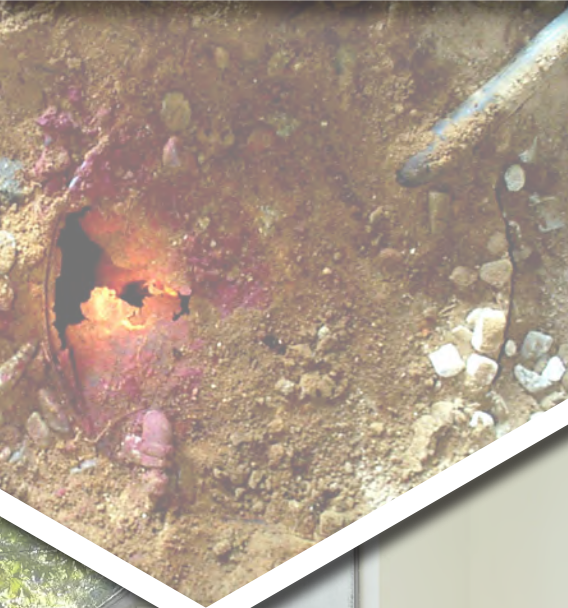


Voluntary Guidelines for Methamphetamine Laboratory Cleanup



Contents

1.0 Introduction	3
1.1 Background	3
1.2 Purpose and Scope	4
1.3 Methodology	5
1.4 Potential for Future Research	6
1.5 How to Use this Document	6
2.0 Remediation Standards	7
3.0 Remediation Sequence and Techniques	8
3.1 Overview of Remediation Sequence	8
3.2 Hiring a Contractor	9
3.3 Ventilation	9
3.4 Worker Safety and Health	9
3.5 Preliminary Assessment	10
3.6 Pre-Remediation Sampling	11
3.7 Cleanup Plan	12
3.8 Removal of Contaminated Materials	12
3.9 Waste Characterization and Disposal Procedures	13
3.10 High Efficiency Particulate Air (HEPA) Vacuuming	13
3.11 Initial Wash	14
3.12 Heating, Ventilation and Air Conditioning (HVAC)	14
3.13 Detergent-Water Solution Washing	15
3.14 Post-Remediation Sampling	16
3.15 Encapsulation	16
3.16 Plumbing	17
3.17 Sewer/Septic	17
3.18 Outdoor Remediation	18
3.19 Final Report	18
4.0 Item- and Material-Specific Best Practices	19
4.1 Walls	19
4.2 Ceilings	19
4.3 Floors	19
4.4 Kitchen Countertops	20
4.5 Concrete, Cement and Brick	20
4.6 Appliances	20
4.7 Wood	21
4.8 Windows	21

4.9 Electrical Fixtures, Outlets and Switch Plate Covers	21
4.10 Dishes, Flatware and Other Hard Non-Porous Household Goods	21
4.11 Toys and Other Children’s Items	21
4.12 Carpets	21
4.13 Clothing and Other Fabrics	22
4.14 Leather or Fabric Upholstered Furniture	22
4.15 Mattresses	22
4.16 Paper Items/Books	22
4.17 Mobile Residences	22
5.0 Potential Sampling Constituents, Theory and Methods	23
5.1 Sampling Constituents	23
5.2 Sampling Theory	24
5.3 Wipe Sampling Methods	25
5.4 Microvacuum Sampling Methods	26
5.5 Other Emerging Sampling Methods	26
5.6 Quality Assurance/Quality Control (QA/QC)	26
Endnotes	27
Other References	28
Key Contributors	29
Appendix A: Primary Methods of Production and Associated Hazards	30
Appendix B: Costs Associated with Meth Lab Cleanup	31
Appendix C: Properties of Chemicals Associated with Methamphetamine	32
Appendix D: State Resources	41
Appendix E: Acronyms	44

1.0 Introduction

1.1 Background

The production and use of methamphetamine (meth) across the United States continues to pose considerable challenges to our nation. Meth is easy to make, is highly addictive and its production and use can have serious impacts on both human health and the environment. Despite a decline in domestic meth production in recent years, vigilance is warranted not only because of the destructive nature of meth itself, but also due to the significant environmental hazards meth laboratories (labs) generate.

Our nation first demonstrated its commitment to better understand the hazards associated with meth labs in March 1990, when the Joint Federal Task Force (Task Force) published the *Guidelines for the Cleanup of Clandestine Drug Laboratories* (commonly referred to as the *Redbook*). The Task Force was created as a result of Section 2405 of the Anti-Drug Abuse Act of 1988 (Public Law 100-690) and included representatives from the Drug Enforcement Administration (DEA), the U.S. Environmental Protection Agency (EPA) and the U.S. Coast Guard (USCG). The Task Force's charge was to issue guidelines to assist state and local officials conducting clandestine laboratory cleanups. The *Redbook*, updated in 2005, presents national guidelines for safely approaching and securing meth lab sites for first responders and other officials with immediate need to enter the site. The *Redbook* also addresses at length the gross removal of hazardous chemicals and chemical wastes found in former meth labs. Whereas the *Redbook* focuses primarily on procedures related to first entry and gross *removal* of meth-related chemicals, this document addresses *remediation* (the cleanup of residual contamination after gross removal has occurred), which is necessary to allow unrestricted future use of the former meth lab.

In 2006, the White House Office of National Drug Control Policy (ONDCP) published the *Synthetic Drug Control Strategy: A Focus on Methamphetamine and Prescription Drug Abuse (Synthetics Strategy)* as a companion to the *National Drug Control Strategy*. The *Synthetics Strategy* acknowledges that, "compared to first responder issues, a more complicated and less understood area of science is the optimal set and sequencing of response actions at former meth lab sites that may possess residual chemical contamination."¹ Thus, the *Synthetics Strategy* tasked EPA with identifying best practices related to the remediation of former meth labs.



In December 2007, the Methamphetamine Remediation Research Act (Public Law 110-143) was passed, which directed EPA to establish voluntary guidelines for the remediation of former meth labs based on the best currently available scientific knowledge. This document, in addition to new research, will serve to meet both the *Synthetic Strategy's* and the Methamphetamine Remediation Research Act's goals of improving "our national understanding of identifying the point at which former methamphetamine laboratories become clean enough to inhabit again."²

EPA's Local Governments Reimbursement Program

In the event of a release (or threatened release) of hazardous substances, EPA may reimburse local governments for expenses related to the release and associated emergency response measures. The Local Governments Reimbursement (LGR) Program provides a "safety net" of up to \$25,000 per incident to local governments that do not have funds available to pay for response actions.

Under the EPA LGR Program, costs associated with the gross removal of meth labs and their related wastes may be eligible for reimbursement. These costs may include overtime wages related to hours spent securing the site or performing decontamination, costs for equipment purchased specifically for the response and contractor cleanup costs incurred by the local government for gross removal. However, costs related to long-term remediation actions as described in these voluntary guidelines (e.g., hiring a remediation contractor, conducting pre- and/or post-remediation sampling, developing a remediation cleanup plan and outdoor remediation) are generally not eligible for reimbursement under the LGR Program.

For more information, please visit the EPA LGR website: www.epa.gov/oem/content/lgr/.

1.2 Purpose and Scope

EPA prepared this document to provide voluntary cleanup guidelines to homeowners, cleanup contractors, industrial hygienists, policy makers and others involved in meth lab remediation. It does not set requirements, but rather suggests a way of approaching meth lab remediation. Those using this document also should consult their appropriate state and local requirements or guidelines. This document is not meant to supersede state and local requirements or guidelines (however, this document may be useful to state and local authorities as they develop and/or review and revise their own requirements or guidelines). EPA did not design this document for real estate transaction purposes. For disclosure laws, those using this document should consult their state and local authorities.

Tracking Former Drug Labs

The DEA maintains the National Clandestine Laboratory Register, which lists some former clandestine drug labs or dump sites. Note that the entries are reported by law enforcement and not verified by DEA. In addition, not all former clandestine drug labs or dump sites appear on the Register. The Register is available at: www.justice.gov/dea/clan-lab/index.shtml.

Some states maintain their own clandestine laboratory registries. Please refer to your specific state for additional information.

Removal vs. Remediation

Making a former meth lab safe for reoccupation requires two basic efforts: 1) the removal of gross contamination (i.e., containers of chemicals, equipment and apparatus that could be used to make illegal drugs); and 2) the remediation of interior structures and surrounding soil, surface waters and groundwater. This document provides voluntary guidelines related to remediation. As the *Synthetics Strategy* explains, “remediation involves utilizing recognized procedures and technology-based standards to restore former meth labs to a state in which the property can be inhabited again—or, instead, identifying properties that are not yet ready for reoccupation and must undergo further treatment.”³ Remediation always occurs after gross chemical removal, when the site is secured and is no longer subject to criminal investigation.

Synthetic Meth Labs

Synthetic drugs other than meth may be manufactured in clandestine labs; however, these voluntary guidelines specifically address the remediation of former meth labs and the unique dangers and hazards associated with them. These voluntary guidelines may be applied to all meth labs regardless of the manufacturing method utilized. For the reasons listed below, no two meth labs are alike:

- Meth labs range from crude, makeshift operations to highly sophisticated and technologically advanced facilities.
- Meth labs can be set up almost anywhere and are often found in private residences, motel and hotel rooms, apartments, trailers, automobiles, campgrounds and commercial establishments. Labs are also found in rural outbuildings, barns and other structures that may appear uninhabitable.
- There are many different ways to make meth, and the precursor chemicals, by-products and hazards associated with each production method differ (see *Appendix A* for a more detailed description).

Partial Labs

The manufacture of meth is a multi-stage process. In some cases, the various steps are performed in more than one lab or structure. For example, unrefined drug precursors may be chemically altered in one location and used in the final steps of the meth manufacture process later at a different location. Labs in which only a partial step of the meth manufacturing process was performed are called “partial labs.” The remediation process described in this document accounts for the possibility that precursor chemicals, in addition to meth, may be present in the structure. While each lab should be evaluated on a case-by-case basis, the remediation techniques contained in this document are applicable to partial labs.

Cooking vs. Smoking

Studies have shown that the smoking of meth alone can produce levels of airborne meth that may result in a general contamination of the structure in which it is smoked (although contamination levels will depend upon how much meth was smoked and the smoker’s technique).⁴ While EPA intends these voluntary guidelines to apply to structures in which meth was manufactured or “cooked,” the voluntary guidelines contained in this document may be useful for cleaning up all sites contaminated by meth.

Household Hazardous Waste

While the Resource Conservation and Recovery Act (RCRA) allows disposal of household hazardous waste (HHW) in municipal landfills, meth lab waste chemicals would neither be generated as waste in normal residential households, nor generated in the quantities that might be used in the normal activities and maintenance of a residence. For these reasons, EPA does not consider meth lab waste chemicals and materials contaminated by those chemicals to be RCRA exempt household hazardous wastes.

Children's Health

Protecting children's health from environmental risks is fundamental to EPA's mission. Children may be more vulnerable to environmental exposures than adults because their bodily systems are still developing; they eat more, drink more and breathe more in proportion to their body size; and their behavior can expose them more to chemicals and organisms.⁵ According to the Department of Justice (DOJ) Office of Justice Programs (OJP), children who live in or visit meth labs or are present during drug production face acute health and safety risks. The age-related behaviors of young children (such as frequent hand-to-mouth contact and physical contact with their environment) increase the likelihood that they will inhale, absorb or ingest toxic chemicals, drugs or contaminated food. Their physiological characteristics (such as higher metabolic and respiratory rates and a developing central nervous system) leave them particularly vulnerable to the effects of toxic chemical exposures. Exposure to drugs and alcohol before birth places infants at increased risk for neurological abnormalities and respiratory problems, which may be compounded by ongoing environmental exposures. Children may also have a special vulnerability to certain harmful materials that may be present during meth lab remediation activities, including lead, asbestos and mercury. For these reasons, special care should be taken when cleaning up a former meth lab if a child lives or will live in the residence.

Drug Endangered Children

Many states have enacted Drug Endangered Children (DEC) laws to protect children from the consequences of drug production, trafficking and abuse. For more information, please see the National Alliance for Drug Endangered Children website: www.nationaldec.org.

Environmental Justice

EPA does not regulate the cleanup of meth labs; the priorities for such cleanups are set by state and local laws. As such, concerns related to environmental justice (an EPA priority) should be left to the discretion of the state and local jurisdiction.

1.3 Methodology

A research team reviewed federal and state requirements and guidelines and other relevant studies, noting potential best practices as well as discrepancies in recommended practices.

After this research was completed, a group convened at EPA headquarters in Washington, D.C. in December 2007 to review the findings, provide feedback and share individual opinions. The group of 13 individuals (internal and external to EPA) included environmental, public health, industrial hygiene and toxicology professionals. During the meeting, these subject matter experts confirmed existing best practices, discussed the discrepancies in recommended practices and shared other best practices based on their own experiences. EPA used both the findings from the research effort and the opinions expressed in the meeting to develop these voluntary guidelines.

Following the meeting, this document was distributed for wider review. EPA received comments from the Association of State and Territorial Solid Waste Management Officials (ASTSWMO), the Agency for Toxic Substances and Disease Registry (ATSDR), the National Association of Counties (NACO), the National Institute of Standards and Technology (NIST), ONDCP and several other stakeholders. Updates were made based on these comments, as appropriate.

Then, in August 2008, the National Alliance of Model State Drug Laws (NAMSDL) convened a forum of its Cleanup and Remediation Working Group in Santa Fe, New Mexico to discuss the issues surrounding the cleanup and remediation of properties contaminated by meth labs. As part of the forum, working group members provided feedback on these voluntary guidelines and addressed outstanding questions. The voluntary guidelines were updated as a result of this input and other feedback from experts around the country.

In November 2012, EPA began a process to update these voluntary guidelines. As such, EPA solicited feedback from the original group of subject matter experts and other partners. The experts and partners assessed whether the information in this document is still accurate and relevant, identified other information that might be added and discussed how these voluntary guidelines are being used. Based on the input from the experts, the document was revised again and distributed for wider review during early 2013. Comments were received from several states and other stakeholders and additional updates were made to finalize these voluntary guidelines in March 2013.

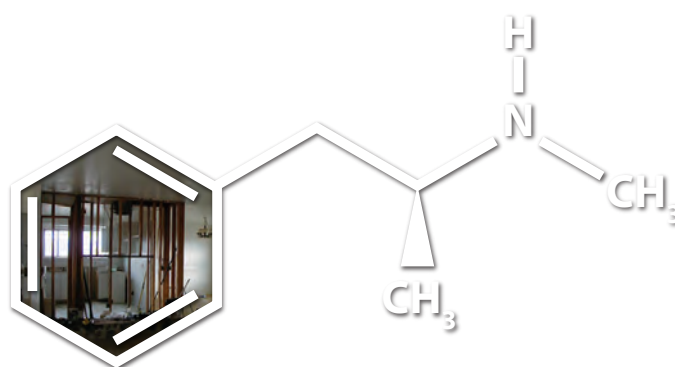
A list of key contributors to this document can be found on page 29.

1.4 Potential for Future Research

Because state and local approaches to cleaning up meth labs vary, there are sometimes differences in recommended practices or techniques. This variance in opinion indicates a need for further research. In many cases, the remediation techniques and approaches included in this document have not been vetted through rigorous scientific review. Instead, the recommendations are based on the lessons learned and practical experience of experts in the field. These voluntary guidelines may be augmented by EPA's research and development, with support from DEA, NIST and other agencies, as it is made available.

1.5 How to Use this Document

This document begins with background information on quantitative meth remediation standards from across the United States. Next, this document presents users with a possible sequence of remediation activities, from securing the site to delivering the final report. Once the process for remediation is understood, users will find best practices on how to clean specific items and/or materials found within a former meth lab (e.g., walls, floors, appliances, electronics, fabrics, toys). Finally, this document provides detailed information on sampling techniques and methods. Additional information and resources are included in the appendices.



2.0 Remediation Standards

Due to the variety of chemicals that could potentially be used to manufacture meth, it can be time consuming and prohibitively expensive to sample for all of them. In addition, many of the chemicals used in the manufacturing process are already present in most homes. [Note: In cases where the manufacturing method is known to employ chemicals that present unique hazards (such as a Phenyl-2-Propanone (P2P) lab), testing for individual components of the manufacturing process may be warranted.]

With this in mind, meth is often used as an indicator for the effectiveness of cleanup activities. This is based on the following assumptions:

- Bulk chemicals will be removed during the gross removal;
- Furniture, appliances or building materials with obvious stains (i.e., contamination) will be discarded;
- Many of the other potential contaminants are volatile organic compounds (VOCs) and tend to volatilize before and/or during cleanup; and
- The activities needed to clean up a structure to meet the applicable state standard for meth should be sufficient to reduce concentrations of other potentially hazardous chemicals as well.

