyurethane.com), or [www.sprayfoam.org](http://www.sprayfoam.org).

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**Appendix F: Helpful Internet Resources**

<b>List of Helpful Internet Resources</b>	
Center for the Polyurethanes Industry (CPI) of the American Chemistry Council	<a href="http://www.americanchemistry.com/polyurethane">www.americanchemistry.com/polyurethane</a> <a href="http://www.spraypolyurethane.com">www.spraypolyurethane.com</a>
Spray Polyurethane Foam Alliance	<a href="http://www.sprayfoam.org">www.sprayfoam.org</a>
OSHA homepage	<a href="http://www.osha.gov">www.osha.gov</a>
NIOSH homepage	<a href="http://www.cdc.gov/niosh">www.cdc.gov/niosh</a>