

# SELF-EVALUATION TOOL FOR PROFESSIONAL SPRAY POLYURETHANE FOAM (SPF) INSULATION APPLICATION AND RELATED ACTIVITIES

## Background

EPA has been working with other federal Agencies and the spray polyurethane foam (SPF) sealants and insulation industry to increase awareness of health and environmental concerns associated with SPF activities and to identify and promote safer, cleaner, and more efficient practices and technologies. To learn more about these stewardship efforts, visit [http://www.epa.gov/dfe/pubs/projects/spf/spray\\_polyurethane\\_foam.html](http://www.epa.gov/dfe/pubs/projects/spf/spray_polyurethane_foam.html).

## What Is this Tool?

This evaluation tool describes recommended safe work practices and strategies for helping to protect workers and building occupants and promote the safe use of SPF insulation. This document was created through a comprehensive literature review (see the bibliography), conference reports and presentations, as well as discussions with SPF installers and representatives of industry and trade associations.

This tool may help you periodically evaluate your company's current practices and technologies and identify areas where you should make improvements to protect your workers, other trade workers, bystanders, and residents/building occupants from potential exposures to substances and mixtures used in these products or generated during application or use of high-pressure, two-component SPF insulation. This tool complements contractor and client checklists for communicating recommended safe workplace practices that are designed to help contractors communicate with clients, and as a resource for installers and assistants on the day of application.

A comprehensive set of certification, accreditation, training, and technical materials is available from the Spray Polyurethane Foam Alliance (SPFA) and the Center for the Polyurethanes Industry (CPI) through their websites. Resources and training are also available from many of the product manufacturers and distributors. We hope these materials serve as complementary tools for continually improving safe work practices throughout the SPF industry.

This tool covers activities across four key operational phases: ongoing, pre-application, application, and post-application activities

- Ongoing activities:
  - Health and safety training and management
  - Equipment maintenance
  - Personal protective equipment (PPE) maintenance
- Pre-application activities:
  - Site planning
  - Spray zone isolation
  - Equipment setup
  - Ventilation
  - PPE

- Application activities:
  - Application—material and equipment considerations
  - Work practices
- Post-application activities:
  - Work practices
  - Housekeeping practices
  - Handling and disposal of drums, waste, and spills
  - Follow-up with the client

### **Instructions for Completing this Evaluation Tool**

Observe your operations in each of the four areas and record your answers to each question by checking the “yes” or “no” box as appropriate. Note that some of the questions will require observations and evaluation of work operations. Many of the questions ask whether workers have actually implemented the control onsite, not whether you’ve purchased the equipment. For example, you don’t get credit for purchasing equipment for onsite ventilation; you get credit for consistently using the equipment in your operations.

#### **✓ Interpret your results**

Track improvement over time by comparing how many questions received “yes” answers in each operational phase to assess how well you are doing at following safer work practices to protect your workers and others. More importantly, target “no” answers as areas for improvement, and assess improvement in these areas at the time of follow-up evaluation.

#### **✓ Perform follow-up evaluations to monitor your improvement efforts**

Allow a reasonable length of time (6 to 12 months) to ensure that improvements you have made become standard operating practice. Then use this tool again to re-evaluate your job sites and check on the effectiveness of your improvement efforts. This tool has “Baseline” and “Follow-up” columns to help you compare your results and assess your progress.) You should continue to use the tool periodically to ensure consistent use of appropriate workplace practices and to identify other areas for improvement. Note that this tool is not a regulatory compliance tool; however, some of the practices included in it may be mandated by EPA and OSHA regulations and/or standards. Where this is the case, the specific EPA or OSHA standard that may apply is noted in brackets and italics after the question associated with the relevant practice.

## I. Ongoing Activities

Recommended Practice and Self-Evaluation Questions	Rationale for Practice: Exposure Impacts and Additional Tips	Baseline Activity Complete? (Yes/No)	Follow-up Activity Complete? (Yes/No)
<b>Health and Safety Training and Management</b>			
<b>Practice: Provide appropriate health and safety, equipment, and installer training before beginning work on site. Provide periodic refresher training to all employees.</b>	Initial and periodic training are important for building and maintaining awareness of safety practices and proper use of equipment.		
Have workers received training on the hazards of the chemicals they use? [29 CFR 1910.1200(h)]	The OSHA Hazard Communication standard specifies that workers must be trained on the hazards of the chemicals they use or could be exposed to in the workplace.		
Is the training documented?	Documentation will allow you to know who has training and who may need training, refresher or otherwise. Documentation can also be an important tool for certification and compliance.		
Do you ensure that installers have attended multi-day spray foam training classes, such as those offered by chemical manufacturers and/or trade associations (e.g., the Spray Polyurethane Foam Alliance [SPFA], the Air Barrier Association of America [ABAA], RESNET, SPF System Houses)?	Training will ensure that installers and other workers know how to avoid exposures. Installer training will also minimize the potential for off-ratio foam, which can impact foam quality and potentially cause odor problems or health effects for workers and returning building occupants. Note that some chemicals used in spray foam, such as methylene diphenyl diisocyanate (MDI), may be odorless or have higher odor thresholds than their exposure standards. Take caution to prevent overexposure to workers, bystanders, and other building occupants.		
Does your company take advantage of free courses offered by distributors, insurance carriers, and equipment manufacturers?	Free online health and safety awareness training and testing is available at <a href="http://spraypolyurethane.org">http://spraypolyurethane.org</a> .		

Recommended Practice and Self-Evaluation Questions	Rationale for Practice: Exposure Impacts and Additional Tips	Baseline Activity Complete? (Yes/No)	Follow-up Activity Complete? (Yes/No)
<b>Practice: Develop a written safety plan</b>	Developing a written safety plan helps ensure management of hazards and compliance with regulatory requirements.		
Do you keep a written safety plan meeting all OSHA, state, and local safety requirements for installers? <i>[Fennell, 2012]</i>	<p>Keep an onsite copy of a written safety plan for installers and other workers.</p> <p>OSHA offers sample programs and eTools that can help employers develop customized programs/plans for required and recommended programs such as respiratory protection, general safety and health, hazard communication, confined spaces, emergency action, and fire prevention.</p> <p>See "Sample Programs:"  <a href="http://www.osha.gov/dcsp/compliance_assistance/sampleprograms.html">http://www.osha.gov/dcsp/compliance_assistance/sampleprograms.html</a>  #OSHA.</p> <p>This link also provides sample safety and health tools from state consultation programs. State requirements may be more stringent than federal OSHA requirements.</p>		
<b>Practice: Develop and implement an effective hazard communication (HAZCOM) program.</b>	OSHA requires that any company whose employees could be exposed to hazardous chemicals have a written hazard communication program to ensure that employees understand the hazards of the chemicals they work with and the handling practices needed to work with them safely.		
Does the company have a written HAZCOM program? <i>[29 CFR 1910.1200(e)]</i>	A HAZCOM program ensures that chemicals are properly inventoried, that Safety Data Sheets (SDSs, formerly called Material Safety Data Sheets/MSDSs) are maintained for all chemical products, that chemical containers are labeled with identity and hazard information, and that employees are trained on the hazards and safety precautions for the chemicals with which they work.		

Recommended Practice and Self-Evaluation Questions	Rationale for Practice: Exposure Impacts and Additional Tips	Baseline Activity Complete? (Yes/No)	Follow-up Activity Complete? (Yes/No)
Does the company have copies of SDSs for all hazardous chemicals used by employees? [29 CFR 1910.1200(g)(1)]	<p>The company must have an SDS for each substance or product containing hazardous chemicals used or present in the workplace. A company should receive SDSs with the chemicals/products it purchases. Chemical manufacturers and distributors are required to provide SDSs for all of the hazardous chemicals they sell or distribute. If a company cannot locate an SDS/MSDS for a product, it can obtain one from the product manufacturer or distributor. Chemical manufacturers and distributors must send updated SDS's when there are changes to the SDS (1910.1200(g)(6).</p> <p>Note that OSHA requires that employee exposure records be retained for 30 years. While SDSs and chemical inventories need not be retained, some record of the chemicals used, and where and when they were used, must be retained for 30 years. [29 CFR 1910.1020(d)(1)(ii)]</p>		
Do you keep a binder at the job site containing SDSs, equipment operating manuals, contracts, product technical sheets, emergency contacts, and best practices materials? [CPI, 2010]	Keeping technical and safety reference information on site is important to ensure that workers can access the information.		
Do you ensure that workers are familiar with the information contained in SDSs, technical data sheets, labels, and other chemical/product directions? [29 CFR 1910.1200(h)]	The SDS and other hazard communication resources inform workers about each product's health hazards and any protective measures recommended by the product manufacturer or supplier. It is important that workers know the dangers so that they can protect themselves.		
Are SDSs readily accessible, and are workers aware of how to access them? [29 CFR 1910.1200(g)(8); 1910.1200(h)(2)(iii)]	HAZCOM requires that SDSs be readily accessible to employees. Note: electronic access to SDS's is allowed.		

Recommended Practice and Self-Evaluation Questions	Rationale for Practice: Exposure Impacts and Additional Tips	Baseline Activity Complete? (Yes/No)	Follow-up Activity Complete? (Yes/No)
<b>Practice: Develop a plan for emergencies.</b>	Planning will mitigate the impact of an incident, should one occur.		
Do you have a plan to respond to emergencies, or evacuate if an emergency occurs? [29 CFR 1910.120(q)(1), 1910.38]	<p>Fires, spills, and other emergencies involving MDI (and other chemicals) require an immediate response by trained and knowledgeable personnel. Additional guidance is available <b>24 hours a day at 1-800-424-9300 from CHEMTREC®</b>, the Chemical Transportation Emergency Center, for any emergency involving a fire, leak, spill, or personnel exposure.</p> <p>Employers who expect their own employees to respond to emergency releases must have a written emergency response plan in accordance with the OSHA Hazardous Waste Operations and Emergency Response (HAZWOPER) standard. Alternatively, employers who instruct their employees to evacuate must have an evacuation plan known as an “emergency action plan.”</p> <p>If workers have not been trained to respond to an emergency, they must leave the area immediately and notify the appropriate emergency response personnel. Consider including in your emergency action plan a site/building map identifying evacuation routes and muster area(s), and establishing evacuation procedures. [29 CFR 1910.120(q)(1), 1910.38]</p> <p>Emergency preparedness should also be included in your written respiratory protection program.</p>		

Recommended Practice and Self-Evaluation Questions	Rationale for Practice: Exposure Impacts and Additional Tips	Baseline Activity Complete? (Yes/No)	Follow-up Activity Complete? (Yes/No)
<b>Practice: Develop and implement an effective respiratory protection program.</b>	A respiratory protection program is needed to ensure that employees are medically able to wear a respirator, that employees understand how to properly use and maintain their respirators, and that their respirators fit properly and are kept clean and in good working order.		
Does the company have a written respiratory protection program? [29 CFR 1910.134(c)]	<p>A written respiratory protection program is required by the OSHA Respiratory Protection standard, 29 CFR 1910.134. This standard is intended to ensure that workers are provided with, and use, appropriate respiratory protection when needed to control inhalation of airborne hazardous chemicals in the workplace.</p> <p>One example of a respiratory program is CPI's model program for isocyanate exposures when applying truck bed liners:  <a href="http://polyurethane.americanchemistry.com/Resources-and-Documents/Library/7095.pdf">http://polyurethane.americanchemistry.com/Resources-and-Documents/Library/7095.pdf</a>.</p>		
Does the company use only NIOSH-certified respirators that provide an appropriate level of protection for each task? [29 CFR 1910.134(d)]	The Respiratory Protection standard requires that only NIOSH-certified respirators be used in the workplace.		
Does the company provide medical evaluations to workers who must wear respirators? [29 CFR 1910.134(e)]	The Respiratory Protection standard requires that workers receive medical evaluations before they may wear respirators in the workplace. The evaluation is intended to ensure that the worker is physically able to wear a respirator. See the OSHA standard for more information on acceptable medical evaluations.		
Do workers who wear tight-fitting respirators receive annual fit tests with the type and size of respirator that they use? [29 CFR 1910.134(f)]	Annual fit tests are required to ensure the proper fit and effectiveness of tight-fitting respirators. Fit tests must be performed with the type and size of respirator that the worker uses in the workplace. Fit tests need to be repeated if a change in physical condition has occurred that could affect respirator fit, such as dental changes, facial scarring, cosmetic surgery, or an obvious change in body weight.		

