Foam Safety

Foam installer protection vs…….

Site and occupant protection
- air quality management
- re-occupancy timing
- combustion appliance safety

Hazards and Safety – Site protection

Site protection - before the work begins

- Notification: Inform building users of air quality issues related to your work
- Provide product safety documentation
- Provide and review your air quality management plan (part of the written safety plan – required by law)
- Review the safety and emergency protocols for the specific site with the applicators and building operators
- Inform building users of the implications of a tight building
- Applicators must be trained in safety and emergency protocols related to foam installations

Hazards and Safety – Site Protection

Protect the site - before the work begins

- Isolate the work area
  - Install fans, signage and barriers
  - Locate the HVAC controls and have them set to isolate the work area from the occupied spaces
- Verify there are no occupants with respiratory problems – vacate when necessary
- Take necessary fire-protection measures
  - Follow CAZ (Combustion Appliance Zone) safety protocols
  - Remove ignition sources (Auto-Ignition Temperature = 650-800°F)

Hazards and Safety – Site protection

Protect the site - During the work

- Work area ventilation vs. evacuation
- When to keep people out and how long before re-entry
- Know what to do in the case of a chemical spill or if there is an off-ratio spray event
  - Most MSDS documents reference other documents
  - Most MSDS don't identify what the hazards are
    - Chemicals components are proprietary
    - Personal protection requirements and exposure limits are not provided
  - Some MSDS don't identify cleanup methods
  - Some MSDS don't explain disposal requirements

Hazards and Safety – Site protection

Protect the site - During the work

- Know what to do in the case of a chemical spill or if there is an off-ratio spray event

Section 2:	Composition and Ingredient Information
Alkanolamine	hazardous
Alkylamine	hazardous
Additional non hazardous ingredients are trade secrets belonging to the general chemical families of polyether/ester polyols, silicone surfactants and halogenated phosphates.	

3. Composition/Information on Ingredients

Hazardous components

Weight percent	Components	CAS-No.
20 - 30%	Polymer	CAS# is a trade secret
7 - 13%	Hydrofluorocarbon	460-73-1
3 - 7%	Tris-(2-chloroisopropyl)-phosphate	13674-84-5
1 - 5%	2-Butoxyethanol	111-76-2
1 - 5%	Tertiary Amine	CAS# is a trade secret
1 - 5%	Ester derivative	CAS# is a trade secret
0.1 - 1%	Tertiary Amine	CAS# is a trade secret

Hazards and Safety – Site protection

Protect the site - During the work

- Know what to do in the case of a chemical spill or if there is an off-ratio spray event

13. Disposal considerations

Waste Disposal Method
Waste disposal should be in accordance with existing federal, state and local environmental control laws.

Empty Container Precautions
Recondition or dispose of empty container in accordance with governmental regulations.

Hazards and Safety – Site protection

Section 6:	Accidental Release Measures

SEE MATERIAL SAFETY DATA SHEET Section 8. Exposure controls, personal protection

Small Spill and Leak: Clean-up should only be performed by trained personnel. People dealing with major spillages should wear full protective clothing including appropriate respiratory protection. Evacuate the area. Prevent further leakage, spillage or entry into drains.

Large Spill and Leak: Contain and absorb large spillages onto an inert, non-flammable adsorbent carrier (such as earth or sand). Shovel into open-top drums or plastic bags for further decontamination, if necessary. Wash the spillage area clean with liquid decontaminant. Test atmosphere for MDI. Neutralize small spillages with decontaminant. Remove and properly dispose of residues. (See Section 13 for disposal considerations). Notify applicable government authorities if release is reportable. The CERCLA RQ for 4,4-MDI is 5,000 lbs. (see CERCLA in Section 15).

Decontaminant: Preparation of Decontamination Solution: Prepare a decontamination solution of 0.2 – 0.5% liquid detergent and 3-8% concentrated ammonium hydroxide in water (5-10% sodium bicarbonate may be substituted for the ammonium hydroxide). Follow the precautions on the supplier's material safety data sheets when preparing and using solution. Use of Decontamination Solution: Allow deactivated material to stand for at least 30 minutes before shoveling into drums. Do not tighten the bungs. Mixing with wet earth is also effective, but slower.