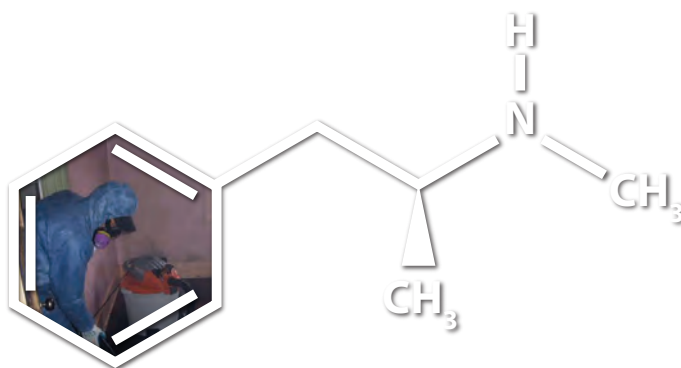
EPA does not intend this document to set, establish or promote quantitative cleanup standards. Many state and local authorities have established quantitative cleanup standards for meth and chemicals associated with its production. As of March 2013, 25 states require or recommend that meth labs be cleaned to meet certain quantitative meth remediation standards. Current state standards range from 0.05 $\mu\text{g}/100\text{ cm}^2$ to 1.5 $\mu\text{g}/100\text{ cm}^2$. The most common standard is 0.1 $\mu\text{g}/100\text{ cm}^2$. Additionally, eight states have process-based cleanup guidance materials, but no associated numerical remediation levels. State resources are listed in *Appendix D*. Those using this document should bear in mind that state and local requirements and guidelines change frequently.

Most state remediation standards are based on analytical detection limits and feasibility—they are not health-based standards. It is important to note, however, that these standards are believed to be set at sufficiently conservative levels to still be health-protective.⁶ In other words, remediation standards are believed to account for the scientific uncertainty involved in meth lab remediation in the interest of protecting human health and the environment.

In December 2007, California's Department of Toxic Substances Control (DTSC) announced that it had calculated a health-based remediation standard for meth of 1.5 $\mu\text{g}/100\text{ cm}^2$.⁷ In February 2009, DTSC finalized the scientific documents that form the basis for this health-based cleanup standard. In October 2009, the new health-based standard of 1.5 $\mu\text{g}/100\text{ cm}^2$ was signed into state law as a safe level of methamphetamine on an indoor surface. Since 2009, Wyoming has adopted the 1.5 $\mu\text{g}/100\text{ cm}^2$ remediation standard. Additionally, both Kansas and Minnesota guidance use the value of 1.5 $\mu\text{g}/100\text{ cm}^2$.

In addition to including remediation standards for meth, some states include quantitative standards for VOCs, corrosives, lead, mercury and iodine. Cleanup standards for meth and VOCs apply to all meth manufacturing sites, regardless of the cooking method(s) used. Cleanup standards for lead and mercury are especially relevant in instances where the P2P method of manufacturing meth was employed.

As of March 2013, 15 states require or recommend VOC levels of less than 1 ppm. Nine states set corrosive standards or recommend targets for surface pH of 6 to 8 (note the challenges associated with pH sampling described in *Section 5.1*). Nineteen states include lead standards or targets in their remediation guidelines; standards and targets range from 40 $\mu\text{g}/\text{ft}^2$ (or its equivalent of 4.3 $\mu\text{g}/100\text{ cm}^2$) to a more protective standard of 10 $\mu\text{g}/\text{ft}^2$ (or its equivalent of 1 $\mu\text{g}/100\text{ cm}^2$). Nineteen states include mercury standards or targets in their remediation guidelines; standards and targets range from a more conservative 0.05 $\mu\text{g}/\text{m}^3$ (equivalent to 50 ng/m^3) to 3.0 $\mu\text{g}/\text{m}^3$ (equivalent to 3,000 ng/m^3) of mercury in air. One state has a surface standard for mercury of 0.0054 $\mu\text{g}/100\text{ cm}^2$. Three states set an iodine standard or target of 22 $\mu\text{g}/100\text{ cm}^2$ for iodine-stained surfaces that are cleaned rather than removed. These standards and associated sampling techniques are addressed in greater detail in *Section 5.0*.



3.0 Remediation Sequence and Techniques

Section 3.0 suggests a remediation sequence and techniques.

3.1 Overview of Remediation Sequence

Below is an overview of the possible sequence in which remediation activities may occur. Each of the processes below is described in greater detail later in this section. The sequence in this list begins after gross removal has occurred and any law enforcement investigation has concluded. All procedures should adhere to the Occupational Safety and Health Administration (OSHA) Hazardous Waste Operations and Emergency Response (HAZWOPER) Standard, 29 CFR 1910.120 and other applicable state and local worker safety and health requirements. Gross removal includes the removal and disposal of bulk chemicals, equipment and apparatus (hazardous wastes) that could be used to manufacture meth and typically occurs immediately following the seizure of a clandestine lab by law enforcement. *[Note: Chemical containers, equipment or apparatus from the lab may be left behind during the gross removal step. If these items are encountered, stop work and contact local law enforcement personnel (or other appropriate agencies). If law enforcement does not need these items and they can be handled safely, dispose of them appropriately as outlined in the Redbook.]*

- 1) Secure the property to prevent unauthorized entry. The structure should not be reoccupied until after remediation is complete.
- 2) Hire a contractor to conduct remediation, sampling and air monitoring.
- 3) Ventilate or “air out” the structure with fresh, outdoor air [e.g., open doors and windows; use fans, blowers and/or a negative air unit with a high efficiency particulate air (HEPA) filtration system] to ensure worker safety and health. Continue ventilation during the remediation process, taking steps to protect nearby or adjacent structures from contamination.
- 4) Perform a preliminary assessment:
 - a. Conduct an off-site evaluation using relevant documentation.
 - b. Conduct an on-site evaluation.
 - c. Assess the need for pre-remediation and post-remediation sampling.
- 5) Conduct pre-remediation sampling, if applicable.
- 6) Develop a cleanup plan using information from the preliminary assessment. This should include a waste disposal plan.
- 7) Remove contaminated materials. Any materials or objects that will be disposed of should be discarded before cleanup begins.
- 8) Vacuum walls, floors and other hard surfaces using a vacuum with a HEPA filter.
- 9) Complete an initial washing of the walls and floors to remove the majority of contamination.
- 10) Clean and seal the heating, ventilation and air conditioning (HVAC) system. Do not run this system again until all other cleanup is complete.
- 11) Flush plumbing traps.
- 12) Use a detergent-water solution to wash ceilings, walls, floors, non-porous furniture and other items that will be kept.
- 13) Conduct post-remediation sampling, if applicable. (Ensure structure/items are completely dry before sampling.)
- 14) Consider encapsulating washed ceilings, walls and floors once they meet remediation requirements or guidelines.
- 15) If wastewater from detergent-water washing is disposed of down drains within the structure, flush the system again after remediation.



- 16) Ventilate the structure once more after indoor cleanup is complete.
- 17) Perform outdoor remediation activities.
- 18) Secure the property once more to prevent unauthorized entry.
- 19) Prepare the final report.

3.2 Hiring a Contractor

Hire a contractor who has hazardous waste expertise and is certified (if certification is required by the state) to conduct cleanup operations at known or suspected meth labs. Several states have developed meth lab remediation certification programs for contractors, which help to ensure remediation processes are adequately conducted. Contractors who have not been certified in a similar program should, at a minimum, complete the 40-hour HAZWOPER training (OSHA 29 CFR 1910.120).

It may also be appropriate to involve a certified industrial hygienist (CIH) in cleanup operations. Some states require that a CIH or experienced industrial hygienist (IH) conduct the preliminary assessment and post-remediation sampling. A CIH is trained in the assessment and control of chemical hazards and can play a significant role in ensuring that working conditions are safe during the remediation process. It is recognized that a CIH may not be available to accompany contractors to every cleanup site and that the use of a CIH can be expensive if he/she is involved in the entire remediation process. Therefore, contractors may consult a CIH to establish a general meth lab cleanup strategy. Other potential resources that may be consulted include state and local health agencies and environmental health specialists.

3.3 Ventilation

For the safety of on-site personnel, ventilate or “air out” meth labs with fresh, outdoor air (by opening doors and windows, and using fans, blowers and/or a negative air unit with a HEPA filtration system) before, during and after the remediation process. HVAC systems should be shut down and remain off until remediation of the former meth lab is complete.

Pre-Remediation Ventilation

Ventilate the lab prior to the entry of cleanup personnel. In some cases, law enforcement personnel will have already ventilated the lab before conducting criminal investigation activity or the gross removal of chemicals. If the lab was sealed after these activities, ventilate the lab again before remediation occurs. Ventilation should be performed per the contractor’s recommendation or for a minimum of 24 hours.⁸

While several state guidelines recommend “baking,” or heating the structure with the doors and windows closed to promote the volatilization of chemicals, its effectiveness has not been documented. It is believed that baking may mobilize and redistribute chemicals, thereby spreading contamination. For this reason, baking is not recommended until further research is conducted.

Continued Ventilation

It is important to continue ventilation throughout the remediation process (except when it would interfere with air monitoring). To protect workers and to limit cross-contamination, leave windows open and use fans, blowers and/or a negative air unit with a HEPA filtration system during cleanup. If using fans, blowers and/or a negative air unit, personnel should take precautions to avoid contaminant migration to areas that were not previously contaminated. A negative air unit equipped with a HEPA filtration system limits or prevents the transfer of airborne contamination from dirty to previously cleaned areas. Also, take precautions to avoid contamination of nearby or adjacent structures during all ventilation activities.

Post-Remediation Ventilation

Ventilate the property after cleanup is completed. After completion of all cleanup activities, contractors, owners and future occupants should be on alert for any new staining and/or odors (the presence of which would indicate that additional cleaning is necessary).

3.4 Worker Safety and Health

All procedures should adhere to OSHA HAZWOPER Standard, 29 CFR 1910.120 and other applicable state and local worker safety and health requirements. Do not begin remediation work until gross chemical removal is complete, law enforcement personnel have cleared the structure of defense measures placed by the lab operators (such as anti-personnel devices or “booby traps”) and the structure has been ventilated. Use the “buddy system” when making initial entry for remediation work, in case unforeseen dangers are encountered. In addition, conduct air quality monitoring to ensure the atmosphere is safe for entry.

Personnel who enter a former meth lab should have safety and health training (40-hour HAZWOPER training), and should use the appropriate level of personal protective equipment (PPE) based on the site-specific conditions. PPE for meth labs may include protective eye glasses, disposable gloves, foot coverings, steel toe boots and long-sleeved coveralls or a disposable protective suit. Decontaminate or discard, as appropriate, all clothing and PPE worn during remediation.

Types and Levels of Personal Protective Equipment (PPE)*

Level A (*greatest level of skin, respiratory and eye protection*) — positive pressure, full-facepiece self-contained breathing apparatus (SCBA), or positive pressure supplied air respirator with escape SCBA, approved by the National Institute for Occupational Safety and Health (NIOSH); totally-encapsulating chemical-protective suit; gloves, outer, chemical-resistant; gloves, inner, chemical-resistant; boots, chemical-resistant, steel toe and shank; and disposable protective suit, gloves and boots (depending on suit construction, may be worn over totally-encapsulating suit).

Level B (*highest level of respiratory protection but lesser level of skin protection*) — positive pressure, full-facepiece SCBA, or positive pressure supplied air respirator with escape SCBA (NIOSH approved); hooded chemical-resistant clothing (overalls and long-sleeved jacket; coveralls; one or two-piece chemical-splash suit; disposable chemical-resistant overalls); gloves, outer, chemical-resistant; gloves, inner, chemical-resistant; boots, outer, chemical-resistant steel toe and shank.

Level C (*concentration(s) and type(s) of airborne substance(s) is known and criteria for using air purifying respirators are met*) — full-face or half-mask, air purifying respirators (APR) (NIOSH approved); hooded chemical-resistant clothing (overalls; two-piece chemical-splash suit; disposable chemical-resistant overalls); gloves, outer, chemical-resistant; gloves, inner, chemical-resistant.

Level D (*work uniform affording minimal protection: used for nuisance contamination only*) — coveralls; boots/shoes, chemical-resistant steel toe and shank.

**OSHA Standard 1910.120, Appendix B*

Because meth can be injected intravenously, loose hypodermic needles may be present in a former meth lab and may pose a danger to those involved in remediation activities. Therefore, wear heavy work gloves and thick-soled leather shoes when collecting and removing trash, bedding, clothing, drapes, furniture, carpet, flooring or materials from any location that could conceal needles.⁹ Dispose of all needles in a labeled sharps container following state and local requirements or guidelines.

Use respiratory protection when removing carpet and other flooring or working in highly contaminated areas. Respirators also should be used if the inhalation of sampling materials and cleanup solvents poses a threat to human health. Never eat, drink, smoke or store food or beverages in a former meth lab prior to or during remediation.

3.5 Preliminary Assessment

Once the materials and equipment used in the manufacture of meth have been removed by law enforcement, a preliminary assessment should be conducted. The goal of the preliminary assessment is to provide information that will inform the development of the sampling and cleanup plan (if needed). The preliminary assessment should be documented in a written summary and include a record review and a site survey.

Record Review

To perform the record review, coordinate with state and local health departments and review copies of law enforcement or hazardous waste removal contractor reports (if available) for information on the duration of lab operation, manufacturing method, chemicals found, cooking locations, storage locations, disposal areas and observed contamination. This information, when coupled with the professional judgment of a cleanup professional (e.g., cleanup contractor, CIH/IH), can provide a foundation for the cleanup plan. Information gathered from those directly involved with the meth lab should be evaluated carefully because they may not be reliable sources.

Based on law enforcement or hazardous waste removal contractor reports, or on the professional judgment of the assessor, the record review can help to:

- 1) Establish the cooking method(s) employed during the manufacturing process.
- 2) Determine the quantities of chemicals found at the site and types of chemicals expected to have been on-site, based on the cooking methods.
- 3) Identify areas of expected contamination.

Site Survey

After compiling all available information, conduct the site survey to confirm the information gathered during the record review, document actual conditions of the site and provide information for developing the cleanup plan. Whenever possible, document conditions of the site with photographs.

While conducting the site survey, take precautions to ensure worker safety and health. Contamination can be removed prior to the preliminary assessment if it poses an imminent threat to human or environmental health. The structure(s) should be ventilated before entry, and assessors should wear the appropriate PPE.

Assessors should notify law enforcement personnel (or other appropriate agencies) if additional materials likely to have been used in the manufacture of meth are discovered.

In order to complete the site survey:

- 1) Compile a description and diagram of the site that includes: address, description and location of all structures; the layout of the property; and a description of adjacent properties and structures. For structures, the diagram should document the size and location of all rooms (e.g., basement, attic, closets), how the rooms connect and their expected use (e.g., bedroom, closet). In addition, the location of doors, windows, the ventilation system and appliances should be noted on the diagram. This description should include interior surfaces (e.g., walls, ceilings, floors, countertops) and any furnishings that remain on-site after gross removal.
- 2) Document areas of heaviest contamination. These areas could be identified by visible evidence of contamination (such as staining) or based on the professional judgment of the assessor. If visible signs of contamination do not exist, this does not mean there is no contamination. Residual meth should be routinely expected throughout the structure.
- 3) Determine or confirm the cooking method(s) employed during the manufacturing process.
- 4) Determine the presence of other potential hazards to cleanup personnel or future occupants including lead, asbestos and mercury which may include specific health concerns in their own right.
- 5) Examine the ventilation system for signs of contamination (e.g., rust). If contamination is suspected, sample the cold air return.
- 6) Examine the plumbing system (e.g., sinks, toilets, showers, tubs, drains) for damage. In addition, the assessor should identify the type of wastewater disposal system present (e.g., sewer connection, septic system).
- 7) Investigate any adjacent or nearby structures for avenues of potential contamination (e.g., common spaces, hallways, shared ventilation system). Cross contamination can often occur in townhouses, motels/hotels, apartments or duplexes.
- 8) Determine if outside disposal occurred (e.g., burning, dumping, burying, drainage to septic system) and caused soil, surface waters or groundwater contamination. Common signs of outside disposal include burned or dead vegetation and stained soil.

3.6 Pre-Remediation Sampling

The decision whether to conduct pre-remediation sampling (and for which constituents) is best made on a property-specific basis. Owners and contractors should consult state and local requirements or guidelines when making the determination whether to conduct pre-remediation sampling.

Pre-remediation sampling can reduce costs by streamlining the cleanup process and identifying materials that are too contaminated to clean and should simply be removed. Pre-remediation sampling also can be useful in excluding certain portions of a property from a cleanup, such as areas to which the operators of the lab did not have access.

If pre-remediation sampling is conducted it should be conducted using the same protocols used for post-remediation sampling (see *Section 5.0*).