Recommended Practice and Self-Evaluation Questions	Rationale for Practice: Exposure Impacts and Additional Tips	Baseline Activity Complete? (Yes/No)	Follow-up Activity Complete? (Yes/No)
Does the company owner/manager ensure that workers who wear tight-fitting respirators do not have facial hair that would interfere with the respirator seal? [29 CFR 1910.134(g)(1)(i)(A)]	Beard growth may compromise the face seal and result in leakage of contaminated air inside the respirator. Positive pressure loose-fitting respirators are an option for people with facial hair.		
Does the company ensure that, when air-purifying respirators (APRs) are used, the type of cartridges used is appropriate for the hazard? [29 CFR 1910.134(d)(1)]	Selection of appropriate air-purifying elements is needed to ensure that the respirator removes the contaminants in the air.		
Has the company implemented an appropriate cartridge change schedule for all APRs worn by workers? [29 CFR 1910.134(d)(3)(iii)(B)(2)]	If workers use APRs, the company must develop and implement a filter change-out schedule to ensure that organic vapor sorbent cartridges are changed before breakthrough occurs and the cartridges are no longer effective in removing contaminants. Employers must also ensure that particulate filters are changed before clogging of the filter leads to increased respirator leakage at the face seal.		
Does the company encourage workers wearing APRs to exit to a clean area when an increase in breathing resistance, facepiece leakage, or vapor breakthrough is noted? [29 CFR 1910.134(g)(2)(ii)]	Under hot working conditions, sweat may interfere with the seal of a tight-fitting respirator, and the user will need to exit the area to dry the face and reposition the respirator. Workers must exit to a clean area, and cartridges must be replaced, when cartridge filter clogging or sorbent breakthrough is noticed.		

Recommended Practice and Self-Evaluation Questions	Rationale for Practice: Exposure Impacts and Additional Tips	Baseline Activity Complete? (Yes/No)	Follow-up Activity Complete? (Yes/No)
<b>Practice: Develop and implement an effective PPE program.</b>	An effective PPE program addresses hazards; selection, maintenance, and use of PPE; training of employees; and monitoring to ensure ongoing effectiveness. PPE requirements will vary depending on the task and the hazards of the chemicals being used (consult SDSs) and should be described in a written hazard assessment. Proper PPE selection, use, and maintenance are needed to ensure that users are protected from the hazards.		
Do installers, assistants, and other workers consistently wear nitrile gloves (or other appropriate non-latex gloves) when working with hazardous chemicals? [29 CFR 1910.138]	Check SDSs and with glove manufacturers for suggested glove types.  Chemically resistant gloves such as nitrile, neoprene, butyl rubber, or PVC are recommended during setup, application and cleanup activities (latex gloves or uncoated fabric gloves should NOT be worn).		
Do installers, assistants, and other workers consistently wear coveralls and a headsock (unless a hooded respirator is used) when spraying? [29 CFR 1910.132(a)]	The isocyanates and solvents used in SPF can be damaging to the skin. Skin exposure to isocyanates can lead to sensitization and serious respiratory problems, such as asthma.		
Do workers wear appropriate eye protection? [29 CFR 1910.133(a)(1)]	Optimal eye protection is provided by a hooded or full facepiece respirator. For activities where such protection is not worn, such as trimming of partially cured foam, goggles should be worn to protect the eyes from irritating vapors, particles, and dust, together with appropriate respiratory protection. For rig-tending or other activities where a splash hazard exists, ANSI-rated safety glasses and/or a face-shield should be worn.		

Recommended Practice and Self-Evaluation Questions	Rationale for Practice: Exposure Impacts and Additional Tips	Baseline Activity Complete? (Yes/No)	Follow-up Activity Complete? (Yes/No)
<p><b>Practice: Implement effective training and practices to protect SPF from ignition sources.</b></p>	<p>Polyurethane foam insulation is combustible. Care must be taken to ensure that it is not exposed to temperatures in excess of 200°F, since foam can degrade and offgas toxic chemicals above this temperature. <i>[AY112, 1994]</i></p> <p>Fires involving SPF may release isocyanates, hydrogen cyanide, amines, and other toxic chemicals into the air. <i>[Blomqvist, 2005]</i></p>		
<p>Are activities coordinated with other trades to ensure that no “hot work,” such as welding, or plumbing activities involving a brazing or cutting torch, is performed in the spray area? <i>[29 CFR 1926.352; 1910.252]</i></p>	<p>Training and use of effective practices will minimize the potential for fire and exposure to combustion byproducts.</p>		
<p><b>Practice: Implement effective training and practices to protect employees from extreme temperature conditions on the job.</b></p>	<p>Training and use of effective practices will ensure that workers are aware of potential heat and cold stress hazards and are protected by appropriate controls.</p>		
<p>Are workers aware of and using controls, PPE, and application practices suited for exposures to extreme hot or cold working conditions? <i>[OSHA, 2001, 2012; ACGIH, 2011]</i></p>	<p>Attic temperatures may reach 140°F during the summer. Temperature and humidity can also affect installation and product performance.</p>		

Recommended Practice and Self-Evaluation Questions	Rationale for Practice: Exposure Impacts and Additional Tips	Baseline Activity Complete? (Yes/No)	Follow-up Activity Complete? (Yes/No)
<b>Practice: Evaluate and monitor work in confined spaces such as attics and crawl spaces.</b>	Work in attics may expose workers to temperature extremes. Attics and crawl spaces may have limited ventilation and restricted means of entry and exit, exposing workers to confined-space hazards. Spray application in a confined area may result in serious overexposure in the event of failure of the worker’s supplied air respirator (SAR), the ventilation system, or the spray equipment.		
Do you evaluate the spaces that workers enter to determine if they pose confined space hazards and, if so, implement appropriate protective practices and training? [29 CFR 1926.21(b)(6)]	Workers entering into confined spaces may be entering into areas that could have accumulated hazardous gases or that can become low oxygen environments, which can pose a risk for asphyxiation. In addition, isocyanates and other agents in the SPF are toxic and potentially flammable and present a fire hazard when used in spaces that are not adequately ventilated.		
Do you implement best practices for confined space entry, including entry procedures, an entry permit system, and worker training, as described in OSHA’s general industry confined space standard? [29 CFR 1910.146]	Implementing best practices will ensure that confined space hazards are controlled.		
<b>Practice: Implement effective fall protection training and practices.</b>	Falls from heights can result in serious injury or death. Training and effective practices addressing work at heights greater than 6 feet, working within 6 feet of a roof edge, and use of equipment such as scaffolds, ladders, or aerial lifts will ensure that workers are aware of potential fall hazards and are protected by appropriate controls.		
Do you evaluate the work site for fall hazards, including use of ladders, aerial lifts, or scaffolding? [29 CFR 1926.501]	Employers have a duty to protect their workers from fall hazards.		
Do you implement appropriate training and practices for use of stairs and ladders? [29 CFR 1926.1052(a); 1926.1053(b); 1926.1060]	Training and proper practices, including routine inspection of ladders, are important to help avoid injuries due to falls.		

Recommended Practice and Self-Evaluation Questions	Rationale for Practice: Exposure Impacts and Additional Tips	Baseline Activity Complete? (Yes/No)	Follow-up Activity Complete? (Yes/No)
Do you implement appropriate training and practices for use of scaffolding and aerial lifts? [29 CFR 1926.451; 1926.453; 1926.454]	Training and appropriate practices are important to help avoid injuries due to falls.		
Do you implement appropriate training and practices for fall protection? [29 CFR 1926.501; 1926.503]	Training and proper work practices are important to help avoid injuries due to falls.		
Do you evaluate the work site for tripping hazards, including stairs and use of hoses and electrical power cords, and implement effective training and practices? [29 CFR 1926.20(b)(2)]	Site evaluation and management of tripping hazards is important to help avoid injuries due to tripping.		
<b>Practice: Assign responsibilities to employees and management for implementing the safe practices listed throughout this table. Hire a consultant if needed for analyzing hazards and developing procedures and training.</b>	Assigning roles and oversight responsibility for safety is important for ensuring that safety programs are implemented and practices are followed. Frequently remind all employees that safety is everyone's responsibility and encourage sharing of best practice suggestions.		
Has the company assigned responsibilities for health and safety, including management commitment and employee involvement, worksite analysis, hazard prevention and control, and training for employees, supervisors, and managers? [OSHA Small Business Handbook]	By assigning responsibilities for health and safety, the owner will ensure that employees and management are focusing on health and safety issues on a daily basis and ensuring that health and safety procedures are consistently followed.		