Hazards and Safety – Site protection

3. COMPOSITION / INFORMATION ON INGREDIENTS

CAS #	Component	Percent
Not Available	Polyester Polyol	30-60
Not Available	Polyether Polyol	10-30
460-73-1	1,1,1,3,3-Pentafluoropropane	5-10
78-40-0	Triethyl phosphate	1-5
13674-84-5	Tris(1-chloro-2-propyl) phosphate (TCPP)	1-5
34354-45-5	Diethanolomine	1-5
108-01-0	Dimethylaminoethanol	0.5-1.5
3855-32-1	Pentamethyldipropylenetriamine	0.5-1.5
107-21-1	Ethylene glycol	0.1-1

B: Component Analysis - Inventory

Component	CAS #	TSCA	DSL
1,1,1,3,3-Pentafluoropropane	460-73-1	Yes	No
1,2-Benzenedicarboxylic acid, 3,4,5,6-tetrabromo-, 2-(2-hydroxyethoxy)ethyl 2-hydroxypropyl ester	20566-35-2	Yes	Yes
Triethyl phosphate	78-40-0	Yes	Yes
Tris(1-chloro-2-propyl) phosphate (TCPP)	13674-84-5	Yes	Yes
Diethanolomine	34354-45-5	Yes	No
Dimethylaminoethanol	108-01-0	Yes	Yes
Pentamethyldipropylenetriamine	3855-32-1	Yes	Yes
Ethylene glycol	107-21-1	Yes	Yes

Vacate the premises

Vacating areas adjacent to the work zone that will be influenced by the foam installation is the most reliable approach

How long before re-entry?

1. "Re-entry time is dependent on product formulation and other factors that affect the foam curing rates."*
2. Require a re-occupancy schedule in the product documentation

*Spray Foam Safety - SPF Contractor and Consumer Guide http://www.sprayfoamsafety.com/reentry-time-spray-polyurethane-foam-applications.html#determining

Hazards and Safety – Site protection

Isolate the work zone

- Install signage - required by OSHA
- Close openings between the work zone(s) and adjacent spaces
- Configure the mechanical systems to prevent cross-circulation between the work zone and the adjacent spaces
- Depressurize the work zone
  - Verify that a constant negative pressure in the work zone with respect to the adjacent spaces is being maintained
  - Verify that the depressurization exhaust is not going to occupied outdoor areas or mechanical system inlets

Hazards and Safety – Site protection

Ventilation

- Depressurization can be used to isolate work areas from other trades or occupants.
- Two air changes recommended to carry out the contaminants after installation – test to verify.
- See new SPC Ventilation Guideline document

Industry information

New draft SPC document: "Residential Ventilation Guide for High-Pressure Spray Polyurethane Foam (SPF) Applications" in structures covered in the International Residential Code (IRC)

- Isolation/containment protocols
- Ventilation
- How long should ventilation continue?

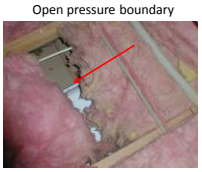
- Refer to information posted on CPI's SPF chemical health and safety website at www.spraypolyurethane.com
- Consult the National Institute for Occupational Safety and Health (NIOSH) by either calling 1-800-CDC-INFO or by visiting the NIOSH website .
- Refer to EPA's Ventilation Guidance for Spray Polyurethane Foam Application

Protect adjoining spaces

Winter attic project

Fan location - depressurization

Open pressure boundary



Protect adjoining spaces

Isolate the mechanical systems

Close openings

Protect adjoining spaces

Pressurization and depressurization

Protect adjoining spaces

Pressurization and depressurization

Work zone ventilation

Use air movers to change the air in the work zone.

1. Provide ventilation to reduce airborne chemical concentrations.
2. Supply air (active or passive) at one end of spray zone.
3. Direct airflow through spray zone from clean to contaminated.
4. Filter and exhaust air at opposite end of spray zone to unoccupied location (ideally outside).

Enclose the work zone as much as possible.

- Create negative pressure within the enclosure (remember CAZ safety) – must be with respect to occupied spaces, not just with respect to the outdoors.
- Maintain depressurization throughout the installation to avoid contamination of the adjacent areas.

Work zone ventilation

Use air movers to reduce airborne chemical concentrations

Work zone ventilation

Remote ventilation – inflated ducting




Hazards and Safety – Site protection

Protect the site - <u>After the foam work</u>

Install thermal or ignition barriers

- Why/when 15-minute thermal and ignition barriers
- Auto-Ignition Temperature (650-800°F)

Hazards and Safety – Site protection

Protect the site - <u>After the fire protection work</u>

- Continue to ventilate the work area and maintain isolation of the occupied areas
- Clean surfaces in the work zone if they were not protected
- Test to verify that safe levels have been achieved in the work zone (and adjacent occupied spaces)
- Provide continued ventilation and air quality monitoring if necessary
- Remove signage and isolation barriers
- Return HVAC settings to normal
- Authorize re-entry

When to re-occupy the building

<u>EPA - Determining safe re-entry times</u>

"To determine a safe re-entry time for unprotected applicators, helpers, other workers, and building occupants, such as homeowners and school children, decision-makers should exercise caution and consult their SPF contractor for specific guidance in advance of SPF installation."*

"Re-entry should be restricted until:

1. the product has finished curing
2. the building has been adequately ventilated and cleaned."