Pre-remediation sampling also may be performed for the following reasons:

- To ensure the safety and health of those working on a site before or during remediation.
- To establish whether contamination exceeds state and local requirements or guidelines.
- To inform the cleanup plan and process by identifying the extent of contamination in areas of the former lab.
- To determine which materials can be cleaned and which should be removed. This assessment can help lower overall cleanup costs.
- To help quantify cost estimates for cleanup.
- To sample for lead and mercury, two elements commonly associated with the P2P method of production, if this method was employed.
- To corroborate or augment information that law enforcement officers gathered from those directly involved with the meth lab.
- To meet pre-remediation sampling requirements of a bank, insurance agency, mortgage holder, other private entity or state and local authorities.
- To allow for the comparison of pre- and post-remediation samples to show the reduction of contaminants achieved through remediation. (*Note: The same sample collection method should be used for both pre- and post-remediation sampling if parties intend to compare results.*)
- To establish a record of baseline conditions prior to remediation.

In other cases, pre-remediation sampling is not required and may increase costs. Some states assume that all areas of a former meth lab are contaminated and require that the entire structure be cleaned. For some structures, it is more cost-effective to remediate the entire structure than to take pre-remediation samples in an attempt to avoid having to remediate certain areas.

3.7 Cleanup Plan

The information from the preliminary assessment and pre-remediation sampling (if conducted) should be used to develop the cleanup plan. This plan will guide the remedial actions at the site and should:

- Describe security provisions in place for the site.
- Contain a summary of all information gathered in the preliminary assessment.
- Provide information on the contractor, project manager and site supervisor performing the cleanup (if applicable). This should include verification and documentation of the contractor's certification and/or qualifications.
- Contain a list of emergency contacts and telephone numbers.
- Determine whether utilities should be disconnected from the structure until cleanup and remediation activities are complete and make appropriate provisions for power needs, if necessary.
- Determine what level of PPE workers should wear while in the contaminated portion of the site. This section should describe any safety and health procedures (including personnel decontamination procedures) that will be followed throughout cleanup. All procedures should adhere to OSHA and other applicable state and local worker safety and health requirements or guidelines. The location and route to the nearest hospital or emergency service facility also should be noted.
- Contain a shoring plan, if structural integrity was determined to be a concern during the preliminary assessment.
- Describe the cleanup methods to be used, including:
 - a list of the items to be removed from the structure;
 - a list of all surfaces or items to be cleaned on-site;
 - procedures for cleaning;
 - areas to be encapsulated;
 - locations and procedures for on-site decontamination; and
 - containment plans for the cleanup to prevent off-site contamination.
- Describe the plan for waste disposal that complies with federal, state and local requirements or guidelines regarding materials removed from the structure. This plan applies to hazardous waste and solid waste, as well as wastewater. The plan should include the name of the disposal facility and documentation that the facility is equipped to handle the types of wastes generated (such as hazardous materials).

- List any permits that will be required for the cleanup.
- Describe pre-remediation (if applicable) and post-remediation (if applicable) sampling methods, including where and how many samples will be collected and the remediation standards that will be used.
- List the personnel collecting the samples, the name of the analytical laboratory and the analytical methods for the samples.
- List Quality Assurance/Quality Control (QA/QC) practices that will be followed.
- Contain a schedule of anticipated actions.
- Outline the post-remediation walk-through and final report to document the effectiveness of the cleanup.

Once developed, the cleanup plan should be accepted by the property owner and the decontamination contractor, and any necessary government approvals should be sought and received.

3.8 Removal of Contaminated Materials

After gross removal has occurred and the structure has been ventilated for a minimum of 24 hours, properly discard all materials that will be removed from the lab per the cleanup plan. *[Note: If you find chemical containers, equipment or apparatus from the lab left behind during the gross removal step, stop work and contact local law enforcement (or other appropriate agencies). If law enforcement does not need these items and they can be handled safely, dispose of them appropriately.]*

Discard any visibly stained, odor-emitting or damaged materials and decide whether to clean or discard other items on a case-by-case basis using information from the preliminary assessment and a cost-benefit analysis. Although there is no single determinant that can be used to decide which items should be discarded and which items can be cleaned and kept, consider the following during the decision-making process:

Potential for Contact — Consider whether inhabitants of the structure are likely to come into contact with the item regularly (such as bedding). Discard contaminated items with a high potential for human contact more readily than items with a low potential for human contact. Take extra consideration when deciding whether to discard items that children are likely to come into contact with (e.g., toys, bottles) as children may be especially vulnerable to environmental toxins.

Intrinsic or Emotional Value — Weigh the intrinsic or emotional value of the item with how much it would cost to effectively clean the item. If sampling will be conducted, the cost of cleanup includes the cost of

sampling to ensure the item is cleaned. In many cases it is more cost-effective to dispose of an item and replace it than it is to clean it. In some circumstances, however, items of great emotional value (e.g., wedding albums) may be salvaged.

Porosity — Consider the porosity of the item or material. In general, porous items and materials are easily penetrated or permeated by hazardous gases, liquids or residues. Non-porous surfaces are more resistant to this type of contamination. As a result, contamination is often located *in* porous items and *on the surface* of non-porous items. Thus, it is generally more difficult to eliminate contamination from porous items and materials.

(Note: Because definitions of “porous,” “semi-porous” and “non-porous” differ, the recommendations in Section 4.0 Item and Material-Specific Best Practices are organized according to item or material.)

Considering the potential for human contact, the intrinsic and emotional value and the porosity of an item or material may help guide decisions as to whether the item or material should be discarded. For example, carpet always should be discarded because it has a high potential for human contact (especially since young children tend to crawl on the floor), has relatively low intrinsic and emotional value and is extremely porous (making it difficult to successfully decontaminate).

Items Brought into a Lab After the Cook Has Vacated

In some unfortunate cases, innocent and unsuspecting individuals and families move into former meth labs before the structure has been properly cleaned. These individuals/families later discover that their home was a lab (e.g., by talking to a neighbor, finding lab paraphernalia or experiencing health symptoms, etc.), and their belongings may be contaminated. Given these circumstances, contents brought into a former lab *after the cook has vacated* should be given special consideration. These items are likely to be less contaminated and, therefore, may be easier to clean.

3.9 Waste Characterization and Disposal Procedures

Some items or materials removed from a former meth lab may be classified as hazardous—depending upon federal, state and local requirements—and may not be appropriate for disposal at a local landfill. Refer to the appropriate federal, state and local solid waste authority to determine what disposal procedures are necessary. Additionally, contact the local landfill operator prior to disposal to ensure the facility will accept the wastes.

Several state requirements and guidelines suggest that all contaminated materials be wrapped and sealed before they are removed from the site to avoid spreading the contamination to unaffected areas. Most states also stress the importance of disposing items in a manner to prevent re-use (i.e., salvaging). For example, couches, other furniture and appliances should be physically destroyed so that they cannot be re-used.

Bear in mind that asbestos and lead-based paint may be present in the structure. This possibility should be considered during the preliminary assessment, and all suspect building materials should be properly sampled and tested prior to disturbance or removal. If asbestos and lead-based paint are present, and it is determined that they should be removed, their removal and disposal should be compliant with all federal, state and local requirements.

3.10 High Efficiency Particulate Air (HEPA) Vacuuming

Vacuum the floors of the structure after removing carpets, pads and other flooring (as necessary), using a vacuum with a HEPA filter. Additionally, use a vacuum equipped with a HEPA filter on walls or other hard surfaces to remove dirt and cobwebs prior to washing with a detergent-water solution (see *Section 3.13*). This step is conducted *in addition* to detergent-water washing.

Use a commercial grade vacuum cleaner, equipped with a HEPA dust collection system (HEPA filter). Bag-less vacuum cleaners and household vacuums equipped with HEPA filters, such as those purchased at retail stores, are not recommended.¹¹

Several states suggest that vacuuming with a machine equipped with a HEPA filter can be used on surfaces that cannot be cleaned with detergent and water (e.g., porous materials such as upholstered furniture). While vacuuming collects some particulate contamination, it does not remove contamination entirely. Therefore, vacuuming is not encouraged as a stand-alone remediation technique but may be useful in select cases when the decision has been made to save an item of intrinsic or emotional value that cannot be washed with a detergent-water solution.

While it is generally recommended that contaminated unfinished structural wood be power-washed (and that a wet vac be used to draw out excess water), power-washing exposed wood may not be advisable in structures susceptible to mold. In these cases, use vacuuming as an alternative.

3.11 Initial Wash

After all materials and items that will not be cleaned have been disposed of and the structure has been vacuumed (with a machine equipped with a HEPA filter), conduct an initial washing of the walls and floors to remove the majority of contamination using a detergent-water solution (see *Section 3.13*). Conducting this initial wash will not only help to ensure the safety of those who enter the structure (e.g., contractors, subcontractors), but it also will lessen the possibility that contamination on the walls and floors will re-contaminate other areas of the structure later in the remediation process.

3.12 Heating, Ventilation and Air Conditioning (HVAC)

If a meth lab is located in a structure with an HVAC system or other residential forced air system (e.g., kitchen or bathroom exhausts) it can be expected that fumes, dust and other contaminants have collected in the vents, ductwork, filters and on walls and ceilings near the ventilation ducts. It should be noted that a single HVAC system can service multi-unit structures (e.g., apartments, storage facilities), and allow contamination to be spread throughout. To limit this possibility, the HVAC system should be shut down and remain off until remediation of the former meth lab is complete. During the preliminary assessment, sampling should be conducted in all areas/rooms/units serviced by the HVAC system to determine the spread of contamination and should be noted in the cleanup plan.

Contractors who specialize in cleaning ventilation systems—or who have experience cleaning ventilation systems in former meth labs—should be used to clean HVAC systems. These contractors have specialized tools and training to ensure thorough cleanup.

It is important to remember that not all ventilation system ducts can be cleaned. For example, some ducts are lined with fiberglass or other insulation (which, if damaged during cleaning, can release fiberglass into living areas). Also, flexible ductwork frequently has a porous inner surface and in most cases cannot be cleaned economically. For this reason, the ductwork should be discarded and replaced after the ventilation system is cleaned.

If it is determined that the HVAC system can be cleaned, it should be cleaned early in the remediation process, after the initial wash has been conducted. Once cleaned, the HVAC system should be sealed at all openings to prevent potential recontamination.

Several states offer a step-by-step explanation of the ventilation system cleaning process. At a minimum,

when approaching a ventilation system constructed of non-porous materials, ventilation contractors should:¹⁰

- 1) Perform a walk-through of the structure to establish a specific plan for decontamination of the ventilation system.
- 2) Follow safety and health procedures, in accordance with OSHA and other applicable state and local worker safety and health requirements or guidelines, to protect workers and others in the vicinity of the structure during the decontamination process.
- 3) Place protective coverings in areas where work is being performed, including plastic or drop cloths around each area where the duct is penetrated.
- 4) Shut off and lock out all air handler units before working on each air conveyance system.
- 5) Perform a visual inspection of the interior ductwork surfaces and internal components.
- 6) Draw a negative pressure on the entire ductwork, using a negative air unit with a HEPA filtration system, throughout the cleaning process.
- 7) Remove and clean all return air grilles.
- 8) Clean the ventilation system using pneumatic or electrical agitators to agitate debris into an airborne state (beginning with the outside air intake and return air ducts). Additional equipment may be used in the cleaning process, such as brushes, air lances, air nozzles and power washers or vacuums equipped with HEPA filters followed by washing with a detergent-water solution (see *Section 3.13*). Controlled containment practices should be used to ensure that debris is not dispersed outside the air conveyance system during cleaning.
- 9) Open and inspect air handling units, and clean all components.
- 10) Remove and clean all supply diffusers.
- 11) Clean the supply ductwork using the techniques described in item 8 above.
- 12) Reinstall diffusers and grilles after cleaning is complete.
- 13) Seal shut access points that were opened.
- 14) Bag and label all debris, including all air filters, and properly dispose of at a landfill.

(Note: There are various types of forced-air systems, therefore, the above steps may need to be modified based on the type of system being cleaned.)

Controlling moisture in ventilation systems is one of the most effective ways to prevent biological growth (such as mold). Consequently, if wet cleaning methods are used (detergent-water washing or power-washing), ventilation systems need to be checked to ensure they have dried thoroughly.

Cleaning methods should be left to the discretion of ventilation contractors at each lab. Experts agree, however, that no chemicals should be added to either break down meth or disinfect ducts. Further research is needed to define the most effective method for cleaning ventilation systems.

Another consideration is whether any residual contamination in the HVAC system can re-contaminate the structure after remediation is complete. The first few minutes of system restart after cleaning is usually when the greatest amount of dust is released. The potential exists for this dust to cause post-remediation samples to exceed state standards. Owners and cleanup contractors should be aware of, and plan for, this possibility. As an added measure of caution, the HVAC system should be turned on prior to post-remediation sampling.

3.13 Detergent-Water Solution Washing

Wash ceilings, walls, floors, furniture and other household items that will not be discarded with a detergent-water solution. Most states recommend using a household all-purpose cleaner. Follow the detergent manufacturer's recommendation to determine the concentration of the solution. Cleaning should thoroughly cover the entire surface, not just spots. The wash water does not have to be hot. Hot water has not been proven more effective than cold water for cleaning.

Where post-remediation sampling is required, the walls should be cleaned until they meet the required remediation standard. In states or local jurisdictions that do not require post-remediation sampling, repeat the cleaning and rinsing process three times before the walls are repainted (i.e., encapsulated). Most states recommend cleaning from ceiling to floor.

Follow each wash with a thorough rinse using clean water and a clean cloth rag. When washing, change cloth rags and detergent-water solutions frequently. After washing, dispose of cloth rags appropriately.

The use of harsh chemicals should be avoided. Consider the following before using bleach, trisodium phosphate (TSP), methanol and peroxide-based proprietary cleaners:

Bleach — The interaction of bleach and meth is not fully understood and their by-products are currently unknown.¹² Until further research is conducted to identify these by-products and their health effects, bleach should not be used as a cleaning agent in a former meth lab. The use of bleach should be specifically avoided if the Red Phosphorus method of production was used to manufacture meth, as the reaction between bleach and iodine (which is used in the Red Phosphorus method of production) could produce a toxic gas.



Trisodium Phosphate (TSP) — The use of TSP is recommended by some states. TSP is a strong cleaning agent, but it can also be irritating to the person using it. There is also a phosphate-free TSP (TSP-PF) that may offer the power of TSP without the phosphates. It should be noted that TSP-PF is a skin and eye irritant that may cause burns.

Methanol — Although some states recommend using methanol as a cleaning agent, the use of methanol should be avoided because it produces flammable vapors and has a low flash point.

Peroxide-based Proprietary Cleaners — While some studies indicate the use of peroxide-based proprietary cleaners may be effective at eliminating meth, it is possible that the meth oxidizes to another compound¹³. Because it is unclear if any by-products remain after the use of peroxide-based proprietary cleaners, the true effectiveness of peroxide-based proprietary cleaners should be verified before they can be recommended for cleaning former meth labs.

Wash Water Disposal

Wash water left over from the detergent-water washing process usually will not be contaminated enough to qualify as hazardous waste. In most cases, capturing and testing the water before disposing of it is not necessary (except in the case of a P2P lab where meth production uses mercury and lead and where the wash water may pose additional hazards) and will increase cleanup costs. However, some states may require the testing of wash water depending on the sensitivity of their hazardous waste criteria. Generally, wash water can be disposed of via the wastewater system (i.e., sanitary sewer).

Sequence of Remediation to Prevent Recontamination

While some states advocate cleaning the areas of highest contamination first, it is often impossible to know where those areas are. Instead of attempting to clean the most contaminated areas first and the least contaminated last (or alternatively the least contaminated first and the most contaminated last), clean the rooms and areas in the structure from the back to the front, sealing those areas and continuing through the structure.

To avoid re-contaminating a room that has been cleaned, seal the room and do not re-enter it. The room can be cordoned off at doors and other openings using plastic sheeting 4 to 6 mm thick. This practice will not only help to minimize potential tracking of contamination into already-cleaned rooms, but also could save time and money spent re-cleaning areas. Taking these steps to prevent recontamination is especially important when post-remediation sampling will not be conducted. By sealing each area/room after it has been cleaned, there can be more confidence that recontamination will not occur.

Cleaning Items On-site

To avoid contaminating another structure, items that will not be discarded should be cleaned on-site. Once items are cleaned, store the items in an already-cleaned room of the structure. It may be beneficial to bag or wrap cleaned items in plastic to prevent recontamination. If allowed by state and local regulations, items may also be stored off-site if they are properly cleaned, sampled (if required) and bagged or wrapped in plastic. Do not bring items stored off-site back into the structure until after the structure has met remediation requirements or guidelines. Always follow state and local requirements or guidelines when cleaning or disposing of items.

3.14 Post-Remediation Sampling

The purpose of post-remediation sampling is to show that cleanup effectively reduced contamination and, thus, the potential for exposure. Post-remediation sampling also can verify that cleaning was completed and that previously contaminated areas were cleaned to applicable standards. If post-remediation samples return results that exceed standards, the site should be cleaned again. In some cases, when portions of the site or structure cannot be cleaned, owners may consider encapsulation or removal if allowed by the oversight agency (see *Section 3.15*). Because the selection of sampling sites greatly influences the results of post-remediation sampling, having an independent third-

party conduct the sampling may be appropriate and is a requirement in some states. See *Section 5.0 – Potential Sampling Constituents, Theory and Methods* for more information.