Recommended Practice and Self-Evaluation Questions	Rationale for Practice: Exposure Impacts and Additional Tips	Baseline Activity Complete? (Yes/No)	Follow-up Activity Complete? (Yes/No)
Are employees and management given enough time, resources and support to implement the company's health and safety program? <a href="#">[OSHA Small Business Handbook]</a>	Achieving best practices can be challenging. Clear health and safety duties and the support of the owner are the keys to consistent use of protective equipment and practices.		
<b>Practice: Develop quality assurance practices for company accreditation.</b>	Accreditation and recordkeeping are important for quality assurance. Keep records of equipment settings and maintenance records, material names, system numbers, seasonal formulations, lot numbers, hazard communication records, and product samples.		
Do you keep records and samples? <a href="#">[Fennell, 2012]</a>	Sample and record retention is an important part of a quality assurance program.		
<b>Practice: Develop site-communication strategies.</b>	Onsite communication is essential to ensure that workers and clients (e.g., residents, bystanders, hiring firms) are protected through awareness of activities, potential hazards, and practices to prevent exposures.		
Are workers and clients aware of the type of work being performed, including application and post-application activities, potential for hazards, work zone exclusion, and exposure-reduction strategies? <a href="#">[CPI, 2010]</a>	<p>Awareness of hazards and exposure-reduction strategies will help bystanders understand the need to follow work zone isolation practices and help keep them safe from potential exposures. Awareness of ventilation requirements will help clients/bystanders understand the need to vacate the space.</p> <p>When communicating with residents and other building occupants, such as in schools, a more concise message is to describe that the building must be vacated during SPF installation.</p>		
Are workers and clients made aware of the potential hazards of all chemicals that will be used in the work area? <a href="#">[CPI, 2010]</a>	Bystanders and building occupants, including homeowners, should be informed regarding the hazards of the chemicals to be used at the site to protect them from potential exposure to chemicals and potential adverse health effects.		
Do workers and clients review labels, SDSs, technical bulletins, and manufacturer recommendations and installation instructions? <a href="#">[CPI, 2010]</a>	This will promote understanding of the potential for adverse health effects.		

Recommended Practice and Self-Evaluation Questions	Rationale for Practice: Exposure Impacts and Additional Tips	Baseline Activity Complete? (Yes/No)	Follow-up Activity Complete? (Yes/No)
<b>Practice: Establish work zone controls that will be used on site.</b>	Work zone isolation and exclusion practices are necessary to prevent potential exposures to clients/bystanders. These include establishing a safe work zone, vacating the work zone, establishing safe worker re-entry and resident re-occupancy times (i.e., when PPE is no longer needed for reentry), and safely re-entering the work zone.		
Do you evaluate and establish work zone controls? [29 CFR 1910.1000; 29 CFR 1926.55, "Air Contaminants"]	<p>OSHA requires engineering controls to be used whenever feasible to reduce exposures to hazardous airborne contaminants such as isocyanates, which are a major component of SPF. Isolating the spray application area and using exhaust fans will prevent contaminant migration to adjacent areas. Excluding unprotected bystanders from the work zone during spray application and curing is necessary to prevent exposures. Note that some chemicals used in spray foam, such as MDI, may be odorless or have higher odor thresholds than their exposure standards. Take caution to prevent overexposure to workers, bystanders, and other building occupants.</p> <p>Various manufacturers recommend resident re-occupancy times of 23 to 72 hours after application, due to foam curing time. Check with your manufacturer to determine the appropriate times for the SPF product(s) being used. Product-specific re-entry times are important to decrease the potential for chemical exposure.</p>		
Do you use ventilation strategies during application and curing stages? [EPA, 2011; 29 CFR 1926.55]	OSHA requires engineering controls such as ventilation to be used whenever feasible to reduce exposures to hazardous airborne contaminants (i.e., isocyanates, amines, aldehydes, blowing agents, volatile organic compounds [VOCs]). EPA offers specific guidance on establishing <a href="#">ventilation strategies</a> for SPF application.		
Are required PPE practices observed in the work zone?	PPE requirements within the work zone and vicinity need to be followed to protect workers.		
<b>Equipment Maintenance</b>			
<b>Practice: Ensure proper maintenance and cleaning of equipment.</b>	Proper maintenance and cleaning are needed to ensure reliable, optimal performance of equipment and ensure foam quality.		

Recommended Practice and Self-Evaluation Questions	Rationale for Practice: Exposure Impacts and Additional Tips	Baseline Activity Complete? (Yes/No)	Follow-up Activity Complete? (Yes/No)
Do you inspect hoses before going to the job site? <i>[CPI, 2010]</i>	Hoses can rupture if weakened, resulting in release of liquid product. Broken heating elements for hoses can cause crystallization in the lines.		
Do you replace worn or damaged parts or discard them if defective? <i>[CPI, 2010]</i>	Never attempt repair if the hose has leaks, cuts, abrasions, bulges, or couplings with damage or movement. Ensure that hose heating elements are in working order. <i>[CPI, 2010]</i>		
Do you ensure that the screens at the proportioner inlet and the screens at the gun are cleaned at least weekly? <i>[interviews, 2012]</i>	Clogging of screens may lead to off-ratio foam due to uneven flow of A and B chemicals.		
Do you ensure that guns are cleaned after each day's use using suitable solvent, avoid using excess grease in the gun, and keep a spare gun at the job site in case of malfunction? <i>[SPFA, 2010; interviews, 2012]</i>	Inadequate cleaning and excessive grease will interfere with proper gun function, which may affect spray application.  Wear appropriate heavy-duty gloves for solvent cleaning. For example, when a malfunction occurs, hand the gun off to the rig tender.		
Do users ensure that the gun safety lock is engaged when not in use? <i>[ICAA, 2011]</i>	Safety practices are important for installers and for other workers on site, or when storing equipment.		
Do you follow the pressure relief procedure before cleaning, checking, or servicing equipment, and when dispensing is completed? <i>[CPI, 2012]</i>	Proper pressure-relief procedures are necessary to prevent chemical splashing.		

Recommended Practice and Self-Evaluation Questions	Rationale for Practice: Exposure Impacts and Additional Tips	Baseline Activity Complete? (Yes/No)	Follow-up Activity Complete? (Yes/No)
<b>PPE Maintenance</b>			
<b>Practice: Ensure that respirators and other PPE are properly cleaned, maintained, and stored.</b>	Proper cleaning, maintenance, and storage of respirators and other PPE will ensure proper fit and protection.		
Do you ensure the PPE is maintained in a sanitary and reliable condition, and that defective PPE is not used? [29 CFR 1910.132(a); 1910.134(e)]	Proper cleaning, maintenance, and storage of PPE will ensure proper fit and protection.		
Do you ensure that respirators are cleaned and disinfected after each day's use, allowed to air-dry, sealed in a bag to protect from dust, and stored in a clean area protected from sunlight? [29 CFR 1910.134(h)]	Proper cleaning, disinfection, and storage of respirators will ensure cleanliness and proper fit.		
Do you ensure that respirators are inspected before each use and during cleaning? [29 CFR 1910.134(h)(3)]	Respirator inspection is necessary to ensure that protective equipment is in good working order.		
Do your workers ensure that foam residue does not interfere with field of vision or with proper function of inhalation and exhalation valves? [29 CFR 1910.134(g)(1)(i)(B)]	Maintaining field of vision is important to prevent accidents such as tripping. Maintaining valve function is necessary to ensure proper protection from a respirator.		
Do you work with respirator manufacturers to establish appropriate cartridge change schedules? [29 CFR 1910.134(d)(3)(iii)(B)(2)]	Proper cartridge change schedules are important to prevent contaminant migration through sorbent cartridges and clogging of particulate filters. Note that humid conditions may require more frequent cartridge change.		

Recommended Practice and Self-Evaluation Questions	Rationale for Practice: Exposure Impacts and Additional Tips	Baseline Activity Complete? (Yes/No)	Follow-up Activity Complete? (Yes/No)
When setting up a SAR, is the air pump inlet located away from possible sources of contamination, such as exhaust from trucks and lift equipment and compressors for spray equipment? <i>[IRSST, 2009]</i>	Locating the compressor in a clean area will ensure that clean air is delivered to the SAR.		

## II. Pre-application Activities

Recommended Practice and Self-Evaluation Questions	Rationale for Practice: Exposure impacts and Additional Tips	Baseline Activity Complete? (Yes/No)	Follow-up Activity Complete? (Yes/No)
<b>Site Planning</b>			
<b>Practice: Work with clients—and heating, ventilation and air conditioning (HVAC) and/or design specialists if needed—to evaluate and plan for long-term ventilation needs.</b>	Tightening a building by installing spray foam may affect pressure relationships between occupied spaces, combustion appliance zones, and crawl spaces due to decreased natural ventilation. Living spaces should be positively pressurized relative to attics, crawl spaces, and combustion appliance zones to prevent odors from migrating into living spaces, which may cause health effects for returning building occupants. Review ASHRAE and other building codes/standards, including local and state codes.		
Do you plan for adequate makeup air into combustion appliance zones that may be impacted by spray foam application? <i>[interviews, 2012]</i>	Makeup air is needed to ensure proper chimney draft for combustion appliances, such as furnaces and hot water heaters.		
Do you ensure that air will not infiltrate into living spaces from attics and crawl spaces once spray foam application is completed? <i>[ASHRAE 62.2-2010]</i>	Air infiltration will occur if occupied spaces are under negative pressure relative to attics and crawl spaces. Proper pressure relationships can be ensured either by providing exhaust from the unoccupied spaces or by assuring an appropriate path is available for makeup air into occupied spaces.		
<b>Practice: Ensure that a thermal barrier such as sheet rock is installed to protect spray foam before any “hot work” is performed.</b>	Spray foam may burn, releasing toxic combustion byproducts. Plumbers commonly use a torch to “sweat pipe.”		
Do you evaluate the worksite for work by other trades that might involve hot work, and are precautions communicated and thermal barriers installed? <i>[AX396, 2008]</i>	Ensure that no “hot work,” such as welding or plumbing activities involving a brazing or cutting torch, is performed in the spray area, or near spray foam insulation, including foam scraps or trimmings. Ensure that cured foam is protected by a thermal or ignition barrier, such as gypsum board (sheet rock), before hot work is performed. <i>[CPI, 2011]</i>		

Recommended Practice and Self-Evaluation Questions	Rationale for Practice: Exposure impacts and Additional Tips	Baseline Activity Complete? (Yes/No)	Follow-up Activity Complete? (Yes/No)
<b>Practice: Consider wind speed. Do not apply foam outdoors if wind speeds are above the manufacturer's recommended levels.</b>	Excessive wind speeds can interfere with spray deposition on the substrate.		
Are wind speeds monitored and schedules adjusted accordingly in planning a job? [IRRST, 2009; CPI, 2010]	General guidance ranges from 6 mph [IRRST, 2009] to 15 mph [CPI, 2010], or higher if wind screens are used. Note that wind screens would be inappropriate for work from aerial lifts or elevated work platforms due to increased risk of tipover. [IRRST, 2009]		
<b>Practice: Plan for temperature and humidity conditions.</b>	<p>Proper temperature conditions are needed to ensure proper foam development. If the product is too cold, the foam may not develop properly. If the substrate is too cold, the foam may not adhere properly. Foam may form cracks if the air temperature drops during curing. Proper foam quality is important for ensuring its insulation value.</p> <p>In general, the difference between the ambient temperature and the substrate temperature should be less than 17°C (approximately 31°F). [IRSST, 2009/CAN/ULC-S705.2-05 standard]</p>		
Do you ensure that air and substrate temperatures are within the manufacturer's specifications for the product being used? [interviews, 2012]	Substrate compatibility and adequate adhesion should be verified before the work begins.		
Do you use the manufacturer's formulation that matches the environmental conditions (winter formulation versus summer formulation)? [interviews, 2012]	In spring and fall, it may be necessary to use winter formulation in the morning and summer formulation in the afternoon, particularly for work in attics, which heat up markedly over the course of the day.		
In winter, do you preheat the space and provide heat during spray foam application and throughout foam curing? [interviews, 2012]	It is necessary to maintain heat in the space to prevent the foam from shrinking and pulling away from the substrate as it cools. Use dry heat sources, such as plug-in radiators or portable heaters that blow hot air in from outside the space. Do not use combustion heaters inside the spray zone due to the risk of fire. [interviews, 2012; Fennell, 2012]		