*Spray Foam Safety - SPF Contractor and Consumer Guide http://www.epa.gov/dfe/pubs/projects/spf/when_is_it_safe_to_re-enter_after_spf_installation.html

When to re-occupy the building

From: spraypolyurethane.org

"Ask your SPF contractor about re-occupancy guidance appropriate for your specific SPF installation and follow that guidance."*

Therefore:
Require verification and certification of when it is safe to re-occupy the space as a part of the installer's work scope. Select a product whose manufacturer provides guidance for the installer about re-occupancy for their "secret formula" product.

*http://www.spraypolyurethane.org/what-to-expect

Re-entry time - EPA

"Some manufacturers estimate that it can take approximately 23-72 hours after application for the foam to fully cure for the two-component high pressure "professional" SPF system, and approximately 8 to 24 hours to cure for one component foam, typically available in 12 oz. to 24 oz. cans."*

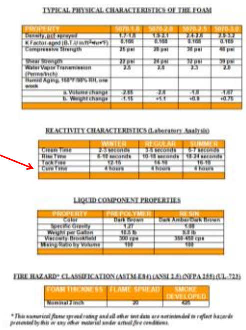
*Spray Foam Safety - SPF Contractor and Consumer Guide

EPA "SPF Research Priorities" includes:

"Evaluating SPF curing times and determining safe re-entry as related to:

- Effects of SPF composition, temperature, applicator technique, and proportioning and mixing on curing.
- Presence of un-reacted isocyanate on dust particles after cutting.
- Replicating real-life conditions to explore ventilation and containment strategies.

Cure time



TYPICAL PHYSICAL CHARACTERISTICS OF THE FOAM

PROPERTY	5070-1.8	5070-2.0	5070-2.5	5070-3.0
Density, pcf sprayed	1.7-1.8	1.9-2.1	2.4-2.6	2.9-3.2
K Factor-aged (B.T.U in/ft²hr°F)	0.168	0.168	0.168	0.169
Compressive Strength	25 psi	28 psi	38 psi	40 psi
Shear Strength	22 psi	24 psi	32 psi	39 psi
Water Vapor Transmission (Perms/inch)	2.5	2.8	2.3	2.0
Humid Aging, 158°F/98% RH, one week				
a. Volume change	-2.65	-2.8	-1.8	-1.87
b. Weight change	-1.15	+1.1	+0.8	+0.75

REACTIVITY CHARACTERISTICS (Laboratory Analysis)

	WINTER	REGULAR	SUMMER
Cream Time	2-3 seconds	3-5 seconds	6-7 seconds
Rise Time	6-10 seconds	10-18 seconds	18-24 seconds
Tack Free	12-15	14-18	16-18
Cure Time	4 hours	4 hours	4 hours

LIQUID COMPONENT PROPERTIES

PROPERTY	PREPOLYMER	RESIN
Color	Dark Brown	Dark Amber/Dark Brown
Specific Gravity	1.27	1.08
Weight per Gallon	10.5 lb	9.0 lb
Viscosity Brookfield	300 cps	350-450 cps
Mixing Ratio by Volume	100	100

FIRE HAZARD* CLASSIFICATION (ASTM-E84) (ANSI 2.5) (NFPA 255) (UL-723)

FOAM THICKNESS	FLAME SPREAD	SMOKE DEVELOPED
Nominal 2 inch	20	425

*This numerical flame spread rating and all other test data are not intended to reflect hazards presented by this or any other material under actual fire conditions.

When to re-occupy the building

Are odors useful as air quality indicators?

1. Odors may indicate benign or toxic outgassing
2. Odor detection is subjective, not quantitative
3. Odors may require concentration to be detected
4. Reductions in odor release rates are hard to verify

When to re-occupy the building

So, how do you verify that the space is safe for re-entry?

Test the air quality to be sure concentrations from both processing and cure off-gassing have been reduced to below the PEL:

- Laboratory testing – long response time, cost
- On-site metering – short response time, cost
- Disposable badges – real-time monitoring, inexpensive, but there are limitations

When to re-occupy the building

Alternative #1: Laboratory testing

"Air sampling and testing the indoor air following SPF installation is one way to assure the foam is completely cured.