3.15 Encapsulation

The extent to which meth and other lab-related chemicals migrate through materials and potentially volatilize is still unknown, though some research has shown that oil-based paint can effectively encapsulate methamphetamine contamination for up to 4.5 months¹⁴. Encapsulation should never be used as a substitute for cleaning. However, sealing with primers, paints and other sealants may provide a protective barrier to help prevent the migration of volatile chemicals to the surface of the material.

Generally, encapsulation should occur after surfaces (e.g., ceilings, walls, floors) have met the applicable remediation standards (i.e., after post-remediation sampling). If post-remediation sampling will not be conducted (although this is not advised), all surfaces and materials should still be encapsulated after they have been washed as thoroughly as possible.

If allowed by the oversight agency, encapsulation may be performed before the remediation standard has been met if the remediation standard cannot be met after at least three repeated washings [especially in states with exceptionally protective clearance levels (such as 0.05 µg/100 cm²)] or if the removal of the contaminated material (such as concrete foundations) would compromise the integrity of the structure. If contamination is left in place under these circumstances, it should be fully disclosed in the final report and communicated to the proper authority and property owner.

Oil-based paint, oil-based polyurethane or epoxies should be used to encapsulate interior surfaces. To encapsulate floors, most experts recommend the use of oil-based polyurethane. It is generally recommended that a primer that will not deteriorate over time be applied first in order to provide a firm bond between the surface and the finish coat. Though finish coats are often applied for aesthetic purposes, they also offer additional protection.

To achieve complete coverage, it may be necessary to apply more than one coat of primer, paint or sealant. Allow primers, paints or sealants to dry for the time stipulated by the manufacturer before applying additional coats. Further, encapsulated areas should be ventilated thoroughly prior to sampling for meth lab wastes remaining from the meth cooking process.

Several states recommend that products applied to encapsulate surfaces be sprayed on and not hand-rolled.

This is a valid recommendation especially for textured surfaces that cannot withstand physical agitation. Initial research suggests that sprayed on paint better encapsulates methamphetamine contamination, though additional research in this area is warranted¹⁵.

3.16 Plumbing

Odors emanating from materials or household systems (e.g., plumbing, HVAC) in former meth labs may indicate contamination. When in doubt about the source, owners should take precautions to protect occupant and/or worker safety and health. Because meth chemicals are frequently poured down the drain during active cooking, concentrations of these chemicals may remain in the traps of sinks and other drains. As a result, plumbing in structures may be compromised and require attention during remediation. Furthermore, plumbing connections and outfalls for wastewater and/or gray water should be verified. Because VOCs are often corrosive or flammable, test plumbing for these chemicals during pre-remediation sampling using a photoionization detector (PID). When remediation of plumbing fixtures begins, all plumbing traps should be flushed. If wastewater from detergent-water washing is disposed of down drains within the structure, the system should be flushed again after remediation.

Visibly contaminated (etched or stained) sinks, bathtubs and toilets should be removed and properly disposed of as they are difficult to clean. Porcelain and stainless steel, unless pitted or damaged, may be cleaned in the same manner as other hard, non-porous surfaces. When staining is noted around sinks, toilets or tubs, or if a strong chemical odor is coming from household plumbing, the plumbing system should be flushed with generous amounts of water to reduce the concentration of residual chemicals.

3.17 Sewer/Septic

Generally, meth lab waste chemicals discarded in sewer systems are flushed from the system within minutes or hours of disposal. However, chemicals may remain in the system longer if connections are on a line of very low flow. During the preliminary assessment, it should be noted if the flow in the line is low.

Large volumes of meth lab wastes can pose a problem if they are flushed and end up in on-site septic systems or in privately-owned wastewater treatment systems or those shared by small communities (e.g., trailer parks, apartment complexes). If there is evidence that meth lab wastes may have been disposed of into the septic system or privately-owned system, field screening of the septic tank or privately-owned system should be performed by an industrial hygienist, cleanup contractor

or other qualified person. VOCs and/or a pH that is too high or too low may indicate the presence of hazardous waste from the production process. Because some cleaning agents kill the flora of a septic system, it is not recommended that wastewater be disposed of in a septic system. Evidence of waste disposal may include, but is not limited to: witness statements; etched or stained sinks, bathtubs or toilets; chemical odors coming from plumbing or septic tank; visual observations of unusual conditions within the tank (dead tank); or stressed or dead vegetation in the leach field.

Systems generally should not be pumped if they contain only VOCs. However, if the leach field is not functioning due to wastes previously sent to the system, pumping may be necessary. Monitoring for VOCs will determine the proper course of action, and disposal of contaminated material should comply with federal, state and local disposal requirements. Wastewater sampling from septic tanks may be appropriate in order to characterize waste while using methods that minimize VOC losses.¹⁷ Field screening of septic systems should include pH testing which may provide an indication of potential issues with the leach field. Field screening should be used to evaluate septic system contamination and should follow the steps described below:

- 1) Prior to sampling, sufficiently excavate the septic tank to determine whether the tank consists of one or two chambers.
- 2) Remove the access cover from the first (or only) chamber and locate the outlet baffle.
- 3) Move any floating surface matter away from the insertion point of the sludge sampler. Do not collect any matter in the sludge sampler.
 - a. For sampling locations in tanks with one chamber, collect samples from the baffle on the outlet end of the chamber.
 - b. For sampling locations in tanks with two chambers, collect samples from the baffle on the outlet end of chamber one.
- 4) Follow instructions for correct usage of a sludge sampler.
- 5) Insert the sludge sampler into the tank, lowering it until you hit the bottom.
- 6) Trap the sample inside the sludge sampler.
- 7) Remove the sludge sampler and fill two 40 mL vials.
- 8) Samples may be taken without preservative or with preservative in the vial. Sampling procedure is determined by the sampler's confidence and ability to maintain sample integrity.
- 9) Place sample containers in a cooler with enough ice or ice packs to maintain a temperature of 4° C.
- 10) Replace the access cover.

Remediation of septic systems should occur at the end of the remediation process in order to ensure that any chemicals disposed of into the septic system are appropriately removed. However, if the leach field is not functioning, remediation of the system should occur as soon as possible, and no wash water or wastes should be added to the system.

3.18 Outdoor Remediation

Meth cooks often discard waste chemicals outside the structure. For this reason, the preliminary assessment may include some outdoor sampling, especially if the ground is visibly stained or otherwise affected (e.g., odors, burn piles, dead vegetation or remnants of reaction waste). If burn or trash pits, discolored soil or dead vegetation are found, refer to state and local requirements or guidelines (related to hazardous and/or solid waste) to determine the appropriate authority and/or agency responsible for outdoor remediation.

3.19 Final Report

A final report should be prepared to document that the property has been decontaminated per applicable state and local requirements or guidelines before the structure can be considered acceptable for re-occupancy.

All inspections and assessments conducted during the remediation process should be fully documented in writing. The report should include the dates that activities were performed and the names of the people/companies who performed the work. Photographic documentation of pre- and post-decontamination property conditions and all sample locations also should be included. Any documents such as drawings, handwritten notes and photographs should be signed, dated and included as part of these cleanup records.

The final report should include, at a minimum, the following information:

Introduction — The introduction should include a case narrative, site description and site assessment. This information should have been collected prior to the start of remediation during both the record review and site assessment. The information should be documented in the Preliminary Assessment (see *Section 3.5*). The type of information and documentation in this section should include:

- Physical address of property, number and type of structures present and description of adjacent and/or surrounding properties.

- Law enforcement reports, documented observations and pre-remediation sampling results (if pre-remediation sampling occurred) that provide information regarding the manufacturing method, chemicals present, cooking areas, chemical storage areas and observed areas of contamination or waste disposal.
- Cleanup contractor, CIH/IH or other qualified environmental professional statement of qualifications, including professional certification and description of experience in assessing contamination associated with meth labs.

Methods — This section of the final report should document cleanup and disposal activities. The cleanup plan (see *Section 3.7*) and documentation that cleanup was carried out according to the plan should be incorporated in this section. The type of information and documentation in this section should include:

- Worker safety and health information.
- Decontamination (e.g., removal, encapsulation) procedures for each area that was decontaminated.
- Waste management procedures, including handling, final disposition of wastes and waste disposal records.

Results — This section of the final report should document that the structure was cleaned to acceptable levels. The type of information and documentation in this section should include:

- A sampling plan, including sample collection, handling and QA/QC.
- A description of the analytical methods used and laboratory QA/QC requirements.
- A written description of the location and results of post decontamination samples, including landmarks for referencing individual sample locations.
- References to appropriate state and local requirements or guidelines.
- Sampling results, in writing, certified by the laboratory that performed the analyses.

The final report should be signed by the cleanup contractor, CIH/IH or other qualified environmental professional who prepared it and submitted to the appropriate state and local authority. The property owner and decontamination contractor should each retain a copy of the report. The report may be reviewed by the appropriate state and local authority responsible for deeming the property suitable for re-occupancy. Decisions about re-occupancy are made by the appropriate state and local authority.

4.0 Item- and Material-Specific Best Practices

Section 4.0 provides possible best practices.

4.1 Walls

Remove and replace wall surfaces (especially those made of absorbent materials, such as drywall or plaster) that show visible signs of staining or are emitting chemical odors. Exceptions may be made if removal of the contaminated material threatens the integrity of the structure.

Clean smooth, painted walls (i.e., those without “popcorn” texture) using a detergent-water solution (see Section 3.13). After cleaning, conduct post-remediation sampling (if applicable) and encapsulate walls (see Section 3.15).

Before textured walls are cleaned or removed, they should be sampled for asbestos. Textured walls that do not contain asbestos should be washed with a detergent-water solution and encapsulated. If asbestos is present but meth is not (or it has been cleaned to an acceptable level), several states suggest sealing the surface with a spray-on asbestos encapsulation product. If the wall meets neither the remediation standard for meth nor asbestos, a certified asbestos abatement contractor should remove the material.

Remove any absorbent building material (such as insulation) that shows visible signs of staining or is emitting chemical odors.

4.2 Ceilings

Ceilings contain some of the heaviest concentrations of residual meth. Although they have a low potential for human contact, ceilings should be cleaned thoroughly in case they are disturbed in the future. When present, ceiling fans should also be cleaned (or discarded). Any ceiling surface that shows visible signs of staining or is emitting chemical odors should always be removed and replaced.

Smooth, painted ceilings that were not removed should be washed with a detergent-water solution and then encapsulated (see Sections 3.13 and 3.15). Encapsulating ceilings should not be used as an initial attempt to reduce meth levels below clearance standards. The exception to this are surfaces that are not amenable to cleaning (such as textured “popcorn” ceilings).

Textured (i.e., “popcorn” or spray-on) ceilings should be sampled for asbestos and meth contamination. Textured ceilings that do not contain asbestos should be encapsulated.

Because ceiling tiles (suspended or attached) are relatively inexpensive, discard tiles that show visible signs of contamination or that were in areas of suspected high contamination. Tiled ceilings should always be sampled for asbestos.

For both textured and tiled ceilings, if asbestos is present and decontamination would disturb the material, several states suggest sealing the surfaces with a spray-on asbestos encapsulation product. A certified asbestos abatement contractor should be consulted, following state and local requirements or guidelines.

4.3 Floors

Before removing or cleaning floors, consider the type of material from which it was made. Resilient flooring such as sheet, laminate or vinyl tile can be kept unless it is stained or melted. (*Note: Vinyl flooring or underlying mastic may contain asbestos. If it is removed, removal and disposal should be compliant with all federal, state and local requirements.*) Porous flooring material, such as cork or unfinished wood, should be removed and discarded.

Consider disposing of floors in high-traffic areas, even when distant from cooking areas, as they often contain high levels of contamination.

After removing any primary flooring (e.g., carpeting, vinyl, laminate) always vacuum with a machine equipped with a HEPA filter to remove contaminated dust and other debris from the sub-flooring. In addition, conduct an initial washing of sub-flooring with a detergent-water solution (see Section 3.13) prior to beginning the cleanup of the rest of the structure.

Wash floors that will not be replaced with a detergent-water solution and re-seal the floors with a product such as polyurethane. Do not cover potentially contaminated flooring with new flooring, as this remediation approach does not prevent unrestricted future use of the structure.

If ceramic or stone tiles are not removed, they should be washed with a detergent-water solution and then re-glazed depending on the porosity of the tile. It is recommended that grout be ground down, re-grouted and then sealed, or at a minimum, encapsulated with an epoxy-based sealant.

4.4 Kitchen Countertops

Because kitchen countertops have high potential for human contact and are food preparation surfaces, there is debate as to whether they should be automatically discarded or whether they can be kept as long as they meet remediation standards. Thus, further research is needed to determine the migration potential of meth (and precursor chemicals) through common types of kitchen countertops.

Currently, several states suggest the following for various types of countertop materials:

- All countertops with visible signs of contamination (e.g., etched, stained, emitting odors) should be discarded.
- Countertops made of porous materials (e.g., wood, granite) should be discarded.
- Countertops made of non-porous, solid materials can be sanded down and washed with a detergent-water solution (see *Section 3.13*).
- Countertops made of stainless steel can be washed with a detergent-water solution.
- Countertops made of ceramic and stone tile should be removed when in high-contact areas. If ceramic or stone tiles are not removed, they should be washed with a detergent-water solution and possibly re-glazed (depending on the porosity of the tile). At a minimum, grout should be encapsulated with an epoxy-based sealant or ground down, re-grouted and then sealed.

4.5 Concrete, Cement and Brick

Exposed painted or unpainted concrete, cement and brick should be washed with a detergent-water solution (see *Section 3.13*). Most states also recommend power-washing concrete and cement as long as a water collection system such as a wet vac is used to absorb excess moisture. Because brick is an especially pervious material, it can absorb cleaning solutions used in the wet cleaning



method. *[Note: It may not be possible (even following adequate remediation) to achieve a neutral pH with concrete since it is normally very basic.]*

Other states discuss the use of HEPA microvacuums rather than wet cleaning methods. However, HEPA microvacuuming is very time consuming and does not remove contamination entirely (see *Section 3.10*).

In areas of suspected high contamination, the removal of concrete, cement and brick materials should be left to the discretion of the cleanup contractor if the removal could impact the integrity of the structure. In such cases, encapsulation methods can be used after washing procedures to add an extra layer of protection.

4.6 Appliances

Discard all appliances, electronics and tools that show visible signs of contamination. Also dispose of large and small appliances that could have been used in the production of meth or storage of meth products (e.g., refrigerators, stoves, ovens, microwaves, hotplates, toaster ovens, coffee makers). In order to protect handlers at waste or recycling facilities who may come into contact with appliances, the outside of appliances should be washed before the items are discarded. Be sure to render appliances unusable so that they will not be salvaged even if they are brought to a recycling facility.

It is generally agreed that large appliances, electronics and other tools should be evaluated on a case-by-case basis. Further research is needed to determine whether it is safe to continue to use appliances that were located in a former meth lab. Some states suggest washing with a detergent-water solution (see *Section 3.13*) the exteriors and interiors of large appliances that were not exposed to high concentrations of meth and show no visual contamination. All appliances with insulation should be sampled and discarded if clearance standards are not met (e.g., dishwashers, refrigerators, storage freezers).

Sampling and cleaning inside motors and circuitry of appliances or electronics is extremely difficult and expensive; therefore, it is usually more practical to discard these items than to attempt to salvage them.¹⁶

4.7 Wood

When deciding whether to discard or clean wooden materials or items, consider the porosity, the degree of exposure (e.g., a wooden hand rail vs. a section of wainscoting high on the wall), level of contamination and the quality of the finish. As a general principle, discard (in a manner to prevent reuse) any wooden surface or item that shows visible signs of contamination (e.g., etched, stained, emitting odors).

If wooden materials or items are not discarded, wash the items using a detergent-water solution (see *Section 3.13*). Additionally, cleaned surfaces should be encapsulated with a non-water based sealant.

Untreated wood will absorb moisture if detergent-water washing or power-washing techniques are used. To prevent the growth of mold, be sure to collect excess water using a wet vac to dry the unfinished wood. Encapsulate the wood after cleaning and sampling.

4.8 Windows

Window glass can be cleaned at the same time as walls. Glass should be triple-washed using a standard household glass cleaner. Clean cloths and solution should be used for each washing.

Wooden trim and hard plastic trim and tracking should be washed with a detergent-water solution (see *Section 3.13*) and sealed. If window trim cannot be adequately cleaned it should be removed and replaced.

4.9 Electrical Fixtures, Outlets and Switch Plate Covers

It is generally agreed that electrical outlet covers and wall switch plate covers should be replaced. These items are low in cost, tend to be high collection points for meth and also have great potential for repeated human contact.

If electrical fixtures are not discarded, wash them using a detergent-water solution (see *Section 3.13*). Always shut off power before removing electrical fixtures, outlet covers and switch covers. When using wet cleanup methods for electrical fixtures, ensure that electrical contact points do not get wet, and that the fixtures are completely dry before reassembly.