Recommended Practice and Self-Evaluation Questions	Rationale for Practice: Exposure impacts and Additional Tips	Baseline Activity Complete? (Yes/No)	Follow-up Activity Complete? (Yes/No)
Do you ensure that relative humidity is within limits recommended by the SPF manufacturer's printed instructions, and ensure that indoor spray areas are free of moisture sources for 24 hours before application, during application, and until curing is completed? <i>[interviews, 2012; Fennell, 2012]</i>	Consider activities of other trades and schedule accordingly. Moisture from unvented combustion heaters or drying plaster can lead to surface moisture, resulting in poor foam adhesion to the substrate. Humidity in the air and moisture on surfaces can result in off-ratio B-rich foam, which can produce persistent chemical odors after installation.		
Do you periodically monitor the dew point throughout the job, ensure that ambient temperatures are at least 5° above the dew point, and ensure that substrates are dry, before applying foam? <i>[SPFA, 2010; Knowles, 2010]</i>	Cold metal surfaces should be checked for condensation and dried before applying foam. Test the surface for moisture before applying foam. A moisture meter can be used. For masonry, another approach is to tape an 18" x 18" sheet of clear plastic to the concrete, making sure it's sealed on all four sides. If condensation appears on the plastic or if the surface of the concrete darkens after 16 hours, the concrete is too wet for foam. <i>[Knowles, 2010]</i>  Moisture content for wood must be below 18%. <i>[AY112, 1994]</i> Concrete must cure for 28 days before spray foam application. <i>[Knowles, 2010]</i>		
<b>Practice: Take steps to manage heat stress. In the summer, attic temperatures can reach 140°F.</b>	Heat stress can cause serious health effects and also limits job productivity. Proper controls including rest breaks are needed to minimize heat stress hazards. <i>[OSHA, 2001, 2012]</i>		
Do you take steps to condition the work space such as running a water sprinkler on the roof, which can drop the temperature inside the attic by 30°F? <i>[interviews, 2012]</i>	Reduction of indoor temperatures improves working conditions.		
Do you consider working at night to reduce heat stress and to avoid other trades? <i>[interviews, 2012]</i>	Working at night reduces indoor temperatures and reduces potential for other workers to enter the work zone during application.		

Recommended Practice and Self-Evaluation Questions	Rationale for Practice: Exposure impacts and Additional Tips	Baseline Activity Complete? (Yes/No)	Follow-up Activity Complete? (Yes/No)
<b>Spray Zone Isolation</b>			
<b>Practice: Restrict access to areas where spray foam is being installed.</b>	Restricting access is necessary to prevent people who do not have the necessary awareness training and PPE from being exposed.		
Are only trained installers with appropriate PPE allowed entry into the work zone? [CPI, 2010]	This will prevent individuals who do not have the necessary awareness training and PPE from being exposed.		
Do you establish an exclusion zone, unless the spray area is enclosed, and do you post warning signs stating that respirators are required? [CPI, 2010]	Distance (or enclosure) is necessary to protect other trades or bystanders from spray that might migrate away from the point of application. Although 25 feet is often suggested, a greater distance may be needed under certain building, atmospheric, or wind flow conditions. Industry studies have shown that detectable concentrations of SPF chemicals may be present at 25 feet, and that an exclusion zone greater than 25 feet may be needed. [Ecoff and Lambach, 2012]		
Do you vacate other trade workers, building or home occupants, and other potential bystanders during application, foam curing, trimming, and cleanup? [ICAA, 2011]	Restricting access to spray areas throughout curing, trimming and cleanup is needed to avoid exposures to chemicals, vapors, and/or dust.		
Do you evaluate and communicate manufacturer's guidelines regarding re-occupancy times for workers not wearing PPE and returning occupants? [CPI, 2010]	Use caution when determining a safe re-occupancy time. Twenty-four hours has been described as a typical guideline for professional-grade two-component foam [ICAA, 2011]; however, re-occupancy time will vary based on the unique characteristics of each site and product. Some manufacturers may offer different guidelines for trade workers than for other building occupants. Proper respiratory protection is required until the reentry time has concluded. Re-occupancy should be restricted until the product has finished curing and the building has been adequately ventilated and cleaned, to prevent exposures to airborne chemical vapors associated with the normal curing process.		

Recommended Practice and Self-Evaluation Questions	Rationale for Practice: Exposure impacts and Additional Tips	Baseline Activity Complete? (Yes/No)	Follow-up Activity Complete? (Yes/No)
Do you isolate the area using fire-resistant plastic sheeting, and do you take care not to seal emergency exit routes? <i>[CPI, 2010]</i>	<p>Emergency exits are necessary to ensure that workers can quickly and safely exit in the event of a fire, or failure of SAR, ventilation, or spray equipment.</p> <p>Seal the overlapping seams with tape. Seal off air handlers, heat pumps, air registers, vents, ducts, windows, doors, lights, and other fixtures in the spray area. Use plastic sheeting rated as fire-resistant by the National Fire Protection Association (NFPA 701-04 Test 1).</p>		
Do you make sure HVAC systems are turned off and/or sealed, for indoor applications or where outdoor applications may migrate into the indoor environment? <i>[EPA, 2011]</i>	<p>Sealing off vents is necessary to prevent migration of chemicals, vapors, and/or dust into adjacent areas where other trades or bystanders may be present.</p> <p>If occupied spaces in larger commercial buildings require heating/air conditioning during work, ensure that the HVAC branches are isolated, and implement depressurization and control of mechanical systems.</p>		
Do you plan for makeup air by leaving some area open at the end opposite the exhaust fan? <i>[EPA, 2011]</i>	Well-designed ventilation strategies increase air exchange and reduce potential for exposure.		
Do you wait 24 hours or longer after completion of application before removal of sheeting and startup of building HVAC? <i>[CPI, 2010]</i>	Waiting will allow foam to cure and reduce potential for migration of chemicals throughout the building once the HVAC is turned on.		
Do you extinguish all sources of flame, including pilot lights, before beginning spray foam application? <i>[CPI, 2012]</i>	Spray foam may burn, releasing toxic combustion products.		
<b>Equipment Setup</b>			
<b>Practice: Ensure that application equipment has adequate size and pressure to meet the manufacturer's specifications for the product being used.</b>	If the pressure is inadequate, the material will be under-processed. The foam structure will not develop properly, and may be off-ratio, resulting in odor problems or health effects for workers and returning building occupants.		

Recommended Practice and Self-Evaluation Questions	Rationale for Practice: Exposure impacts and Additional Tips	Baseline Activity Complete? (Yes/No)	Follow-up Activity Complete? (Yes/No)
Do you ensure that the gun is properly sized for the job? <i>[interviews, 2012]</i>	<p>If the gun is too big, there will be more overspray. A smaller gun may need to be used in tight spaces such as crawl spaces.</p> <p>Overspray can result in increased potential for inhalation and dermal exposure, and can create voids in the foam.</p>		
Do you ensure that gun tips (plugs/orifices) are appropriate for the type of spray application (e.g., roof application versus interior application)? <i>[interviews, 2012]</i>	Proper orifices are needed to produce the right spray pattern for the job.		
Do you use a primary heater and heated hoses to ensure proper product temperatures; ensure that equipment is warmed up and adjusted before applying foam; and ensure that chemicals are at the proper temperature before use, as per the manufacturer's specifications? <i>[SPFA, 2010; interviews, 2012]</i>	<p>If the product is not heated to 140°F, it might not react fully due to increased viscosity and poor mixing, resulting in poor foam quality and leaving unreacted amine catalyst. If the chemicals are too hot, there will be more overspray, leading to more exposure. <i>[interviews, 2012]</i></p> <p>Drum heaters may also be needed, particularly if air temperatures are below freezing. Preferably, drums should be no cooler than room temperature when delivered to the site. <i>[interviews, 2012]</i></p>		
Do you loosen the bung to release pressure before heating B-side drums? <i>[CPI, 2010]</i>	Heating an unvented B-side drum may result in pressure buildup. Use gentle agitation to ensure even heating. <i>[CPI, 2010]</i>		
Do you consider other impacts extreme temperatures may have on equipment? <i>[interviews, 2012]</i>	<p>On cold days it may be necessary to decrease the size of the mix chamber in the gun to heat the material. <i>[interviews, 2012]</i></p> <p>The product temperature at the gun affects the spray pattern and foam texture and quality. <i>[SPFA, 2010]</i></p>		
Do you use computer-controlled proportioners with inlet temperature and pressure monitors to ensure a proper ratio of A- and B-side chemicals? <i>[SPFA, 2010]</i>	Temperature and ratio monitoring will ensure proper mixing of chemicals and prevent application of off-ratio foam.		