Testing should be conducted by a certified laboratory using a validated method such as the Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers, Version 1.1 (2010) (PDF) (52pp, 429KB, About PDF) under California Section 01350."*

*http://sprayfoamsafety.com/spray-foam-exposure-off-gassing.html#curingrates

Monitoring and testing air quality

Alternative #2: Personal or zone monitoring devices

- IsoSense kit (DOD ~ $1,500)
- Cost each test (<$1.00)
- 1.0 ppb (TL), TWA = 5.0 ppb
- +/- 25% accuracy

DOD Technologies, Inc
740 McArdle Drive, Unit C
Crystal Lake, IL 60014
815-788-5200

Monitoring IAQ

Occupational Hygiene Air Monitoring for MDI & TDI Guidance

Colorimetric Paper Tape Instruments

Generally, area (fixed point) monitoring devices generate short period and/or time weighted average (TWA) values. They have the capability of data logging and can be used for MDI, TDI and other diisocyanates such as as hexamethylene diisocyanate (HDI).

Paper tapes have a limited shelf life. Use in accordance with the manufacturer's instructions.

ChemKey® TLD Toxic Gas Detector (measurement range ~2 to 60 ppb)

SPM Single Point Monitor (measurement range - most diisocyanates (including HDI, MDI & TDI) ~ 2 to 60 ppb)

ChemLogic 1 Single Point Continuous Monitor (measurement range 0 to 100 ppb & 0 to 200 MDI & TDI, 0 to 100 ppb HDI)

CLPX NextStep (measurement range ~0 to 200 ppb MDI & TDI; ~0 to 200 ppb HDI)

Paper tape instruments illustrated below are no longer commercially available but may still be in use:

GMD AutoStep Plus (measurement range ~1 to 200 ppb MDI & TDI; ~1 to 500 ppb HDI)

NextStep (measurement range ~0 to 200 ppb MDI & TDI; ~0 to 200 ppb HDI)

GMD Remote Intelligent Sensor (RIS) (measurement range ~1 to 2000 ppb for TDI; ~1 to 200 ppb for MDI)

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Monitoring and testing air quality

Alternative #3: Vapor test badges

- Morphix ($3.50/badge)
- 3.5 ppb (TL), TWA = 5.0 ppb
- +/- 25% accuracy with 95% confidence

Prices Effective January 1, 2011

SafeAir® System

Badges (50/box)	Part No.	Price
Ammonia	382010-50	$142.95
Aniline	382021-50	$174.95
Aromatic Isocyanates (TDI and MDI)	382001-50	$174.95
Carbon Dioxide	382017-50	$142.95
Carbon Monoxide	382012-50	$142.95
Chlorine	382009-50	$142.95
Chlorine/Chlorine Dioxide	382003-50	$174.95
Dimethyl Amine	382019-50	$222.95
Formaldehyde	382011-50	$142.95
Hydrazine	382002-50	$174.95
Hydrides	382037-50	$174.95

Monitoring and testing air quality

1. Note that the published levels for occupants is different than for construction workers.
2. Foam manufacturers provide information about cure time or re-occupancy time for their products.
3. Specify/select a product that includes adequate safety information in the product literature. If this is not published by the manufacturer or readily available upon request, choose one of the other quality foam products that has full documentation.

Summary – General air quality safety requirements

- Personal protection for the installers is mandatory (OSHA), straight-forward, generally well understood by installers, and manageable at reasonable costs – verification is not costly.
- Mandatory Air quality levels (PELs) are included in the OSHA-required product documentation (make this a requirement).
- Site protection requires prior notification, signage, work zone isolation, ventilation, and CAZ management protocols (specify/require an air quality management plan be part of the OSHA-mandated written safety plan).
- Re-occupancy can be estimated in terms of time or ventilation, but verification of safe air quality levels requires effective testing (always require re-occupancy certification and an AQ report as part of the final documentation).

Summary – Re-occupancy

- The contractor is responsible for determining when re-entry to the work zone by the building occupants is allowed, unless it is specified otherwise in the contract.
- For unoccupied spaces adjacent to occupied spaces, isolating and maintaining depressurization is the first/best strategy for protecting the occupants, and is manageable at normal costs.
- Standards for re-entry to all occupied areas are still being researched by the EPA – OSHA does not cover building occupants.
- Verifying when air quality is at acceptable levels for occupants is required and can be determined by monitoring. Verification is difficult and much more costly if the EPA mandates levels that are below the OSHA threshold.

Summary – Re-occupancy

- Cure time is one industry benchmark for when the out-gassing has ended and resident MDI vapors will have dissipated with ventilation. Cure time varies, but is typically reported by the manufacturer (specify/require that this is included in the product documentation).
- Verifying when air quality is at acceptable levels for occupants can be accomplished reasonably if the OSHA threshold is observed for building occupants.
- Air quality in spaces adjacent to the work zone should be verified before re-occupancy even if the depressurization strategy is used. Ideally, PEL verification should be carried out for at least 24 hours after the work is completed.

Industry resources