4.10 Dishes, Flatware and Other Hard Non-Porous Household Goods

Dishes, flatware and other hard non-porous household goods including ceramics, hard plastics, metals and glass should be discarded to prevent reuse if they show any signs of having been used during the meth cooking process (e.g., etched, stained, emitting odors).

Dispose of all plastic infant bottles, nipples and any infant/toddler eating utensils or dishes in a manner to prevent reuse, regardless of their contamination level.

Using a detergent-water solution (see *Section 3.13*) wash all items made of ceramic, metal, hard plastic or glass that were not used in the meth cooking process.

4.11 Toys and Other Children's Items

Infant toys that have the potential to be placed in the mouth (e.g., teething ring, pacifier, rattle) as well as any toys that show visible signs of contamination (e.g., etched, stained, emitting odors) should be disposed of in a manner that prevents reuse. Stuffed animals and other porous toys are very difficult to clean and should be discarded. It is generally agreed that toys made of metal or hard plastic may be washed using a detergent-water solution (see *Section 3.13*). The decision to decontaminate or dispose of softer plastic toys, items with electronic features or toys that have small crevices should be left to the discretion of the cleanup contractor (but disposal is highly recommended). Exceptions can be made for medical items (e.g., eye glasses, artificial limbs) if they are effectively cleaned to the prescribed clearance levels.

4.12 Carpets

Remove all carpet and discard it in a manner that prevents reuse. Do not vacuum, steam-clean or shampoo carpet. Carpet should always be discarded rather than cleaned because it is extremely difficult to remove all of the contamination from the fibers and weave of the carpet.

Additionally, carpet padding and flooring beneath carpet in a former meth lab are often contaminated. Leaving the carpet in place could pose a threat to future occupants who may decide to remove the carpet and unknowingly come into contact with this contaminated padding or flooring.

4.13 Clothing and Other Fabrics

Discard clothing or other fabrics with visible staining or contamination. Machine-washable clothing may be safely cleaned in a washing machine¹⁸. If a washing machine is used to wash potentially contaminated fabric, consider the following:

- Use the washing machine available on-site. Do not wash contaminated fabric off-site.
- Run an empty load before washing the fabric.
- Wash fabric three times in small- to medium-sized loads using the cycle setting that is normally recommended for the fabric type.
- Use a standard laundry detergent. Do not use detergents with bleach, oxidizing detergents or fabric softener.
- Do not dry items between washes. After washing items three times, bag the items and take them off-site to dry.
- Run an empty load after contaminated items have been washed before using the washing machine again.

Discard non-machine-washable fabrics in a manner that prevents reuse. In some cases, exceptions may be made for items of intrinsic value, such as a wedding dress, if the owner understands and accepts the risk associated with keeping it. Do not dry clean items, as doing so could contaminate other people's clothing.

4.14 Leather or Fabric Upholstered Furniture

Discard upholstered furniture. In some cases, however, furniture can be stripped of its upholstery (including cushions) and cleaned like hard furniture with a detergent-water solution (see *Section 3.13*). Destroy furniture before discarding it to prevent it from being reused.

4.15 Mattresses

While most states suggest that mattresses should always be discarded, some note that a mattress can be saved when:

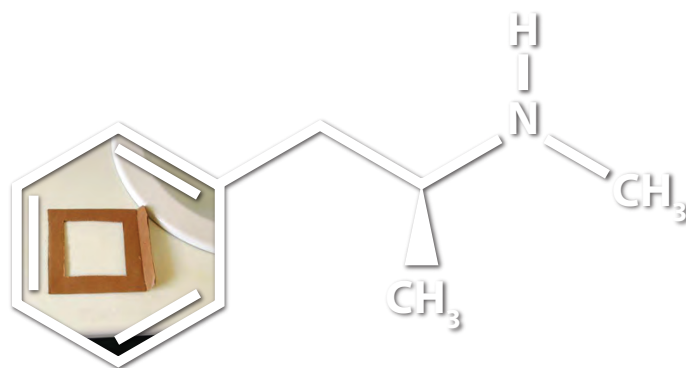
- pre-remediation samples indicate low levels of meth in the structure;
- the mattress was far removed from the area of cooking; and
- the mattress was not located in a room serviced by the same HVAC system as the room in which meth was cooked.

4.16 Paper Items/Books

Discard paper items and books found in the former meth lab. Exceptions may be made for important legal documents or photographs, papers or books of historical value.

4.17 Mobile Residences

Generally speaking, mobile residences should be cleaned like any other structure identified as a meth production site. However, past experience with the cleanup of mobile homes, campers and other mobile residences (such as vehicles) indicate that they may contain more porous/absorbent materials than fixed structures. For this reason, in some states, it has been found to be cost-prohibitive to clean mobile residences. Demolition may be considered a more cost-effective option.



5.0 Potential Sampling Constituents, Theory and Methods

5.1 Sampling Constituents

Sampling for meth is the most common way to establish whether portions of a structure are contaminated. Most states suggest property owners hire a qualified environmental or health professional to conduct sampling and testing. Because every meth manufacturing site is unique, sampling plans will differ and should be tailored to each specific case. In most cases, samples for meth are collected by wipe sampling; however, many states have established requirements or guidelines that dictate the sampling methodology. In all cases, persons collecting samples should use approved sampling methods as prescribed by federal, state and local government agencies (including EPA, NIOSH and OSHA). Some states require sampling for other constituents described below.

Volatile Organic Compounds (VOCs)

VOCs are emitted as gases from certain solids or liquids. VOCs include a variety of chemicals, some of which may have both short- and long-term adverse health effects. VOCs are emitted by a wide array of chemicals found

in former meth labs, which include but are not limited to: acetone, benzene, ether, freon, hexane, isopropanol, methanol, toluene, Coleman fuel, naphtha, ronsonol and xylene.

Monitoring for VOCs should be done for indoor air quality (in the adult and child breathing zones), in the plumbing and/or septic system and over outdoor areas with suspected soil contamination. VOC monitoring should be conducted using a PID. Some states suggest using a Summa canister for air monitoring; however, Summa canisters are expensive and sensitive enough to detect compounds from normal household cleaning activities, making the results difficult to interpret.

pH

pH is a term used to indicate the corrosiveness of a substance as ranked on a scale from 1.0 to 14.0. Corrosives commonly found in former meth labs include, but are not limited to: hydrochloric acid, hypo phosphorous acid, sodium hydroxide, sulfuric acid, anhydrous ammonia, phosphoric acid and other common acids and bases. pH sampling should be used to confirm that levels of acids and bases do not pose a health hazard. pH sampling should be conducted during pre-remediation sampling and is done onsite with pH paper.

pH testing should occur on food preparation countertops, stained materials (where there is visible contamination) and anything that leads to the septic system. pH testing should also occur within the septic system, on at least three locations in each room within the areas with visible contamination and within areas known to have been used for storage or handling of chemicals. *[Note: It may not be possible (even following adequate remediation) to achieve a neutral pH with concrete since it is normally very basic.]*

Summary of Quantitative State Remediation Standards (as of March 2013*)

VOCs

States that set VOC standards for VOC air monitoring in their remediation guidelines set the standard at less than 1 ppm.

pH

States that set corrosive standards in their remediation guidelines set a surface pH standard of 6 to 8.

Mercury

State standards range from 50 ng/m³ to 3.0 µg/m³ of mercury in air. One state has a surface standard for mercury of 0.0054 µg/100 cm².

Lead

State standards range from 40 µg/ft² (or its equivalent of 4.3 µg/100 cm²) to 10 µg/ft² (or its equivalent of 2 µg/100 cm²).

Meth

State standards range from 0.05 µg/100 cm² to 1.5 µg/100 cm². The most common standard is set at 0.1 µg/100 cm².

**See Appendix D for links to individual state requirements and guidelines.*

Lead, Mercury and Asbestos

Lead and mercury are commonly associated with labs where the P2P method was used to produce meth. If the P2P method was used, it is recommended to sample for airborne mercury and take surface samples for lead. In addition, former labs where meth is known to have been manufactured for several years should be tested for lead and mercury. Sampling for these constituents may be complicated because lead-based paints may be present in structures built prior to 1978, and mercury can be found in structures built prior to 1990. A variety of common household items also can contain small amounts of mercury.

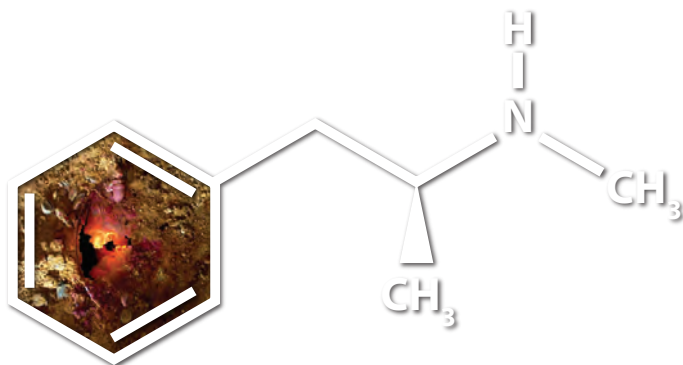
When conducting sampling for lead and mercury, be sure to test the plumbing and septic systems, in addition to the structure. If either mercury or lead is detected in pre-remediation sampling, test for it after completing cleanup activities.

Asbestos can be found in a variety of construction materials in homes and other structures. Many construction products on the market today still contain asbestos. In cases where portions of the structure (e.g., walls, floors, ceilings) will be removed, an asbestos survey should be performed. If a structure has a sprayed-on, “popcorn” ceiling, it should be sampled for meth-related contamination. If not contaminated, it should be left intact and/or encapsulated because of the potential presence of asbestos.

(Note: When removing any materials contaminated with lead or mercury, federal and state disposal requirements should be followed. In addition, materials removed from the site should be tested for asbestos per federal and state requirements.)

Iodine and Red Phosphorous

Sampling for iodine and red phosphorous generally is not necessary, since these chemicals leave visible stains that should be detected during the site survey. In most cases, surfaces or appliances that are visibly stained will be removed and will not need to be sampled.



5.2 Sampling Theory

When conducting sampling for meth contamination, follow an *authoritative* sampling approach. This process does not assign an equal probability of being sampled to every part of the structure. Instead, authoritative sampling targets areas suspected to have the highest levels of contamination. The validity of this sampling method depends on the professional judgment, knowledge and qualifications of the person conducting the sampling, who should have a detailed understanding of the individual site conditions and the suspected manufacturing method.

Several states reference two methods of authoritative sampling, both of which are described in ASTM D631198 (2003), *Standard Guide for Generation of Environmental Data Related to Waste Management Activities: Selection and Optimization of Sampling Design*. A description of the two methods, *biased* sampling and *judgmental* sampling, follows:

Biased sampling seeks to identify the “best” and “worst” locations at the site, rather than find the average concentration of contamination. By sampling at locations that are highly suggestive of contamination (e.g., cook sites, spill sites), this approach helps identify the maximum levels of contamination expected to be present at the site. Biased sampling also is useful in post-remediation sampling, since samples will be taken at the locations known or expected to be most contaminated before a site meets standards for reuse.

Judgmental sampling relies heavily on the experience of the person conducting the sampling to gauge the “average” concentration of contamination present in the structure. Judgmental sampling can be useful, assuming that the person conducting the sampling has sufficient information on the former manufacturing activities at the site and the necessary experience to select appropriate sampling locations. Judgmental sampling can become less accurate when only partial or incomplete information exists about past activities at the site or when the person conducting the sampling intentionally or accidentally selects sampling locations that misrepresent the site.

Hypothesis Testing

Both biased and judgmental sampling should be informed by data quality objectives (DQOs). DQOs establish the type, quality and quantity of data needed and specify tolerable levels of potential decision errors.¹⁹ DQOs should be established before environmental data collection activities begin. Sampling plans should be designed to meet DQOs, be cost-effective and minimize the likelihood of error. (Note: For additional information on QA/QC see Section 5.6). Each sampling plan should set forth a hypothesis, and sampling should be conducted to either prove or disprove that hypothesis. The hypothesis initially set forth will be different for pre-remediation and post-remediation sampling.

For pre-remediation sampling, the hypothesis being tested is that the site is clean and that there is no evidence of meth or its production. To test this hypothesis, a sampling plan is devised to answer the question, “Is there evidence of the presence of meth production in this area?” All data gathered will be weighed against this question, including information from the preliminary assessment as well as samples collected. Data that disprove the hypothesis suggest that the area is contaminated with meth or other associated materials.

In post-remediation sampling, the hypothesis is that the site has not been thoroughly cleaned. The owner or contractor will seek to prove, through biased sampling, that the site contains contaminant levels that exceed the relevant standard. As the site is cleaned, the hypothesis will become more difficult to prove; instead, the site will prove to be compliant. Once every habitable structure on the site is deemed compliant, the site can be released. Post-remediation sampling can be used as an oversight mechanism to ensure cleaning was adequate. Post-remediation sampling can also provide owners with a liability shield, quantifying that the structure meets the applicable standards.

5.3 Wipe Sampling Methods

Wipe sampling is the most often recommended method for sampling surface concentrations of meth. There are two conventional methods for wipe sampling: discrete and composite. In many remediation efforts, a combination of both composite and discrete sampling will be needed.

In *discrete sampling*, also known as “individual” sampling, single samples are taken at spatially discrete locations. This sampling technique should be used in areas that are “hot spots” highly suggestive of contamination. Discrete sampling should be performed in areas where there is a high probability of exposure (e.g., countertops, ventilation systems).

In *composite sampling*, multiple discrete samples are combined and treated as a single sample for analytical purposes. This sampling technique can be useful because it is more cost-effective. Composite sampling strategies should be used when the distribution of contamination is expected to be homogeneous. Composite sampling can be used on personal items (e.g., furniture, photo albums) and other belongings that the owner would like to save.

Many jurisdictions have prescribed methods for collecting wipe samples. Before conducting a sampling effort, be sure to consult and comply with applicable state and local requirements or guidelines. In general, collecting discrete wipe samples for surface meth contamination includes the following steps:

- 1) Document the area(s) of the structure to be sampled in a map or sketch.
- 2) Make a template of each individual area to be sampled. This template should be made with chalk, masking tape, Teflon or another material that will not contaminate the sample and is resistant to the solvent being used. Most guidance documents suggest a minimum sample area of 100 cm².
- 3) Use a new set of clean, non-powdered impervious gloves for each sample collected.
- 4) Wet the sample media with solvent.
- 5) Press firmly with the sample media, using caution to avoid touching the surface within the template. Smooth surfaces should be wiped; rough surfaces should be blotted.
- 6) When wiping the sampling area, two methods may be used:
 - a. The square method involves wiping in a square around the outside edge of the sample site and wiping in concentric squares towards the center.
 - b. The “S” method involves wiping from side-to-side in an overlapping “S” motion until the entire sample surface is covered.
- 7) Fold the sample media with the sampled side in without allowing the media to contact any other surfaces.
- 8) Repeat the wiping method with the folded sample media. If using the “S” method, wipe from top-to-bottom on the second pass.
- 9) Again, fold the media in half with the sampled side in. Seal the sample media in a sample container and label with the sample number and location.
- 10) Collect at least one sample media blank for every 10 samples collected. This media should be treated with solvent and folded but not wiped.

For composite samples, the same procedure should be used with the following considerations:

- 1) Use a single pair of gloves to collect all component samples that will make up a composite sample.
- 2) All component samples that will make up a composite sample should be placed in the same sample container.
- 3) Use enough solvent on the sampling media to properly collect all samples. The composite sample should consist of no more than four discrete samples.

Sample Media

Sample media can consist of a number of materials, which vary according to state and local requirements or guidelines. Examples of recommended sample media include:

- rayon/polyester or cotton general-purpose medical sponges;
- 11 cm filter paper (Whatman™ 40 ashless or equivalent);
- filter paper, including Whatman™ 40, 41, 42, 43, 44, 540, 541, Ahlstrom 54, VWR 454, S&S WH Medium or other filter paper with equivalent performance; and
- cotton gauze pad, including Johnson & Johnson cotton squares or equivalent.

Solvent

Agreement has not yet been reached as to which solvent should be used in sampling for meth. The three most common lifting agents—deionized water, isopropyl alcohol and methanol—are described below:

- Deionized water is safe for use and is generally adequate for sampling surface concentrations of meth. However, the use of deionized water as a solvent requires an additional extraction step once the sample is sent to the lab for analysis.
- Methanol is very effective at picking up meth; however, it may remove paint from wipe surfaces and over-represent the levels of contamination available through normal exposure pathways (such as touching a wall).
- In terms of safety and effectiveness for meth sampling, isopropyl alcohol lies somewhere between deionized water and methanol.

It is important that sampling methods be performed in a consistent fashion throughout the site. The degree to which various solvents lift or extract contaminants from the sampling surface will become more important as remediation standards become health-based.