Recommended Practice and Self-Evaluation Questions	Rationale for Practice: Exposure impacts and Additional Tips	Baseline Activity Complete? (Yes/No)	Follow-up Activity Complete? (Yes/No)
Do you use a closed circuit drum pump? <i>[IRSST, 2009]</i>	Using a closed circuit drum pump will reduce potential exposure during liquid transfer.		
Do you ensure that all spray foam equipment is electrically grounded and use ground fault circuit interrupters (GFCIs)? <i>[ICAA, 2011]</i>	This is necessary to protect employees from the risk of electric shock and is OSHA-required on construction sites. Portable GFCI devices are available. Alternatively, you may implement an Assured Equipment Grounding Conductor Program (AEGCP).		
<b>Ventilation</b>			
<b>Practice: Implement ventilation strategies, including the use of exhaust fans, to ventilate the spray zone. <i>[EPA, 2011]</i></b>	Ventilation is needed to reduce exposures and prevent contaminant migration.		
Do you locate the exhaust discharge outdoors away from building air intakes, and ensure that ventilation exhaust areas are clear of bystanders and workers? <i>[EPA, 2011]</i>	Controlling access to the exhaust discharge area is important for preventing exposures to contaminants being exhausted from the spray zone.		
When feasible, do you consider using filtered exhaust fans or a “negative air machine” to exhaust the application area and create a negative pressure zone, and do you position the filter between the spray zone and the fan blades? <i>[EPA, 2011; interviews, 2012]</i>	<p>Establishing a negative pressure zone will prevent contaminant migration out of the application area.</p> <p>The filter should be before the exhaust fan to protect the fan blades from spray, which could decrease the fan’s performance. Change the filter periodically to avoid obstructing the airflow. The size of an exhaust fan should depend on the job and room size. <i>[EPA, 2011]</i></p>		
When using both supply and exhaust fans, do you ensure that your exhaust fan capacity is 10% greater than your supply fan to ensure directional, inward airflow? <i>[EPA, 2011]</i>	Directional, inward airflow will reduce worker exposures outside the spray zone. Use a smoke stick or pencil to check that there is inward airflow into the control zone. <i>[EPA, 2011]</i>		

Recommended Practice and Self-Evaluation Questions	Rationale for Practice: Exposure impacts and Additional Tips	Baseline Activity Complete? (Yes/No)	Follow-up Activity Complete? (Yes/No)
Do you position supply fans at the opposite end of the containment area, position the exhaust inlet as close as possible to the application site, start application at the point closest to the exhaust, and position the spray gun between the exhaust and the operator? <i>[EPA, 2011]</i>	Positioning supply fans at the opposite end of the containment area will help create movement of air toward the exhaust fan. Positioning the exhaust inlet near the point of spray application will capture overspray as it is generated, which will be more effective in reducing potential breathing zone exposure and contact with the worker's clothing and skin. When feasible, have the assistant reposition the exhaust inlet as the work progresses. <i>[EPA, 2011]</i>		
Whenever feasible, do you use an exhaust fan when applying foam in a crawl space or attic, and do you avoid blocking the entry/exit point with ventilation or spray equipment? <i>[CPI, 2010]</i>	Blocking the exit point creates a significant hazard in the event of an emergency such as equipment or respirator failure.		
Do you consider combustion appliances (e.g., furnace, hot water heater) being used in the building and whether it may be necessary to use a temporary fan to provide supply air to the furnace room? <i>[interviews, 2012]</i>	Supplying air to the furnace room is necessary to prevent backdraft due to the negative pressure spray zone. <i>[interviews, 2012]</i>		
After application is completed, do you continue running exhaust fans while the foam cures and until trimming and cleanup are complete? <i>[EPA, 2011]</i>	Keeping fans running will purge the space of odors produced by unreacted chemicals. Time is needed to allow dissipation of odors, such as amines. Foam will cure faster when fans are left running. Note that some chemicals used in spray foam, such as MDI, may be odorless or have odor thresholds higher than their exposure standards. Take caution to prevent overexposure to workers, bystanders, and other building occupants.		
<b>PPE</b>			
<b>Practice: Evaluate and identify the proper PPE needed for each task.</b>	The proper PPE for each task is important to prevent harmful exposures. Tasks with the highest exposure potential (application of SPF) should be matched by use of PPE with the best protection (i.e., SARs).		

Recommended Practice and Self-Evaluation Questions	Rationale for Practice: Exposure impacts and Additional Tips	Baseline Activity Complete? (Yes/No)	Follow-up Activity Complete? (Yes/No)
When handling contaminated equipment, do workers wear protective gloves, eye protection, and protective coveralls or apron? <i>[CPI, 2010]</i>	PPE is needed to prevent skin contact when handling contaminated equipment.		
When tending the rig, do workers wear safety glasses, chemically resistant gloves, and chemically resistant Saran-coated smock or apron with sleeves? <i>[OSHA, 2012; CPI, 2010]</i>	This will reduce contact with liquid, which could lead to sensitization. Handling liquid chemicals poses a splash hazard. Breathable coveralls such as Tyvek™ or Kleengard™, which are suitable for spray activities, do not provide adequate protection from liquid contact/spills.		
If handling open containers of heated chemicals, do workers wear APRs with organic vapor cartridges and N95 or P100 pre-filters? <i>[OSHA, 2012; CPI, 2010]</i>	When at room temperature, A- and B-side chemicals are not particularly volatile. Heating of chemicals increases the volatility, necessitating use of a respirator.		
For trimming, cutting, and scraping of foam, do workers wear chemically resistant gloves, clothing, eye protection (i.e., goggles) and respiratory protection? <i>[CPI, 2010]</i>	<p>PPE is needed to avoid exposure to product surfaces, dust, or particles that may contain isocyanates or other substances that have not had time to fully cure. <i>[Maddux and Carter, 2009]</i></p> <p>During cleanup, a half-face APR with combination organic vapor/N95 cartridge, with goggles, could be worn instead of the more protective full-face APR or SAR; however, use of a full-face APR provides better coverage and avoids frequent leakage problems associated with the use of goggles and half-face respiratory protection.</p>		

Recommended Practice and Self-Evaluation Questions	Rationale for Practice: Exposure impacts and Additional Tips	Baseline Activity Complete? (Yes/No)	Follow-up Activity Complete? (Yes/No)
<p>Is an appropriate NIOSH-approved respirator selected for indoor versus outdoor applications? [OSHA, 2012; CPI, 2010]</p>	<p>Proper respiratory protection is needed to prevent inhalation exposure.</p> <p>For indoor spray foam application, both the installer and the assistant (who may be standing nearby and/or may switch duties with the spray installer) should use only full-face or hooded supplied air (airline) respirators. Use only compressors approved for use with SARs. Locate the air inlet in a clean area, away from vehicle exhaust and the spray zone.</p> <p>For indoor spray foam application, wear a SAR whenever feasible, operated in positive pressure or pressure-demand mode.</p> <p>For outdoor applications, a full-face APR may be appropriate with the use of organic vapor cartridges with particulate pre-filters (for MDI exposures). Powered air-purifying respirators (PAPRs) that can provide cooling may also be considered, especially for outdoor applications on hot days.</p> <p>Some respirator manufacturers offer tight-fitting full-face respirators that can convert from APR to SAR configuration. The tight-fitting style might be preferred when working in tight spaces, since the hooded style does not always turn with the wearer’s head. [OSHA, 2012; CPI, 2010]</p>		
<p>Do you ensure that users of tight-fitting respirators are clean-shaven where the face seal meets the face, and provide prescription eyewear inserts for tight-fitting respirator wearers who need visual correction? [29 CFR 1910.134(g)(1)]</p>	<p>The hooded style is particularly helpful for employees who wear glasses or have facial hair and is also an effective way to provide improved cooling during summer conditions.</p> <p>If a hooded-style SAR is used, double-check the manufacturer’s “assigned protection factor.”</p>		

Recommended Practice and Self-Evaluation Questions	Rationale for Practice: Exposure impacts and Additional Tips	Baseline Activity Complete? (Yes/No)	Follow-up Activity Complete? (Yes/No)
Is the worker trained and equipped to manage fogging of the respirator visor, a common challenge particularly for indoor application? <i>[interviews, 2012]</i>	<p>Keeping the respirator visor clear is essential to ensuring compliance with wearing a respirator, installing quality foam, and avoiding safety hazards.</p> <p>Several approaches can be used to keep the visor (lens) clear on a respirator. You can apply multiple peel-off respirator lens covers, or use a lens cover with viewing frames that are advanced by turning a knob. Plastic transparencies can also be taped over the visor. Alternatively, the visor can be sprayed with a silicone-based foam release agent or “mold release” so that foam can be wiped off. <i>[interviews, 2012]</i></p>		
When APRs are worn, do workers wear organic vapor cartridges with N95 or HEPA pre-filters, and are appropriate cartridge change schedules established? <i>[CPI, 2010; OSHA, 2012]</i>	<p>Proper change schedules are necessary to prevent filter clogging, which can lead to respirator face-seal leakage, and to prevent vapor migration and sorbent breakthrough in the cartridges.</p> <p>Work with respirator manufacturers to select the appropriate cartridge and establish appropriate cartridge change schedules, which may vary depending on the intensity of exposure and strenuous activity. Daily cartridge change may be needed to avoid saturating the cartridge. Users should not rely on odor inside the respirator as a signal to change the cartridge. Some respirator cartridges may have an End of Service Life Indicator (ESLI); work with respirator manufacturers to understand the limitations of ESLIs.</p>		
Do workers wear chemically resistant gloves during setup, application, and cleanup activities (i.e., heavy-duty synthetic rubber gloves, such as nitrile, neoprene, butyl, PVC, PVA, chlorinated polyethylene, or fluoroelastomer [Viton™]), and do workers visually inspect gloves before use to be sure they are free of tears and abrasion? <i>[AX178, 2002]</i>	<p><i>Do not</i> wear latex gloves or uncoated fabric gloves. Visual tests confirm that uncoated fabric gloves are penetrated by spray foam.</p> <p>Consider wearing cotton work gloves on top to protect the chemically resistant gloves, or wearing two pairs of lightweight nitrile/neoprene gloves. If lightweight rubber gloves are worn, wear nitrile or neoprene, <i>not</i> latex or vinyl. Check the glove manufacturer’s product data to confirm appropriateness. Have a range of glove sizes available to improve user acceptance.</p>		

Recommended Practice and Self-Evaluation Questions	Rationale for Practice: Exposure impacts and Additional Tips	Baseline Activity Complete? (Yes/No)	Follow-up Activity Complete? (Yes/No)
<p>Do workers ensure wrist protection by taping the gloves to the coveralls using masking or other mildly adhesive tape, or wearing Tyvek™-type sleeves? <i>[interviews, 2012]</i></p>	<p>Taping the gloves to the suit will prevent exposure of the wrists, but using duct tape is likely to tear the suit.</p>		
<p>Do workers wear coveralls such as chemically protective Saran-coated coveralls, and if their coveralls tear, do they immediately exit the containment area and either tape over the tear with duct tape or replace the coveralls? <i>[OSHA, 2012; interviews, 2012]</i></p>	<p>Preventing skin contact is necessary because skin exposure can lead to skin irritation and sensitization. Skin is a likely exposure route to sensitization and subsequent inhalation exposures can cause asthma.</p> <p>In hot weather, a breathable suit such as Tyvek™ or Kleengard® may be preferred. <i>[CPI, 2010]</i></p>		
<p>Do workers wear head coverings such as spray socks, hooded coveralls, or hooded respirators for spray foam application? <i>[CPI, 2010; interviews 2012]</i></p>	<p>Preventing skin contact is necessary because skin exposure can lead to irritation and sensitization.</p>		