5.4 Microvacuum Sampling Methods

Microvacuum sampling can be used to determine the presence of meth contamination on porous materials (e.g., furniture, upholstery) that cannot be sampled by wiping. This method does not quantitatively represent the mass of meth in the material, but the results may be used qualitatively to indicate the presence of meth. Though less sensitive than wipe sampling, microvacuums can be useful for site-screening purposes or the evaluation of personal items. Microvacuuming is not recommended for post-remediation sampling when wipe sampling is possible. When conducting microvacuuming, follow the appropriate prescribed guidelines (e.g., EPA, NIOSH, ASTM).

5.5 Other Emerging Sampling Methods

It is possible that new methods may emerge to conduct surface meth sampling. Until additional studies are available, it is not possible to determine the accuracy of these new methods for use in meth lab cleanup.

5.6 Quality Assurance/Quality Control (QA/QC)

QA/QC in sample analysis does not begin in the lab, but rather in the field. The following practices should be considered to maximize the integrity of samples:

- Collect samples in a uniform manner.
- Ensure as few people as possible handle the samples.
- Collect at least one sample media blank, treated in the same fashion but without wiping, for every 10 samples collected.
- Handle sample media with stainless steel forceps, tweezers or gloved fingers.
- Change gloves with each sample to avoid cross-contamination.
- Complete a sample label for each sample with waterproof, non-erasable ink and note sample number, date, time, location and sampler's ID.
- Seal samples immediately upon collection and always document when seals are broken or replaced and reseal open boxes of unused containers.
- Keep samples in a secure (locked) location.
- Properly store samples until they are transported to the lab for analysis per the laboratory's specifications.
- Deliver samples to the laboratory in a timely manner. The appropriate time frame for sample delivery will depend on the sampling method, material and laboratory protocol.

Endnotes

1. White House Office of National Drug Control Policy. (2006). *Synthetic Drug Control Strategy: A Focus on Methamphetamine and Prescription Drug Abuse*, pg. 39.
2. White House Office of National Drug Control Policy. (2006). *Synthetic Drug Control Strategy: A Focus on Methamphetamine and Prescription Drug Abuse*, pg. 39.
3. White House Office of National Drug Control Policy. (2006). *Synthetic Drug Control Strategy: A Focus on Methamphetamine and Prescription Drug Abuse*, pg. 39.
4. National Jewish Medical and Research Center. (2004). *Methamphetamine Contamination on Environmental Surfaces Caused by Simulated Smoking of Methamphetamine*.
5. Office of Children's Health Protection. yosemite.epa.gov/ochp/ochpweb.nsf/content/homepage.htm
6. Colorado Department of Public Health. (2005). *Support for Selection of a Cleanup Level for Methamphetamine at Clandestine Drug Laboratories*.
7. California Department of Toxic Substances Control. (2007). *Development of a Health-Based Meth Cleanup Standard*. www.dtsc.ca.gov/SiteCleanup/ERP/Clan_Labs.cfm#Research
8. National Jewish Medical and Research Center. (2005). *A 24-Hour Study to Investigate Chemical Exposures Associated with Clandestine Methamphetamine Laboratories*. www.nationaljewish.org/pdf/Meth-24hour-study.pdf
9. North Carolina Department of Health and Human Services. (2005). *Illegal Methamphetamine Laboratory Decontamination and Re-Occupancy Guidelines*, pg. 13.
10. Alaska Department of Environmental Conservation. (2004). *Guidance and Standards for Cleanup of Illegal Drug-Manufacturing Sites*, pg. 29.
11. Colorado Department of Public Health and Environment. (2005). 6 CCR 1014-3, *Regulations Pertaining to the Cleanup of Methamphetamine Laboratories*, Appendix C.
12. California Department of Toxic Substances Control. (2004). *Preliminary Analysis of the Efficacy of Using Cleaning Products to Break Down Methamphetamine*. www.dtsc.ca.gov/SiteCleanup/ERP/upload/SMBRB_MEMO_Prelim_Analysis.pdf
13. Serrano, Martyny, Kofford, Contreras, and Van Dyke. (2012). *Decontamination of Clothing and Building Materials Associated with the Clandestine Production of Methamphetamine*, *Journal of Occupational and Environmental Hygiene*, vol. 9:3, pgs. 185-197.
14. Serrano, Martyny, Kofford, Contreras, and Van Dyke. (2012). *Decontamination of Clothing and Building Materials Associated with the Clandestine Production of Methamphetamine*, *Journal of Occupational and Environmental Hygiene*, vol. 9:3, pgs. 185-197.
15. Serrano, Martyny, Kofford, Contreras, and Van Dyke. (2012). *Decontamination of Clothing and Building Materials Associated with the Clandestine Production of Methamphetamine*, *Journal of Occupational and Environmental Hygiene*, vol. 9:3, pgs. 185-197.
16. Washington State Department of Health, Division of Environmental Health. (2005). *Guidelines for Environmental Sampling at Illegal Drug Manufacturing Sites*, pg. 12.
17. American Industrial Hygiene Association. (2007). *Clandestine Methamphetamine Laboratory Assessment and Remediation Guidance*, pg. 22.
18. Serrano, Martyny, Kofford, Contreras, and Van Dyke. (2012). *Decontamination of Clothing and Building Materials Associated with the Clandestine Production of Methamphetamine*, *Journal of Occupational and Environmental Hygiene*, vol. 9:3, pgs. 185-197.
19. United States Environmental Protection Agency. (2000). *Data Quality Objectives Process for Hazardous Waste Site Investigations*. www.epa.gov/quality/qs-docs/g4hw-final.pdf

Other References

- Association of State and Territorial Solid Waste Management Officials. (2006). *Clandestine Drug Laboratory Remediation: A Guide to Post Emergency Response*.
- Arbuckle, Shawn L., Eric J. Esswein, Nicola Erb, John W. Martyny, Charles S. McCammon Jr., Mike Van Dyke. (2007). *Chemical concentrations and contamination associated with clandestine methamphetamine laboratories*, Journal of Chemical Health & Safety, pgs. 40-52.
- Arbuckle, Shawn L., Nicola Erb, John W. Martyny, Charles S. McCammon Jr., Mike Van Dyke. (2008). *Methamphetamine contamination on environmental surfaces caused by simulated smoking of methamphetamine*, Journal of Chemical Health & Safety.
- Contreras, John R., Kate A. Serrano, John W. Martyny, Shalece Kofford, Mike V. Van Dyke. (2012). *Decontamination of Clothing and Building Materials Associated with the Clandestine Production of Methamphetamine*, Journal of Occupational and Environmental Hygiene, vol. 9:3, pgs. 185-197.
- Contreras, John, Shalece Kofford, John W. Martyny, Kate A. Serrano, Mike V. Van Dyke. (2011). *Variability and Specificity Associated with Environmental Methamphetamine Sampling and Analysis*, Journal of Occupational and Environmental Hygiene, vol. 8:11, pgs. 636-641.
- National Jewish Medical and Research Center. (2004). *Chemical Exposures Associated with Clandestine Methamphetamine Laboratories Using the Anhydrous Ammonia Method of Production*.
- United States Department of Justice Drug Enforcement Administration. (2005). *Guidelines for Law Enforcement for the Cleanup of Clandestine Drug Laboratories*. www.justice.gov/dea/resources/img/redbook.pdf
- United States Environmental Protection Agency. (2008). *RCRA Hazardous Waste Identification of Methamphetamine Production Process By-products*. www.epa.gov/epawaste/hazard/wastetypes/wasteid/downloads/rtc-meth.pdf

*Front cover inset and photo on page 15 courtesy of Tacoma-Pierce County, Washington Health Department
Photos on page 9 and 23 courtesy of National Jewish Health*

Key Contributors*

- Curry Blankenship, Cherokee Nation Environmental Programs
- Lisa Boynton, U.S. Environmental Protection Agency
- Colleen Brisnehan, Colorado Department of Public Health and Environment
- Jeff Burgess, MD, MPH, University of Arizona
- Steven Connolly, New Mexico Environment Department
- Ryan Costello, Agency for Toxic Substances and Disease Registry
- Jace Cujé, U.S. Environmental Protection Agency
- Jim Faust, Idaho Department of Health and Welfare
- Anna Fernandez, Hawaii Department of Health
- Sherry Green, National Alliance of Model State Drug Laws
- Deb Grimm, Montana Department of Environmental Quality
- Leo Henning, Kansas Department of Health and Environment
- Thomas Hunting, Arkansas Department of Environmental Quality
- Erik Janus, University of Maryland University College
- Karen Keller, Utah Department of Environmental Quality
- Shalece Koffard, Utah Department of Health
- Kim Leingang, Kentucky Division of Waste Management
- Kathy Marshall, Illinois Department of Public Health
- John Martyny, PhD, CIH, National Jewish Health
- Greg McKnight, Washington State Department of Health
- James Michael, U.S. Environmental Protection Agency
- Terrel Mitchell, Cherokee Nation Environmental Programs
- Jim Morrison, Tennessee Department of Environment and Conservation
- Marilyn Parker, North Carolina Department of Health and Human Services
- Bill Rees, Utah Department of Environmental Quality
- Rick Rosky, National Meth Chemicals Initiative Southwest Meth Initiative
- Charles Salocks, California Environmental Protection Agency
- Will Service, North Carolina Division of Waste Management
- Brett Sherry, Oregon Health Authority
- Kent Schierkolk, Kansas Department of Health and Environment
- Larry Souther, Minnesota Department of Health
- Ed Thamke, Montana Department of Environmental Quality
- Scot W. Tiernan, Alaska Department of Environmental Conservation
- Greg Art Vollmer, New Mexico Environment Department
- Corey Yep, California Department of Toxic Substances Control

**This list includes key contributors to the 2009 document and the 2013 update.*

Appendix A: Primary Methods of Production and Associated Hazards

Nazi/Birch Reduction Lab Profile	
Precursor:	Ephedrine or Pseudoephedrine
Product:	d-Methamphetamine
Method:	Ephedrine reduction using anhydrous ammonia and lithium, sodium metal or elemental potassium and hydrochloric acid
Other Names:	"Lithium-Ammonia" Lab or "Sodium Metal" Lab
Unique Hazards:	Reaction of water with sodium or lithium metals as well as mixing sodium metal with sodium hydroxide increases flammability potential
	Irritant toxicity hazard from concentrated ammonia atmospheres
	Use of corrosive acids and bases
	Use of acid gas generators
Variations:	Use of an acetone/dry ice bath to keep original anhydrous ammonia mixture from evaporating prematurely
	Recovery of lithium ribbon from camera batteries

Red Phosphorus/Hydriodic Acid Lab Profile	
Precursor:	Ephedrine or Pseudoephedrine
Product:	d-Methamphetamine
Method:	Ephedrine reduction using red phosphorus, hydriodic acid and hydrochloric acid
Other Names:	"Red P" Lab, "Tweaker" Lab, "HI" Lab or "Mexican National" Lab
Unique Hazards:	Phosphine gas production
	Conversion of red phosphorus to white phosphorus
	Iodine and hydriodic acid vapors
	Use of corrosive acids and bases
Variations:	Use of acid gas generators
	Use iodine and water to make hydriodic acid
	Use hypophosphorus acid instead of red phosphorus
	Use liquid from tablet extraction directly in reflux step

P2P Amalgam Lab Profile	
Precursor:	Phenyl-2-Propanone (phenylacetone)
Product:	Mixture of l-Methamphetamine (50%) and d-Methamphetamine (50%)
Method:	P2P reduction using methylamine, mercuric chloride and hydrochloric acid
Other Names:	"Biker" Lab or "Prope Dope" Lab
Unique Hazards:	Methylamine could cause severe eye and skin irritation and may cause blindness, flammable in high concentrations, a skin absorbent and a central nervous system (CNS) toxicant
	Use of lead acetate and highly toxic mercuric chloride
	Use of corrosive acids and bases
	Occasional use of methylamine compressed gas cylinders
	Use of acid gas generators
Variations:	Acidify the oil layer directly (i.e., delete solvent washing step)

One-Pot Lab Profile	
Precursor:	Pseudoephedrine
Product:	d-Methamphetamine
Method:	Ephedrine reduction using ammonium nitrate, lithium metal, sodium hydroxide, ether and hydrochloric acid
Other Names:	"Shake and Bake" Lab or "Six Pack" Lab
Unique Hazards:	Heat generated by reaction can degrade structural integrity of plastic reaction vessel and may result in a release of flammable liquids and vapors
	Reaction of water with sodium or lithium metals can cause lithium to tear through plastic vessel and ignite the flammable liquids and vapors, resulting in fire
	Discarded reaction vessels carry residual chemicals that are muddy brown in color and can be toxic and flammable
	Use of acid gas generators
Variations:	Use of other non-polar solvent in place of ether
	Use of other ammonium salts

Appendix B: Costs Associated with Meth Lab Cleanup

As explained previously in this document, meth labs range from crude makeshift operations to technologically advanced facilities and are found almost anywhere: in private residences, motel and hotel rooms, apartments and trailers. Because no two meth labs are alike, the cost of cleanup varies. The Institute for Intergovernmental Research estimated that the average cost of cleanup can range from \$5,000–\$150,000.* The following variables may impact the cost of meth lab remediation:

Size of Property and Structure

- Larger labs are usually more costly to remediate simply because there is more surface area to clean.

Property Accessibility

- Meth labs are sometimes found in remote locations. If the lab is located in an area that is difficult to access, costs will increase.

Contractor Rates

- Contractor rates vary depending on geographical location.

Amount of Debris

- A considerable amount of debris is generated during meth lab cleanup (e.g., carpet, contaminated household items). The more contaminated debris that needs to be discarded, the more the cleanup will cost.

Presence of Asbestos

- If asbestos is found in materials that have to be cleaned or removed, the cost of the cleanup may increase.

Contamination Level

- Labs with high levels of contamination may cost more to clean than labs with lower levels of contamination.

Pre- and Post-remediation Sampling

- Pre-remediation sampling may be useful in some cases (see *Section 3.6*); others may not require pre-remediation sampling.
- The results of post-remediation samples demonstrate whether previously contaminated areas have been cleaned to an acceptable level. Although post-remediation sampling may increase costs, it is an important step in meth lab remediation and should not be skipped.

Inclusion of Refurbishment Costs

- The cost of cleanup will increase if one includes refurbishment activities (e.g. repainting, re-carpeting) within the scope of “cleanup.”

**The Methamphetamine Problem: Question and Answer Guide*, Institute for Intergovernmental Research.

Appendix C: Properties of Chemicals Associated with Methamphetamine*

Chemical and CAS Number	Form	Hazard	Health Effect	Fate and Transport
Acetic Acid (64-19-7) [Reacts with phenylacetic acid to yield Phenyl-2-Propanone (P2P)] [syn: ethanoic acid, glacial acetic acid]	Colorless liquid with pungent odor	Corrosive and flammable	Vapors cause eye irritation. Exposure to high concentrations causes inflammation of airway and ulcers of eyes. IDLH: 50 ppm; NIOSH REL: TWA 10 ppm (25 mg/m ³) STEL 15 ppm (37 mg/m ³); OSHA PEL: TWA 10 ppm (25 mg/m ³).	Miscible in water. While reacting with soil components, likely to be neutralized or diluted in soil. Readily biodegrades by aerobic or anaerobic mechanisms.
Acetic Anhydride (108-24-7) (Reacts with phenylacetic acid to yield of P2P) [syn: acetic oxide, acetyl oxide]	Colorless liquid with strong acetic odor	Corrosive and flammable	Vapors cause eye irritation. Exposure to high concentrations may lead to ulcerations of the nasal mucosa and can severely damage the eye. IDLH: 200 ppm. NIOSH REL: C 5 ppm (20 mg/m ³); OSHA PEL: TWA 5 ppm (20 mg/m ³).	Dissolves slowly in water. Specific gravity is greater than 1 so there is potential that it will sink in ground/surface water. Will degrade over time to acetic acid.
Acetone (67-64-1) (Solvent) [syn: dimethyl ketone, 2-propanone]	Colorless liquid with fragrant odor	Flammable	Vapors may cause skin irritation. Prolonged exposure to high concentration may lead to blurred vision, fatigue, convulsions and death. IDLH: 2,500 ppm; NIOSH REL: TWA 250 ppm (590 mg/m ³); OSHA PEL: TWA 1,000 ppm (2,400 mg/m ³).	Miscible in water. Not persistent. Readily biodegrades in soil or water.
Ammonia (7664-41-7) (Used in Nazi/Birch method) [syn: anhydrous ammonia]	Colorless gas with pungent odor anhydrous form is liquid under pressure	Corrosive	Liquid anhydrous ammonia causes severe skin burns on contact. Lung irritant at low concentrations. IDLH: 300 ppm; NIOSH REL: TWA 25 ppm (18 mg/m ³) STEL 35 ppm (27 mg/m ³); OSHA PEL: TWA 50 ppm (35 mg/m ³).	Lighter than air gas, likely to dissipate into atmosphere.
Ammonium Hydroxide (1336-21-6) (Found during synthesis in Nazi/Birch and one-pot methods)	Clear colorless solution with ammonia odor	Corrosive and Poison	Ammonium solution (10-35% ammonia) can cause upper respiratory irritation. Exposure to greater than 5,000 ppm can be fatal. Can cause irritation and burns to skin. Ingestion of as little as 2-3 mL can also be fatal. ACGIH TLV: TWA 25 ppm; OSHA PEL: TWA 50 ppm, STEL 35 ppm NIOSH REL: TWA 25 ppm, STEL 35 ppm.	Toxic to aquatic life. 28% solution has high vapor pressure and is likely to evaporate if spilled.
Ammonium Sulfate (7783-20-2) (Used with sodium hydroxide to produce anhydrous ammonia for use in one-pot method) [syn: sulfuric acid diammonium salt]	Brownish gray to white odorless granules or crystals	Corrosive	Irritant and corrosive to the skin, eyes, respiratory tract and mucous membranes. Exposure to liquid or rapidly expanding gases may cause severe chemical burns and frostbite to the eyes, lungs and skin. Skin and respiratory related diseases could be aggravated by exposure. Exposure limits N/A.	Possibly hazardous short term degradation products are not likely. However, long term degradation products may arise. The product itself and its products of degradation are not toxic.
Benzaldehyde (100-52-7) (Precursor for amphetamine or P2P) [syn: benzoic aldehyde, artificial essential oil of almond, benzenecarbonal]	Colorless liquid, bitter almond odor	Combustible	Mild irritant to lungs. Central nervous system depressant. Exposure limits N/A.	If released in sufficiently large quantities, can migrate to shallow water table. Slightly soluble in water with specific gravity of 1.05. Moderately biodegradable.
Benzyl Chloride (100-44-7) (Precursor for P2P) [syn: chloromethyl benzene, alpha-chlorotoluene]	Colorless to pale yellow liquid with pungent aromatic odor	Combustible	Eye, skin and respiratory irritant. IDLH: 10 ppm; NIOSH REL: C 1 ppm (5 mg/m ³) [15-minute]; OSHA PEL: TWA 1 ppm (5 mg/m ³).	Not persistent. Hydrolysis in moist conditions. Readily biodegradable.

Chemical and CAS Number	Form	Hazard	Health Effect	Fate and Transport
Benzene (71-43-2) (Solvent)	Colorless liquid with aromatic odor	Flammable	Vapor in high concentrations may cause dizziness, headache, coughing. Chronic exposure may cause anemia or leukemia. IDLH: 500 ppm; NIOSH REL: Ca TWA 0.1 ppm STEL 1 ppm; OSHA PEL: (1910.1028) TWA 1 ppm STEL 5 ppm.	Mobile in soils. Lighter than water and slightly soluble. Will biodegrade over time. MCL of 5 µg/L.
Chloroform (67-66-3) (Solvent)	Colorless liquid with a pleasant odor	May explode if it comes into contact with certain materials, including aluminum powder, lithium and perchlorate.	Irritation eyes, skin; dizziness, mental dullness, nausea, confusion; headache, lassitude (weakness, exhaustion); anesthesia; enlarged liver, suspect carcinogen. IDLH: 500 ppm; NIOSH REL: Ca STEL 2 ppm (9.78 mg/m ³) [60-minute]; OSHA PEL: C 50 ppm (240 mg/m ³).	Chloroform has a high vapor pressure and is likely to evaporate if spilled. In the event of a large spill, it may migrate to shallow groundwater. It is not toxic to aquatic life.
Coleman Fuel (68410-97-9) (Used in Nazi/Birch reduction, red phosphorus/hydriodic acid and one-pot methods) [syn: petroleum ether, petroleum naphtha, petroleum, distillate]	Clear colorless liquid with odor of rubber cement. Mixture of light petroleum distillates containing up to 25% n-hexane and 15% cyclohexane.	Flammable	Skin irritant. Central nervous system suppressant (dizziness, nausea, blurred vision, drowsiness, loss of coordination). Chronic exposure can cause damage to sensory and motor nerve cells, kidneys and liver. IDLH: 1,100 ppm; NIOSH REL: TWA 350 mg/m ³ C 1,800 mg/m ³ [15-minute]; OSHA PEL: TWA 500 ppm (2,000 mg/m ³).	Vapors are heavier than air and may accumulate in low spots. Small spills are likely to evaporate. Large spills can penetrate soil and may reach groundwater. Will biodegrade over time.
Diethyl Ether (60-29-7) (Solvent) [syn: ether, ethyl ether, ethyl oxide]	Clear colorless liquid with sweet pungent odor	Highly flammable	Inhalation may cause headache, drunkenness and vomiting. IDLH: 1,900 ppm; NIOSH REL: none; OSHA PEL: TWA 400 ppm (1,200 mg/m ³).	Spilling of small amounts to ground or soil will likely result in volatilization. Expected to be mobile in soil and resistant to biodegradation.
Ephedrine (299-42-3) (Precursor for meth)	Odorless white crystal	None	Skin and respiratory irritant. Exposure limits N/A.	Not available.
Ethanol (64-17-5) (Solvent) [syn: ethyl alcohol, ethanol, anhydrous alcohol, ethyl hydroxide, methyl carbinol]	Clear colorless liquid with pleasant odor	Highly flammable	Respiratory irritant. Central nervous system suppressant. IDLH: 3,300 ppm; NIOSH REL: TWA 1,000 ppm (1,900 mg/m ³); OSHA PEL: TWA 1,000 ppm (1,900 mg/m ³).	Miscible with water. Large spills may reach water table. Very biodegradable.
Ethylamine (75-04-7) (Used in P2P method) [syn: ethanamine, monoethylamine]	Gas with ammonia-like odor	Highly flammable and corrosive liquid	Vapor irritates the mucous membranes, respiratory system and eyes; in high concentrations it may affect the central nervous system; liquid may irritate eyes and skin; if ingested may be irritating and poisonous. OSHA: TWA 10 ppm (18 mg/m ³)	If released to soil, ethylamine is expected to have very high mobility. Volatilization from moist soil surfaces is not expected to be an important fate process based upon its cationic state.
Formic Acid (64-18-6) (Reacts with phenyl-2-propanone and methylamine to produce methamphetamine)	Colorless fuming liquid with a pungent odor	Corrosive and moderate fire hazard	Highly toxic with inhalation for short duration. Produces blisters and burns on contact with skin. Prolonged exposure to low concentrations may cause liver and kidney damage. IDLH: 30 ppm; NIOSH REL: TWA 5 ppm (9 mg/m ³); OSHA PEL: TWA 5 ppm (9 mg/m ³).	Miscible in and heavier than water. When released in quantity to soil is expected to leach to shallow groundwater with moderate biodegradation. Because of its fire hazard and tendency to react explosively with oxidizing agents should not be flushed into sanitary sewer.

Chemical and CAS Number	Form	Hazard	Health Effect	Fate and Transport
Normal Hexane (110-54-3) (Solvent)	Clear colorless liquid with slight odor	Highly Flammable	May cause skin irritation. Inhalation irritates respiratory system and overexposure may cause light headedness, nausea, headache and blurred vision. Chronic inhalation may cause peripheral nerve disorders and central nervous system damage. Potential teratogen. IDLH: 1,100 ppm; NIOSH REL: TWA 50 ppm (180 mg/m ³); OSHA PEL: TWA 500 ppm (1,800 mg/m ³).	When spilled on the ground expected to evaporate. If it penetrates the ground, not likely to leach (log K _{ow} of > 3.0) to groundwater. Not very soluble and lighter than water. Moderate biodegradation expected.
Cyclohexane (110-82-7) (Solvent)	Clear colorless liquid with faint ether-like odor	Highly Flammable	Causes irritation to respiratory tract. High concentrations have a narcotic effect. Chronic exposure may cause skin effects. IDLH: 1,300 ppm; NIOSH REL: TWA 300 ppm (1,050 mg/m ³); OSHA PEL: TWA 300 ppm (1,050 mg/m ³).	When spilled on the ground expected to evaporate. If it penetrates the ground, may leach to groundwater. Not very soluble, lighter than water. Moderate biodegradation expected.
Hydrochloric Acid (7647-01-0) (Used to gas out meth product) [syn: muriatic acid, hydrogen chloride.]	Clear colorless liquid with pungent odor (hydrogen chloride dissolved in water)	Corrosive and Poison	Skin exposure will cause burns. Long-term exposure to concentrated vapors may cause erosion of teeth. Inhalation can lead to permanent lung and respiratory tract damage. IDLH: 50 ppm as HCl gas; NIOSH REL: C 5 ppm (7 mg/m ³); OSHA PEL: C 5 ppm (7 mg/m ³).	Small spills may evaporate (water and HCl gas). Miscible with water and slightly heavier. What does not react with soil may reach shallow groundwater through leaching process.
Hydriodic Acid (10034-85-2) (Used in red phosphorus method) [syn: hydrogen iodide (aqueous solution)]	Clear colorless liquid with pungent odor (hydrogen iodide dissolved in water). Yellow to brown upon exposure to light and air.	Corrosive and Poison	Vapors cause severe irritation and burns to respiratory tract. Liquid may cause burns to skin. Exposure limits N/A.	Small spills may evaporate (water and HI gas). Miscible with water and slightly heavier. What does not react with soil may reach shallow groundwater through leaching process.
Hydrogen Sulfide (7783-06-4) (Reacts with iodine suspended in water to yield hydriodic acid for use in the red phosphorous method; sometimes mistakenly used as substitute for hydrogen chloride gas)	Clear colorless gas with rotten egg odor. Heavier than air.	Flammable and Poison	If in gas cylinder, escaping gas can cause frostbite. Short term inhalation exposure depending upon concentration can cause irritation, cough, eye sensitivity to light, changes in blood pressure, nausea, vomiting, breathing difficulty, headache, drowsiness, dizziness, disorientation, tremors, hallucinations, coma and death. Long-term exposure can cause loss of appetite, weight loss, irregular heart beat, headache, nerve damage, lung congestion, paralysis and brain damage. IDLH: 100 ppm; NIOSH REL: C 10 ppm (15 mg/m ³) [10-minute]; OSHA PEL: C 20 ppm 50 ppm [10-minute maximum peak].	Hydrogen sulfide is heavier than air and may accumulate in low-lying areas.
Hypophosphorus Acid (6303-21-5) (Used in place of red phosphorus)	Clear colorless and odorless liquid	Corrosive and Reactive. Strong reducing agent, heat may cause fire or explosive decomposition liberating phosphine gas (poison).	Destructive to mucus and upper respiratory tract tissue. Symptoms may include coughing, wheezing, laryngitis, shortness of breath, headache, nausea and vomiting. May cause redness and burning of skin tissue. Exposure limits N/A.	Not available.

Chemical and CAS Number	Form	Hazard	Health Effect	Fate and Transport
Iodine (7553-56-2) (Reagent in synthesis of hydriodic acid)	Solid purple crystals or flakes with sharp odor	Corrosive, Reactive and Poison	Inhalation may result in severe irritation and burns to respiratory tract. Inhalation of concentrated vapors may be fatal. Highly toxic to eye tissue. Chronic exposure may cause insomnia, tremors, conjunctivitis, bronchitis, diarrhea and weight loss. IDLH: 2 ppm; NIOSH REL: C 0.1 ppm (1 mg/m ³); OSHA PEL: C 0.1 ppm (1 mg/m ³).	Slightly soluble in water (300 mg/L) with very low vapor pressure.
Iodine, Tincture, No CAS number. (Reagent in synthesis of hydriodic Acid)	Dark red solution (Mixture of ethanol, iodine crystals and sodium iodide)	Flammable (ethanol)	See description for ethanol and iodine.	Not available.
Isopropyl Alcohol (67-63-0) (Solvent) [syn: 2-propanol, isopropanol, dimethyl carbinol)	Colorless liquid with slightly bitter taste	Flammable	Inhalation of the vapor in high concentrations and ingestion of the liquid may result in headache, dizziness, mental depression, nausea, vomiting, narcosis, anesthesia and coma; liquid may damage eyes severely. OSHA: TWA 400 ppm (980 mg/m ³).	Possibly hazardous short term degradation products are not likely. However, long term degradation products may arise. The product itself and its products of degradation are not toxic.
Lead Acetate (6080-56-4) (Reagent in P2P synthesis)	Solid white crystals or grey, brown in commercial grades with slight acetic acid odor	Poison	Unless a large amount is ingested, lead acetate is a chronic poison that accumulates lead through ingestion and inhalation of dust. Chronic exposure symptoms are like those of ingestion poisoning: restlessness, irritability, visual disturbances and hypertension. Can have a negative effect on the mental development of children (lower IQ). IDLH: 100 mg/m ³ as lead.	As a solid, unlikely to move into ground but could be spread by wind. If left exposed to weathering is very soluble (60gm per 100gm water) and will likely move with precipitation into the subsurface. Subsurface mineral content will determine whether it stays in solution. Lead bioaccumulates.
Lithium (metal) (7439-93-2) (Used in Nazi/Birch and one-pot methods)	Soft, odorless silvery-white metal. Yellowish upon exposure to moist air.	Flammable, Water- Reactive to give off hydrogen gas and form LiOH, a strong highly corrosive base and corrosive lithium oxide fumes.	The moisture-reactive property of lithium makes it corrosive to any tissue it contacts. Inhalation of fumes generated from a water reaction will irritate or damage upper respiratory tract tissues. Exposure limits N/A.	Only small quantities of lithium are likely to be used in a meth laboratory and should not present an environmental problem. In a release scenario, the metal will likely be transformed to LiOH and Li ₂ O.
Lithium Aluminum Hydride (16853-85-3) (Hydrogenation in multiple processes)	Solid white to grey odorless powder	Flammable, Reactive (water to form hydrogen gas and corrosive LiOH) and Corrosive	When inhaled is destructive to mucus membranes and tissues of respiratory tract. Corrosive to skin, may cause redness or burns. Exposure limits N/A.	Can ignite with friction. LiOH may be mobile in soil.

Chemical and CAS Number	Form	Hazard	Health Effect	Fate and Transport
Mercuric Chloride (7487-94-7) (Reagent in meth synthesis using P2P method)	Solid white crystals	Poison and Corrosive	Vapor inhalation can burn the mucus membranes of nose and throat as well as allow mercury sorption in blood stream. Causes irritation and burns to the skin. Chronic exposure can result in mercury poisoning: muscle tremors, personality and behavior changes, memory loss, metallic taste, loosening of the teeth, digestive disorders, skin rashes, brain and kidney damage. IDLH: 10 mg/m ³ as mercury.	As a solid, unlikely to move into ground but could be spread by wind. If left exposed to weathering is very soluble (7.6gm per 100gm water) and will likely move with precipitation into the subsurface. Subsurface mineral content will determine whether it stays in solution. Mercury bioaccumulates; if mercuric chloride is disposed of into surface water it will have negative effects on the biota.
Methyl Alcohol (67-56-1) (Solvent; HEET Gas Line Antifreeze is 99% methanol) [syn: methanol, wood alcohol, carbinol]	Clear colorless liquid	Flammable and Poison	Inhalation acts on nervous system. Overexposure symptoms may include headache, drowsiness, nausea, vomiting, blindness, coma and death. Usual fatal ingestion dose is 100-125 mL. Chronic exposure may cause marked impairment of vision. IDLH: 6,000 ppm; NIOSH REL: TWA 200 ppm (260 mg/m ³) STEL 250 ppm (325 mg/m ³); OSHA PEL: TWA 200 ppm (260 mg/m ³).	Methanol is miscible in and lighter than water. When released to the ground in sufficient quantities to get into the subsurface it will leach into percolating water and may reach the groundwater. Methanol is biodegradable.
Methylamine (74-89-5) (Precursor for P2P method) [syn: methanamine, aminomethane]	Clear colorless gas with rotten fish/ammonia odor. (Usually encountered in dissolved state in water)	Flammable and Corrosive	Exposure to vapors may cause irritation to eye and mucus membranes. Skin contact may result in irritation or burns. Symptoms may include coughing, shortness of breath and headaches. IDLH: 100 ppm; NIOSH REL: TWA 10 ppm (12 mg/m ³); OSHA PEL: TWA 10 ppm (12 mg/m ³).	A spill of methylamine (dissolved in water) to the ground will tend to evaporate. If it enters the soil it is likely to leach rapidly through the soil to groundwater (log K _{ow} of -0.57). Methylamine is biodegradable.
Methyl Ethyl Ketone (78-93-3) (Solvent) [syn: 2-butanone, methyl acetone]	Clear, colorless liquid with a sharp mint-like odor	Extremely flammable	Inhalation causes irritation to nose and throat at high concentrations. May cause headache, dizziness, nausea, shortness of breath and nervous system depression. Contact with skin and eyes may cause irritation—skin absorption with possible systemic effects. Chronic exposure may cause dermatitis or central nervous system effects. IDLH: 3,000 ppm; NIOSH REL: TWA 200 ppm (590 mg/m ³) STEL 300 ppm (885 mg/m ³); OSHA PEL: TWA 200 ppm (590 mg/m ³).	Methyl Ethyl Ketone is fairly soluble in water (239,000 mg/L) and has a log K _{ow} of 0.29. If released to the ground it will partially evaporate, and if the release has a sufficient quantity to enter the subsurface will leach to shallow groundwater. It does not biodegrade readily.
Nitric Acid (7697-37-2) (Used with sodium hydroxide to produce anhydrous ammonia for use in one-pot method) [syn: ammonium nitrate, ammonium saltpeter, ammonium salt]	Clear colorless to yellowish liquid with suffocating acrid odor/ white, odorless solid crystals	Corrosive Oxidizer	Inhalation causes extreme irritation of upper respiratory tract. Skin contact can result in deep ulcers and staining of skin. IDLH: 25 ppm; NIOSH REL: TWA 2 ppm (5 mg/m ³) STEL 4 ppm (10 mg/m ³); OSHA PEL: TWA 2 ppm (5 mg/m ³).	Incompatible with most materials.