Recommended Practice and Self-Evaluation Questions	Rationale for Practice: Exposure impacts and Additional Tips	Baseline Activity Complete? (Yes/No)	Follow-up Activity Complete? (Yes/No)
<p>When not applying foam, do workers wear eye protection to protect the eyes from chemical splash and/or vapor hazards, as appropriate to the task? [OSHA, 2012]</p>	<p>Eye exposure to vapors from amine catalysts, for example when trimming foam, can cause irritation leading to halovision or “blue haze.” [AX173, 2011]</p> <p>Full-face and hooded respirators, when used, protect the eyes and face from splash and vapor hazards. If a half-face APR is used, goggles would also be needed whenever there may be a vapor hazard (e.g., when re-entering the application area before the foam has fully cured). The use of full-face or hooded respirators would be considered a safer practice in giving the worker more coverage and protection from leakage. [OSHA, 2012]</p> <p>Exposure to liquid splash can cause severe irritation. Wrap-around safety glasses may be appropriate for rig tending, and a face-shield is needed if a splash hazard exists (e.g., when changing drums or pouring chemicals). [CPI, 2010]</p>		
<p>Do workers wear either chemically resistant boot covers or booted coveralls for spray foam application? [CPI, 2010]</p>	<p>Preventing skin contact is necessary because skin exposure can lead to irritation and sensitization.</p> <p>If boot covers are worn, tape the boot covers to the coveralls.</p>		
<p>Do workers: remove coveralls before taking breaks and before leaving the job site; either decontaminate coveralls or bag them for disposal; and put on clean coveralls before resuming work? [IRSST, 2009]</p>	<p>Putting on coveralls that have not been decontaminated can transfer contamination from the outside of the suit to hands and other exposed skin.</p> <p>Tearing of coveralls exposes the skin to the aerosol during spray application. Keep spare coveralls on hand, as tearing may occur. Where breathable suits are worn, plan on using two suits per day. [interviews, 2012]</p> <p>Do not drive or ride in used coveralls. [IRSST, 2009]</p>		

Recommended Practice and Self-Evaluation Questions	Rationale for Practice: Exposure impacts and Additional Tips	Baseline Activity Complete? (Yes/No)	Follow-up Activity Complete? (Yes/No)
When workers remove PPE before breaks, do they take care to avoid transfer of contamination from gloves to other PPE?	<p>Liquid chemical can remain on the gloves after spray foam application and might be transferred to coveralls during removal.</p> <p>If double gloves are worn, remove the outer gloves, then the coveralls, then the respirator, and lastly the inner gloves. Where a single pair of gloves is worn, consider wiping the gloves with a cleaning wipe before removing other PPE.</p>		
Are protective suits visually inspected for tears before use, decontaminated before reuse, and replaced at appropriate intervals?	Some garments (such as breathable Tyvek™) are considered limited-use and will become more prone to tearing with repeated use. Do not reuse limited-use garments for more than one week. Tearing can result in skin exposure if it occurs during spray application.		
Are breathable garments discarded if direct liquid contact occurs?	Wipe test kits (Swype®) are available with colorimetric indicators to detect the presence of MDI.		
Are heavy-duty coveralls and heavy-duty gloves decontaminated using a water-based cleaner containing dilute, mild detergent/surfactant, or cleaning wipes?	<p>Do not use solvents to clean protective clothing or gloves: it can damage them and degrade their protective barrier properties.</p> <p>Refer to the PPE manufacturer for additional information on proper cleaning methods.</p>		
Do workers change into a clean set of street clothes upon leaving the job worksite or warehouse, store clean street clothes in a separate area from work clothes, and avoid taking home potentially contaminated work clothes? [IRSST, 2009]	This will reduce take-home contamination, which can lead to continued exposure after leaving the job site. Contaminated clothes can be treated with neutralizer solution before laundering. Contaminated leather items should be discarded.		
Are steps taken to manage heat stress, such as using a vortex cooler or “chillbox” to cool breathing air, or using air- or water-cooled vests under coveralls? [interviews, 2012]	<p>Heat stress can cause serious illness or death. Measures to provide cooling are essential.</p> <p>Supply air can also be cooled by running the air line through an ice chest. If a hooded-style SAR is worn, tucking the inner bib into the coveralls will provide cooling for the upper torso.</p>		

### III. Application Activities

Recommended Practice and Self-Evaluation Questions	Rationale for Practice: Exposure Impacts and Additional Tips	Baseline Activity Complete? (Yes/No)	Follow-up Activity Complete? (Yes/No)
<b>Application—Material and Equipment Considerations</b>			
<b>Practice: Use only clean, properly maintained equipment. [AY-137]</b>	Proper maintenance and cleaning in accordance with guidance from suppliers and product manuals is needed to ensure reliable, optimal performance of equipment and to ensure foam quality.		
Do you rotate stock (moving older product to the front of a pallet, shelf, etc.) so that it is used/taken to a job site before fresher product?	Stock rotation can play an important role in avoiding the formation of off-specification product.		
Do you ensure that chemical drums, hoses, and other equipment are warmed to the proper temperature before use, as per manufacturers' guidelines? [interviews, 2012]	If the product is not heated to 140°F, it might not react fully due to increased viscosity and poor mixing, resulting in poor foam quality and leaving unreacted amine catalyst. If the chemicals are too hot, there will be more overspray, leading to more exposure. [interviews, 2012]		
Do you ensure that proper equipment settings (e.g., pressure, temperature, proportioning) are used? [SPFA, 2010]	Temperature and ratio monitoring will ensure proper mixing of chemicals and prevent application of off-ratio foam. Off-ratio foam can cause odor problems and affect curing and product performance.		
Do you use computer-controlled proportioners with inlet temperature and pressure monitors to ensure proper ratio of A- and B-side chemicals? [SPFA, 2010]	Ensuring proper ratio of A- and B-side chemicals, according to manufacturer's specifications, is important in preventing the production of "off-spec" products. Also computerized equipment may provide quality assurance records.		
<b>Work Practices</b>			
<b>Practice: Ensure that onsite workplace practices apply to installers, assistants, and other trade workers.</b>	All workers should follow safe work practices to reduce exposures.		

Recommended Practice and Self-Evaluation Questions	Rationale for Practice: Exposure Impacts and Additional Tips	Baseline Activity Complete? (Yes/No)	Follow-up Activity Complete? (Yes/No)
Do installers work with at least one assistant who is wearing the same PPE as the installer?	Assistants are important to ensure that site and equipment preparation, ventilation, PPE maintenance, and application (movement of hoses) are carried out safely.		
On the job site, do workers maintain line of sight or communication contact with all workers in the spray zone, particularly when working at heights or in confined spaces? <i>[ICAA, 2011]</i>	Close monitoring of employees when they are working in confined spaces or at heights is important in the event of an accident or equipment failure. Spray application in a confined area may result in serious overexposures in the event of failure of the SAR, ventilation, or spray equipment.		
If working outdoors, is work performed upwind of the spray, with no spraying performed if wind speeds exceed recommended levels? <i>[CPI, 2010; IRSST, 2009]</i>	Working upwind will reduce the amount of spray in the worker's breathing zone and in contact with their clothing and skin.  Wind screens may be used when working at grade level, but should not be used on lifts or scaffolds due to the risk of tipover.		
When possible, is work positioned to avoid overhead spraying (an elevated work platform may be needed)? <i>[interviews, 2012]</i>	Spraying overhead results in the installer's breathing zone being in an area of elevated chemical concentration, leading to potentially increased inhalation exposure. Overhead spraying can cause overspray to settle on the respirator, fogging its visor and, where an APR is worn, clogging cartridges. Clogged cartridges lead to increased breathing resistance and face-seal leakage.		
Do installers ensure that the substrate is clean and dry before applying spray foam? <i>[Knowles, 2010]</i>	If the surface isn't clean, or if concrete has a release agent on the surface, spray foam might not adhere well.		
Do you follow product specifications for foam application?	Proper application of foam will reduce the chances of producing off-ratio foam. Off-ratio (B-rich) foam can cause odor problems or potential health effects for workers and returning building occupants.		
Do you perform a test spray, or series of test sprays if needed, of a small area, allowing the foam to set for 3 to 6 minutes, and then check foam quality and make any necessary equipment adjustments to achieve the proper ratio? <i>[interviews, 2012]</i>	Performing a test spray(s) will reduce the chances of installing off-ratio foam, which could cause odor problems or health effects for workers and returning building occupants.		

Recommended Practice and Self-Evaluation Questions	Rationale for Practice: Exposure Impacts and Additional Tips	Baseline Activity Complete? (Yes/No)	Follow-up Activity Complete? (Yes/No)
Do installers check a sample from the test spray, visually assess the foam's density and break it open to examine the cell structure (while wearing a respirator)? <i>[interviews, 2012]</i>	<p>Checking a test spray sample for foam quality will reduce the chances of installing off-ratio foam, which could cause odor problems or health effects for workers and returning building occupants.</p> <p>If the foam is brittle and dense, it is A-rich; if it is spongy and gummy, it is B-rich, may have an unpleasant fishy odor, and may never set properly. Other ways to assess foam quality are to cut a 1-inch square and weigh it on a digital scale to see if it has the proper weight, or to use water displacement to see if it displaces the proper volume of water. <i>[interviews, 2012]</i></p>		
To avoid overspray, do installers position the spray gun at the proper distance from the surface, as per manufacturer's product data and installer training? <i>[interviews, 2012]</i>	<p>Overspray can result in increased potential for inhalation and dermal exposure and can create voids in the foam.</p> <p>There will be more overspray if the gun is too close to the surface. A smaller gun may need to be used in tight spaces such as crawl spaces where the gun can't be held farther from the surface.</p>		
When spraying in a small space such as a crawl space, do installers adjust the pump speed to decrease the volume (flow rate of material) to avoid overspray? <i>[interviews, 2012]</i>	<p>Overspray can result in increased potential for inhalation and dermal exposure and can create voids in the foam.</p>		
Is foam applied in layers ("lifts") of the proper thickness in accordance with the manufacturer's specifications (2 inches or less is a typical industry recommendation for lift thickness for medium-density, closed-cell SPF, depending on product specifications and site temperature conditions)?	<p>If lifts are too thick, overheating can result in scorching, igniting, and even fires. Overheating can also result in off-gassing after installation and excess shrinkage, causing the foam to delaminate from the substrate. With a lift at 2 inches the core temperature may be around 130 to 150 degrees; applying a lift beyond the 2 inches can result in extremely high temperatures within the core of the insulation that can char the foam or degrade its structure, which will adversely affect performance. <i>[interviews, 2012]</i></p> <p>Thinner lifts may need to be applied in the afternoon as the day warms up. <i>[interviews, 2012]</i></p>		

Recommended Practice and Self-Evaluation Questions	Rationale for Practice: Exposure Impacts and Additional Tips	Baseline Activity Complete? (Yes/No)	Follow-up Activity Complete? (Yes/No)
<p>Is adequate cooling time allowed before applying another lift, particularly for closed-cell foam, as per the manufacturer's guidelines? <i>[interviews, 2012; Knowles, 2010]</i></p>	<p>If a second lift is applied too soon, overheating can result in off-gassing for a period of time following installation, and can even result in fires. Overheating can also result in excess shrinkage, causing the foam to delaminate from the substrate.</p> <p>In cool weather, 10 to 15 minutes is generally considered sufficient. Additional time may be necessary in summer weather. Some manufacturers suggest twenty minutes between passes or longer, if multiple passes, to allow the heat to dissipate from the applied foam. Again, consult manufacturer's installation instructions.</p> <p>Typically, an installer can spray 200 to 300 square feet of surface and then go back and apply a second lift at the starting point. <i>[interviews, 2012; Knowles, 2010]</i></p>		
<p>Do your installers use a stick probe thermometer or meat thermometer to ensure that the temperature does not exceed the manufacturer's recommended top-end temperature? <i>[interviews, 2012]</i></p>	<p>Overheating can result in off-gassing after installation, and can even result in fires. Overheating can also result in excess shrinkage, causing the foam to delaminate from the substrate.</p> <p>For cavity filling, an infrared thermometer can be used.</p>		
<p>As per training, do installers visually monitor the quality of the foam as it develops and, if it does not look right, do they stop work and check their equipment? <i>[interviews, 2012]</i></p>	<p>Application of off-ratio foam can result in off-gassing after installation and can also reduce the foam's insulation value.</p> <p>A-side (isocyanate) rich foam may be dense and brittle, while B-side (polyol blend) rich foam may be spongy and gummy, and may have a fishy odor.</p> <p>Proper troubleshooting techniques will help resolve problems and minimize the generation of off-ratio foam.</p>		

Recommended Practice and Self-Evaluation Questions	Rationale for Practice: Exposure Impacts and Additional Tips	Baseline Activity Complete? (Yes/No)	Follow-up Activity Complete? (Yes/No)
<p>Are installers trained to trouble-shoot whether applied foam is being affected by materials which are too cold or too hot?</p>	<p>Proper troubleshooting techniques will help resolve problems and minimize the generation of off-ratio foam.</p> <p>If hose temperature is too low to start, the pattern appears as a stream, with small pattern; coarse, large droplets; slow material reaction; and poorly mixed material. If the primary heater is too low, the pattern will start off normally and then droplets will get coarser. <i>[SPFA, 2013]</i></p> <p>Alternatively, if the hose is too hot when first starting to spray, you will need to reduce its temperature. In the warmer months, the high hose temperature may be a result of absorbing heat from a hot substrate. If this is the cause, adjustments will have to be made to remedy the problem, such as moving the hose to a shaded area of the deck when not spraying or changing your work hours. <i>[SPFA, 2013]</i></p> <p>Materials that are too cold will cause a rather narrow spray pattern that drives into the rising deposited foam and causes dimples, blowholes, roughness, and ridges. <i>[SPFA, 2013]</i></p> <p>If the materials are too hot, the spray foam deposited will be reacting too fast to permit leveling. An uneven surface texture trending toward “popcorn” will develop, even though the spray pattern is full. <i>[SPFA, 2013]</i></p> <p>Materials that are too cold will have an overall effect of a popcorn-like foam surface or, in extreme cases, a “tree bark” foam surface. <i>[SPFA, 2013]</i></p>		

Recommended Practice and Self-Evaluation Questions	Rationale for Practice: Exposure Impacts and Additional Tips	Baseline Activity Complete? (Yes/No)	Follow-up Activity Complete? (Yes/No)
Do installers check pressure settings? [SPFA, 2013]	<p>Proper troubleshooting techniques will help resolve problems and minimize the generation of off-ratio foam.</p> <p>Pressure set too <i>low</i> will result in a smaller than normal pattern with coarse droplets and poor mix.</p> <p>Pressure set too <i>high</i> will over-atomize the material, resulting in lower transfer efficiency to the intended substrate and more material lost to overspray. Pressure set too <i>high</i> also increases the forward velocity of the material coming out of the spray gun, which can result in uneven foam thickness and a rough surface. [SPFA, 2013]</p>		
Do you discourage the installation of transitional foam, such as switching formulations, between open- and closed-cell or between one manufacturer's product and the next? [interviews, 2012]	<p>Transitional material should not be installed in a building because it might affect foam quality and can result in potential off-gassing, which may lead to odor problems or health effects for workers and returning building occupants. [interviews, 2012]</p> <p>Follow the manufacturer's guidance. In some cases, one can flush the hoses with the new product; some of the original material can be recovered and saved for later reuse. [interviews, 2012]</p>		
If off-ratio ("off-spec") foam is identified, do you remove the foam? [interviews, 2012]	Removing off-ratio foam is important to ensure proper insulating and sealing properties and to prevent off-gassing of odors. In general, B-rich foam is spongy and may be gummy and have an unpleasant fishy odor. A-rich foam is dense and may be cracked and brittle.		

## IV. Post-Application Activities

Recommended Practice and Self-evaluation Questions	Rationale for Practice Exposure Impacts and Additional Tips	Baseline Activity Complete? (Yes/No)	Follow-up Activity Complete? (Yes/No)
<b>Work Practices</b>			
<b>Practice: Follow good hygiene and work practices during trimming and cleanup.</b>	During trimming and cleanup, wearing chemically protective clothing will reduce dermal exposures, and wearing goggles will protect the eyes from amine vapors. However, a full-face or hooded respirator provides greater protection from leakage that may expose the eyes to vapors or dust.		
Do you use a HEPA-rated vacuum cleaner for final cleanup? [CPI, 2010]	Using a HEPA-rated vacuum cleaner will reduce inhalation exposures.		
Do you ensure that foam is adequately cured before cutting?	Waiting until foam is fully cured will reduce inhalation and eye exposures to amine vapors and other offgassing compounds		
Do you continue running the exhaust fan(s) during cleanup? [EPA, 2011]	Running exhaust fans to ventilate the space will reduce inhalation and eye exposures to amine vapors.		
Do you wear chemically resistant gloves, clothing, eye protection (i.e., goggles) and proper respiratory protection during cleanup? [CPI, 2010]	Maintaining PPE practices during cleanup activities is an important, and potentially overlooked, way to prevent exposures to chemicals that may be continuing to cure.  During cleanup, a half-face APR with combination organic vapor/N95 cartridge, with goggles, could be worn instead of the more protective full-face APR or SAR; however, use of a full-face APR provides better coverage and avoids frequent leakage problems associated with the use of goggles with half-face respiratory protection.		
When cutting or trimming foam, do workers use band saws, oscillating saws, or high-pressure water jets rather than hot-wire cutting methods, and do workers allow adequate cooling time, to prevent thermal degradation and potential fires? [AX396, 2008]	Ensure that foam is not exposed to temperatures above 200°. Hot-wire cutting methods can result in non-flaming thermal degradation, which can begin at temperatures as low as 200°F, leading to release of toxic degradation products. This can occur without visible smoke. Emission breakdown levels are usually extremely low for the recommended alternative cutting methods. [AY112, 1994]		

Recommended Practice and Self-evaluation Questions	Rationale for Practice Exposure Impacts and Additional Tips	Baseline Activity Complete? (Yes/No)	Follow-up Activity Complete? (Yes/No)
Do you protect installed foam with a 15-minute thermal barrier to separate installed SPF from occupied spaces? [AY112, 1994]	A thermal barrier is used to slow the temperature rise of material behind the barrier during a fire. Installed spray polyurethane foam is combustible.		
When removing off-ratio B-rich foam, which has a gummy texture and may have an amine (fishy) odor, do your workers wear coveralls, gloves, and a full-face APR or tight-fitting goggles with a half-face APR?	Wearing an APR will reduce inhalation exposures. Wearing chemical protective clothing will reduce dermal exposures.  Wearing goggles protects the eyes from amine and other chemical vapors; however, instead of using goggles and a half-face APR, consider a full-face APR to provide better coverage and to avoid frequent leakage problems associated with the use of goggles with half-face respiratory protection.		
When removing off-ratio foam, do you use plastic sheeting to isolate the area and prevent dust migration, and dispose of removed foam appropriately?	A-rich foam can be landfilled after removal. For B-rich foam, it may be necessary to consult state and local regulations/regulators regarding proper disposal.		
<b>Housekeeping Practices</b>			
<b>Practice: Ensure appropriate hygiene facilities and practices at the job site.</b>	Hygiene practices are important to prevent contamination outside the work zone.		
Do you provide an eyewash at the site? [29 CFR 1910.151; 1926.50]	Eyewashes are needed whenever the eyes may be exposed to injurious corrosive chemicals.		
Do you establish a changing station near the entrance to the work zone (or near the rig) for putting on and removing PPE? [CPI, 2010]	Establishing a changing area will minimize tracking of contamination from the work zone to clean areas.		
Are there hand-washing facilities (such as a portable foot-pedal-style hand-washing sink or disposable cleaning wipes) at the changing station? [NIOSH, 2005]	Washing facilities are needed where contaminants may be harmful to employees. Corn oil may also be used on the skin as a safe solvent for removing chemicals from the skin. Avoid using solvents such as acetone on the skin. [OSHA, 2010]		

Recommended Practice and Self-evaluation Questions	Rationale for Practice Exposure Impacts and Additional Tips	Baseline Activity Complete? (Yes/No)	Follow-up Activity Complete? (Yes/No)
Do you ensure that workers do not eat, drink, smoke, or chew gum in the work zone? [CPI, 2010]	Eating, drinking, or smoking in contaminated areas may result in accidental ingestion of contaminants. Smoking around combustible material may cause a fire or inhalation of toxic thermal degradation products.		
Do you implement safe storage and handling practices for chemicals to prevent spills, leaks, and explosions?	Preventing spills or leaks will help minimize the potential for worker exposures.		
Do you keep only the minimum amount of chemicals on site that are needed for the job?	Minimizing the amount of chemicals present at the job site will reduce the severity of any spill incident.		
Do you establish procedures to prevent and respond to spills of various types, and have spill-containment materials and equipment available at the job site and on the truck during chemical transport?	Having all the spill response supplies will help mitigate exposure should a spill occur.		
<b>Handling and Disposal of Drums, Waste, and Spills</b>			
<b>Practice: Ensure that drums are properly stored.</b>			
Are drums stored indoors, tightly sealed with original bung covers, and kept away from moisture, direct sunlight, heat sources, and ignition sources? [Robert, 2011]	Moisture is incompatible with A-side chemicals. Store A-side chemicals away from water or alcohols. Segregate A- from B-side chemicals, and segregate these from other incompatible chemicals (e.g., acids/caustics, oxidizers/reducing agents).		
Are drums stored at the temperature recommended by the manufacturer's specifications? [Robert, 2011]	Improper storage temperatures can adversely affect product quality. If product freezes, it should not be used and should be disposed of or returned to the supplier.		
Do you make sure that emergency contact information is kept on site in case workers need to contact trained emergency responders? [CPI, 2010]	If a bulging drum is observed, contact the manufacturer or a private or county hazardous materials (HAZMAT) team for assistance. The material may have overheated or become contaminated with water. The product should not be used; it should be disposed of or returned to the supplier.		

Recommended Practice and Self-evaluation Questions	Rationale for Practice Exposure Impacts and Additional Tips	Baseline Activity Complete? (Yes/No)	Follow-up Activity Complete? (Yes/No)
Do you ensure that the transport truck is adequate for the weight of drums, and are all drums secured during transport? <i>[Robert, 2011]</i>	Proper transport conditions are necessary to ensure product quality and prevent spills during transport. In winter, a heated truck may be needed for delivery of drums to the job site.		
Do you choose appropriately sized chemical drums for the size of the job?	Minimizing chemicals at the site will reduce the size of a potential spill and reduce transportation and hazardous materials management costs.		
Do you plan for collection and removal of debris and trash, and is waste properly contained on site and while being transported off site?	<p>Planning for waste collection will help ensure an orderly job site. Uncontained trash can pose a tripping hazard. Scraps of cured foam may be bagged and landfilled, usually in a construction and demolition debris landfill. However, you should always check with your local waste and licensing boards for any local and state restrictions concerning disposal or specific places where such material(s) should be discarded (e.g., a specific landfill type, a roll-off container on site).</p> <p>Note that local municipalities may require a permit or approval for large waste collection devices used during construction or demolition.</p>		
Do you ensure that waste foam is fully cooled before bagging? <i>[CPI, 2012]</i>	<p>Cooling is necessary to prevent smoldering and fire and related toxic thermal decomposition products. Cut open large pieces and douse with water to prevent conditions that could lead to smoldering or a fire. <i>[CPI, 2012]</i></p> <p>When handling waste, always make sure that appropriate PPE is used.</p>		
Do you refer to product labels, technical data sheets, and manufacturer's guidance for handling and disposal of unused SPF chemicals and waste foam generated?	Proper disposal will minimize environmental impacts of waste foam. If you have questions regarding disposal of waste chemicals or building debris, consult federal, state, and local permits, licensing, and rules, or contact your state environmental agency or EPA Regional Office.		

Recommended Practice and Self-evaluation Questions	Rationale for Practice Exposure Impacts and Additional Tips	Baseline Activity Complete? (Yes/No)	Follow-up Activity Complete? (Yes/No)
<p>Do you follow safe practices when consolidating materials from drums of the same Side A or Side B product formulation, such as using a controlled setting (i.e., warehouse), drum pump, and proper PPE?</p>	<p>Exposures during transfer are possible. Keeping moisture out is important to ensure product quality. Proper PPE and engineering controls will prevent inhalation and skin exposure. Wear goggles, heavy-duty rubber gloves, and a chemically protective smock or apron/sleeves when consolidating drums. <i>[SPFA, 2010]</i></p> <p>Do not combine Side A or Side B drums from different suppliers that may have different product formulations.</p> <p>Never use a cutting torch or electric saw to open a drum. <i>[ICAA, 2011]</i> A cutting torch may start a fire, and an electric saw may result in formation of toxic decomposition products.</p>		
<p>Do you clean and dry the drum transfer pump before and after use, and use a desiccant trap on the air vent to keep moisture out of the drum? <i>[Robert, 2011]</i></p>	<p>Since A-side chemicals are water-reactive, it is necessary to prevent moisture from entering the drums. Ensure that containers are labeled with contents and hazard information. <i>[Robert, 2011]</i></p>		

Recommended Practice and Self-evaluation Questions	Rationale for Practice Exposure Impacts and Additional Tips	Baseline Activity Complete? (Yes/No)	Follow-up Activity Complete? (Yes/No)
<p>Are empty drums sent to a drum re-conditioner for recycling? [Candelori, 2009; CPI, 2010]</p>	<p>Consult the re-conditioner regarding drum decontamination procedures. Proper decontamination and recycling/disposal of drums will minimize environmental impacts of waste. [Candelori, 2009]</p> <p>For more information on re-conditioners or drum take-back, consult your SDS, technical data sheets, and/or your state or local environmental agency or Regional Office.</p> <p>Drums are generally considered “empty” when drip-dry (e.g., when less than 1” of product remains in a drum). 40 CFR 261.7 provides additional specifications for containers that formerly held hazardous (e.g., ignitable) wastes. Drums are “empty” if:</p> <ul style="list-style-type: none"> <li>• All wastes have been removed that can be removed using the common practices for removing materials from that type of container (e.g., pouring, pumping, and aspirating), and no more than 2.5 centimeters (1 inch) of residue remain on the bottom of the container or inner liner, <i>or</i></li> <li>• No more than 3% by weight of the total capacity of the container remains in the container or inner liner if the container is less than or equal to 119 gallons in size, <i>or</i></li> <li>• No more than 0.3% by weight of the total capacity of the container remains in the container or inner liner if the container is greater than 119 gallons in size.</li> </ul>		

Recommended Practice and Self-evaluation Questions	Rationale for Practice Exposure Impacts and Additional Tips	Baseline Activity Complete? (Yes/No)	Follow-up Activity Complete? (Yes/No)
Do you participate in drum recycling or take-back programs, should they be available?	<p>Recycle and reuse take-back programs for drums should be promoted. There is demand for reuse of drums and alternatives to creating large amounts of waste foam as a means of disposing of leftover materials. These programs would prevent disposal of thousands of drums per year into landfills.</p> <p>States, municipalities, industry associations, and nongovernmental organizations may offer chemical take-back programs or hazardous waste collections. To check for chemical take-back programs in your area, or to inquire on how to develop a take-back program, contact your supplier, manufacturer, and/or state or local environmental agency.</p> <p>Chemical residuals within Side A or Side B drums would be more likely to be replenished with the same product formulation mixture in a more controlled industrial setting. This should reduce exposures and encourage materials recycling.</p>		
<b>Practice: Ensure that adequate emergency supplies are available.</b>	Having appropriate supplies will mitigate the impact of an incident.		
Do you ensure that a first aid kit, eyewash, fire extinguisher, and spill cleanup sorbents are available at the site, for example in the truck/rig? [CPI, 2010]	Having all the emergency supplies will help mitigate exposure should it occur.		
Do you post emergency phone numbers near the first aid kit? [CPI, 2010]	Having emergency contacts available will enable workers at the site to respond quickly to accidents (e.g., falls).		
Do you keep a fire extinguisher (minimum size 2A) within 100 feet of the work area and a larger one (10B minimum) on the truck/rig? [ICAA, 2011]	Having fire extinguishers readily available will help mitigate a fire if one occurs.		

Recommended Practice and Self-evaluation Questions	Rationale for Practice Exposure Impacts and Additional Tips	Baseline Activity Complete? (Yes/No)	Follow-up Activity Complete? (Yes/No)
Do you keep skin decontamination solution at the job site, and ensure that workers clean (decontaminate) skin promptly if contact with liquid chemicals occurs? <i>[IRSST, 2009]</i>	<p>Immediate cleaning after exposure is important to remove chemicals from the skin and prevent or reduce the severity of effects such as irritation and chemical burns.</p> <p>Note: Polypropylene glycol, corn oil, and polyglycol-based cleaner may be more effective than soap and water. Cleaning may not completely remove skin contamination. It is important to use engineering controls, PPE, and good workplace practices to prevent skin contamination. <i>[Robert, 2012]</i></p>		
Do you maintain suitable spill cleanup materials at the job site, ensure minor spills cleaned up promptly using sorbent materials, such as kitty litter, sand, or vermiculite, and scooped up and collected in an open top drum or heavy-duty bag for proper disposal? <i>[CPI, 2010]</i>	Using sorbents will reduce evaporation of spilled materials and airborne exposure. Avoid using saw dust or paper sorbents due to the risk of fire. A-side spills may release CO <sub>2</sub> , so it is best not to seal the container of waste collected from the spill to avoid pressure buildup. For A-side spills, keep the container open and keep outdoors or in a well-ventilated and restricted area.		
Do spill cleanup workers put on coated coveralls, boot covers, heavy-duty gloves, and a full-face cartridge respirator?	Proper PPE will prevent exposure during cleanup activities.		
Are spills and/or spill debris treated with neutralizing solution as per the product SDS?	Neutralizing spills will reduce the reactivity and skin hazard, and can reduce odors during storage of spill debris. Commercially available decontamination solutions can also be used. Neutralize and dispose of in accordance with supplier SDS.		
For major spills, do you maintain onsite call information for CHEMTREC and outside emergency assistance, such as a private or county HAZMAT team? <i>[Robert, 2011]</i>	<p>Contacting trained emergency responders will ensure that employees are not overexposed.</p> <p>Reporting to regulatory authorities might also be required (e.g., if the spill involves more than 15 drums of A-side isocyanate chemicals).</p>		

Recommended Practice and Self-evaluation Questions	Rationale for Practice Exposure Impacts and Additional Tips	Baseline Activity Complete? (Yes/No)	Follow-up Activity Complete? (Yes/No)
<p>Do you have information for contacting your state or local HAZMAT/emergency services departments, and if you are a RCRA Subtitle C–regulated hazardous waste generator, do you have all necessary state- or EPA-required emergency and contingency planning information?</p>	<p>Even if you are not explicitly regulated by EPA or a state agency, they may be able to help answer some of these aforementioned questions, and have staff online and available to help you. They can be a resource in finding more appropriate contacts to address your needs.</p> <p>If you are also a RCRA Subtitle C regulated entity, many of the aforementioned questions may already be covered in your RCRA emergency and contingency planning paperwork, records, or postings. Consider using that information to inform other questions where you are not sure if information/practices are available. Also, consider contacting your state environmental agency or EPA Regional Office for compliance assistance.</p> <p>Note that three years is the standard period of time for RCRA Subtitle C participants (e.g., hazardous waste generators) to retain records.</p>		
<p><b><i>Follow-up with the Client</i></b></p>			
<p>Have you asked the client if they are satisfied with their purchase of SPF insulation and its performance? If the client is not satisfied, have you responded to any questions and identified follow-up actions?</p>	<p>Documentation of satisfied customers will help show a relationship between implementation of best practices and reduction in exposures.</p>		

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- 29 CFR 1910.146

#### OSHA Ladders Standard (Construction)

- 29 CFR 1926.1052, Stairways
- 29 CFR 1926.1053, Ladders
- 29 CFR 1926.1060, Training requirements

#### OSHA Personal Protective Equipment Standard

- 29 CFR 1910.132, General requirements
- 29 CFR 1910.133, Eye and face protection
- 29 CFR 1910.138, Hand protection

#### OSHA Respiratory Protection Standard

- 29 CFR 1910.134(c), Respiratory protection program
- 29 CFR 1910.134(d), Selection of respirators
- 29 CFR 1910.134(e), Medical evaluation
- 29 CFR 1910.134(f), Fit testing
- 29 CFR 1910.134(g), Use of respirators

#### OSHA Scaffolds Standard

- 29 CFR 1926.451, General requirements
- 29 CFR 1926.453, Aerial lifts
- 29 CFR 1926.454, Training requirements

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