Chemical and CAS Number	Form	Hazard	Health Effect	Fate and Transport
Nitroethane (79-24-3) (Precursor for P2P synthesis)	Colorless oily liquid with a mild fruity odor	Flammable	Skin contact may cause dermatitis. Eye contact may cause corneal damage. Inhalation causes respiratory irritation and may cause dizziness and suffocation. IDLH: 1,000 ppm; NIOSH REL: TWA 100 ppm (310 mg/m ³); OSHA PEL: TWA 100 ppm (310 mg/m ³).	With small spills on an impervious or wet ground, evaporation may be significant. After entering the subsurface, likely to move through the soil to shallow groundwater (log K _{ow} of 0.18) or pond on low permeability soils. Slightly denser than water; water solubility of 4.5% by weight. Biodegradable under aerobic conditions.
Nitromethane (75-52-5) (Used in P2P method)	Clear oily liquid	Flammable	Vapors may cause irritation to respiratory tract. A weak narcotic, higher concentrations may cause nausea, vomiting, diarrhea and headaches. Skin contact can cause irritation, pain and redness. Absorbed through skin. Prolonged exposure can cause dermatitis and liver damage. IDLH: 750 ppm; NIOSH REL: none; OSHA PEL: TWA 100 ppm (250 mg/m ³).	Possibly hazardous short term degradation products are not likely. However, long term degradation products may arise. The products of degradation are more toxic.
Perchloric Acid (7601-90-3) (Used in P2P method)	Clear to yellowish odorless liquid	Corrosive Oxidizer. Unstable at normal pressure and temperature and may decompose explosively.	Inhalation may cause irritation to upper respiratory tract. Skin contact may result in burns and discoloration. Exposure limits N/A.	May form sensitive explosive mixtures with organic materials.
Petroleum Distillates (Naphtha) (8002-05-9) Note that there are many Naphthas and they contain different ratios of petroleum hydrocarbons and have somewhat different properties in terms of toxicity. CAS 8002-05-9 is the one characterized by OSHA. Rosonol, a lighter fluid, is made up of Naphthas. (Solvent)	Clear colorless liquid with a hydrocarbon odor	Flammable	Inhalation may cause dizziness, drowsiness, headache and nausea. Skin contact will cause defatting and cracking. Vapors are an irritant to eyes nose and throat. IDLH: 1,100 ppm; NIOSH REL: TWA 350 mg/m ³ C 1,800 mg/m ³ [15-minute]; OSHA PEL: TWA 500 ppm (2,000 mg/m ³).	Naphthas are hydrophobic and lighter than water. In sufficient volume, they will move through the subsurface until they encounter a low permeability soil or the groundwater. Naphthas are biodegradable, but the process is lengthy.
Phenylacetic Acid (103-82-2) (Precursor for P2P synthesis) [syn: benzeneacetic acid, alpha-toluic acid]	Solid white crystal with a floral odor	None	Contact is irritating to skin and eyes. Inhalation may cause upper respiratory tract irritation. Potential teratogen. Exposure limits N/A.	Not available.
Phenyl-2-Propanone (103-79-7) (Precursor for meth or amphetamine synthesis)	Clear, moderately viscous liquid	None	Irritating to eyes and skin. Inhalation may lead to headache, nausea and dizziness. Exposure limits N/A.	Not available.
Phosphine (7803-51-2) (Unintended byproduct of red phosphorous method)	Colorless gas with a fish- or garlic-like odor. Note: commercially made product has odor phosphine itself is odorless.	Flammable and Poison	Inhalation may cause dizziness, drowsiness, nausea, chest pressure, tremors, convulsions and central nervous system damage. Exposure symptoms can be delayed for up to 48 hours. IDLH: 50 ppm; NIOSH REL: TWA 0.3 ppm (0.4 mg/m ³) STEL 1 ppm (1 mg/m ³); OSHA PEL: TWA 0.3 ppm (0.4 mg/m ³).	Heavier than air. May accumulate in low spots. High reactivity will minimize environmental effects.

Chemical and CAS Number	Form	Hazard	Health Effect	Fate and Transport
Phosphoric Acid (7664-38-2) (Precursor for meth)	Thick, odorless crystalline solid often used in an aqueous solution	Corrosive	Not an inhalation hazard unless misted or heated to high temperatures. Skin contact may cause burns. IDLH: 1,000 mg/m ³ ; NIOSH REL: TWA 1 mg/m ³ STEL 3 mg/m ³ ; OSHA PEL: TWA 1 mg/m ³ .	When released in sufficient quantities may reach shallow groundwater. Neutralization leaves phosphate.
Pseudoephedrine (90-82-4) (Precursor for meth)	Nearly odorless, white crystalline powder	None	Contact with skin or eyes may result in irritation. Inhalation may result in respiratory irritation. Exposure limits N/A.	Completely soluble in water with a log K _{ow} of 1.74. As crystal may be transported by wind. Dissolved in water or subjected to water (rain) will leach through soil. Moderately biodegradable.
Pyridine (110-86-1) (Reagent in the synthesis of P2P from phenylacetic acid in the presence of acetic anhydride)	Colorless to yellow liquid with a nauseating fish-like odor	Flammable	Skin and eye irritant. Short-term inhalation may cause irritation, headache, drowsiness, dizziness and loss of coordination. Long-term inhalation may cause nausea, vomiting, diarrhea, stomach pain, loss of appetite, dizziness, sleep and emotional disturbances, loss of coordination, nerve, heart, kidney and liver damage. IDLH: 1,000 ppm; NIOSH REL: TWA 5 ppm (15 mg/m ³); OSHA PEL: TWA 5 ppm (15 mg/m ³).	Pyridine is miscible in water and has a log K _{ow} of 0.65. As such, when released in sufficient quantity it should move freely through the subsurface, and lesser amounts will leach with rainfall. Very biodegradable.
Red Phosphorus (7723-14-0) (Used in red phosphorus method for meth production)	Odorless red to violet solid	Less reactive than white or yellow phosphorus. Flammable and explosive when mixed with organic materials. In the presence of water vapor and oxygen decomposes to form phosphine gas.	May cause eye and skin irritation. Inhalation may cause respiratory tract irritation. Chronic ingestion or inhalation may induce systemic phosphorous poisoning. Liver damage, kidney damage, jaw/tooth abnormalities, blood disorders and cardiovascular effects can result. Exposure limits N/A.	Harmful to aquatic organisms. Insoluble in water. Will remain on ground surface if released.
Sodium (7440-23-5) (Catalyst in Nazi/Birch method)	Silvery white solid	Flammable and Corrosive. Severe fire risk in contact with water in any form. Reaction forms hydrogen gas and sodium hydroxide. Ignites spontaneously in dry air when heated.	Reacts with moisture on skin, mucus membranes and eyes to cause chemical and heat burns. Exposure limits N/A.	High reactivity with air and moisture will quickly eliminate the metallic form. In a lab, it should be found as solids under a hydrocarbon solution.
Sodium Hydroxide (1310-73-2) (Used to make sodium, a catalyst in Nazi/Birch method; Drano® contains 30-60% by weight of sodium hydroxide.)	Colorless to white solid (flakes, beads, pellets)	Corrosive and Poison	Contact with skin will cause irritation to severe burns. Inhalation depending upon concentration can cause mild irritation to severe damage to upper respiratory tract. IDLH: 10 mg/m ³ ; NIOSH REL: C 2 mg/m ³ ; OSHA PEL: TWA 2 mg/m ³	Dissolves in water with release of heat, creating a high pH solution.

Chemical and CAS Number	Form	Hazard	Health Effect	Fate and Transport
Sodium Thiosulfate (7772-98-7) (Used in red phosphorous method to remove remaining iodine from solution) [syn: sodium hyposulfite, "hypo", antichlor, sodothiol, sulfthiorine, ametox]	Powder; odorless crystals or granules	None	Moderately toxic by subcutaneous routes Exposure limits N/A.	Possibly hazardous short term degradation products are not likely. However, long term degradation products may arise. The product itself and its products of degradation are not toxic.
Sulfuric Acid (7664-93-9) (Reagent and main component in generating HCl; Battery acid is sulfuric. Used battery acid may contain high concentrations of lead. Liquid Fire Drain Cleaner contains sulfuric acid.) [syn: oil of vitriol, hydrogen sulfate]	Colorless to yellow viscous, odorless liquid	Corrosive	Contact with skin or eyes can cause severe deep burns. Inhalation of fumes can result in severe damage to upper respiratory tract. IDLH: 15 mg/m ³ ; NIOSH REL: TWA 1 mg/m ³ ; OSHA PEL: TWA 1 mg/m ³ .	Miscible with water with evolution of heat. In sufficient quantity may leach to shallow groundwater. Release to a surface water may be toxic to aquatic organisms if sufficient energy is not available for quick dilution.
Thionyl Chloride (7719-09-7) (Reacts with ephedrine or pseudoephedrine to form intermediary) [syn: sulfurous oxychloride]	Pale yellow to red liquid with a pungent characteristic odor	Corrosive and Poison	Extremely destructive to tissues of the mucous membranes and upper respiratory tract when inhaled; can be fatal. Skin and eye contact may cause irritation and blistering burns. Prolonged or repeated exposure may cause conjunctivitis, dermatitis, rhinitis and pneumonitis. IDLH: none; NIOSH REL: C 1 ppm (5 mg/m ³); OSHA PEL: none.	Reacts violently with water to form HCl and SO ₂ . Not likely to remain in the environment as thionyl chloride.
Thorium Oxide (1314-20-1) (Catalyst for P2P synthesis)	White heavy crystalline powder	None	Irritant to skin and eyes. May cause mild irritation to respiratory system when inhaled. Thorium is a confirmed human carcinogen producing angiosarcoma, liver and kidney tumors, lymphoma and other tumors of the blood system. Chances of developing cancer increase with increased exposure. Exposure limits N/A.	Thorium oxide may spread through the environment by runoff or wind. It is insoluble in water and will likely remain where it is spilled.
Toluene (108-88-3) (Solvent) [syn: methyl benzene, phenylmethane]	Clear colorless liquid with an aromatic odor	Flammable and Poison	Toluene is a central nervous system depressant and an irritant of the eyes, mucous membranes and skin in humans. In contact with the eyes, toluene causes reversible corneal injury; prolonged skin contact causes defatting and dermatitis. Exposure while pregnant may affect fetal development. IDLH: 500 ppm; NIOSH REL: TWA 100 ppm (375 mg/m ³) STEL 150 ppm (560 mg/m ³); OSHA PEL: TWA 200 ppm C 300 ppm 500 ppm [10-minute maximum peak].	Toluene has a solubility in water of about 534 mg/L. When released to the soil near-surface toluene will evaporate, with deeper releases leaching to shallow groundwater. Toluene will slowly biodegrade in both the soil and groundwater. It is lighter than water, so it will stop migrating down at the water table. (Howard Vol. II)

Chemical and CAS Number	Form	Hazard	Health Effect	Fate and Transport
1,1,2-Trichloroethane (79-00-5) (Solvent)	Colorless liquid with sweet odor	None	Inhalation may cause irritation, irregular heartbeat, headache, symptoms of drunkenness and kidney and liver damage. IDLH: 100 ppm; NIOSH REL: Ca TWA 10 ppm (45 mg/m ³) [skin]; OSHA PEL: TWA 10 ppm (45 mg/m ³) [skin].	Slightly soluble in water (4,420 mg/L). Has a log K _{ow} of 2.07; unlikely to sorb to soil. If released in sufficient quantities may migrate to shallow ground water. Heavier than water and will sink through the water table. Not likely to biodegrade. Small spills likely to evaporate.
1,1,2-Trichloro-1,2,2-Trifluoroethane (76-13-1) (Solvent)	Clear colorless liquid with a slight ethereal odor	None	Eye and skin contact may cause redness and pain. Causes irritation to upper respiratory tract. Air concentrations above 2,500 ppm may cause feeling of excitement and incoordination. Fatal arrhythmias are possible at high concentrations. IDLH: 2,000 ppm; NIOSH REL: TWA 1,000 ppm (7,600 mg/m ³) STEL 1,250 ppm (9,500 mg/m ³); OSHA PEL: TWA 1,000 ppm (7,600 mg/m ³).	1,1,2-Trichloro-1,2,2-Trifluoroethane has a very high vapor pressure and releases to soil or water will evaporate quickly. In the subsurface, it is hydrophobic (solubility in water of 1,100 ppm) and denser than water (1.56 specific gravity), it should move through the subsurface and with sufficient head, through the water table. 1,1,2-Trichloro-1,2,2-Trifluoroethane does not readily biodegrade.

C – Ceiling REL

Ca – Potential Carcinogen

CAS – Chemical Abstracts Service

HCl – Hydrochloric Acid

HI – Hydrogen Iodide

IDLH – Immediately Dangerous to Life or Health

LiOH – Lithium Hydroxide

Li₂O – Lithium Oxide

logK_{ow} – Octanol-Water Partition Coefficient

MCL – Maximum Contaminant Level

NIOSH REL – NIOSH Recommended Exposure Limit

OSHA PEL – OSHA Permissible Exposure Limits

SO₂ – Sulphur Dioxide

STEL – Short-Term Exposure Limit

TWA – Time Weighted Average

**From EPA's Office of Research and Development (ORD)*

Appendix D: State Resources

Note: State requirements and guidelines change frequently. Please consult your appropriate municipal, county or state agency for the most up-to-date local information.

Alaska

dec.alaska.gov/spar/perp/methlab/index.htm
www.state.ak.us/dec/spar/perp/docs/druglab_guidance.pdf

Arizona

www.btr.state.az.us/regulations/drug_lab.asp

Arkansas

www.adeq.state.ar.us/hazwaste/branch_programs/clcc.htm

California

www.dtsc.ca.gov/SiteCleanup/ERP/Clan_Labs.cfm
www.oehha.ca.gov/public_info/clanlabs.html

Colorado

www.colorado.gov/cs/Satellite/CDPHE-HM/CBON/1251615964360

Connecticut

www.ct.gov/dph/LIB/dph/environmental_health/EOHA/pdf/METH_LAB_CLEANUP_PROTOCOL.pdf

Georgia

health.state.ga.us/pdfs/environmental/chemhazards/misc/methbrocure.pdf

Hawaii

eha-web.doh.hawaii.gov/eha-cma/Leaders/HEER/methamphetamine-laboratory-cleanup

Idaho

www.healthandwelfare.idaho.gov/Health/EnvironmentalHealth/MethamphetamineClandestineLabCleanup/tabid/183/Default.aspx

Illinois

www.idph.state.il.us/envhealth/factsheets/meth-cleanup.htm

Iowa

www.idph.state.ia.us/eh/common/pdf/hseess/meth_lab_cleanup.pdf

Kansas

www.kdheks.gov/methlabs/ml_cleanup.html

Kentucky

chfs.ky.gov/NR/rdonlyres/41D3DED0-597D-4566-BF4B-F6FF6AABE5B1/0/MethamphetamineGuidance765.doc
www.mrsc.org/ArtDocMisc/M58KY-MethLab.pdf

Louisiana

www.deq.louisiana.gov/portal/Portals/0/remediation/meth_cleanup_guidelines.pdf

Michigan

www.michigan.gov/documents/mdch/CDL_Guidance_6-5-07_Final_198589_7.pdf

Minnesota

www.health.state.mn.us/divs/eh/meth/
www.health.state.mn.us/divs/eh/meth/lab/guidance0910.pdf

Missouri

health.mo.gov/atoz/pdf/MethLabCleanupGuidelines.pdf

Montana

www.deq.mt.gov/meth/default.mcp

Nebraska

dhhs.ne.gov/publichealth/Pages/puh_enh_environmentalriskassessment_labs.aspx
dhhs.ne.gov/publichealth/Documents/FinalRegs.pdf

New Hampshire

des.nh.gov/organization/commissioner/pip/publications/co/documents/r-co-07-7.pdf

New Mexico

cdli.nmenv.state.nm.us/guidance.php

North Carolina

www.methlabcleanup.com/NC%20Standards

North Dakota

www.ndhealth.gov/wm/Publications/BestManagementPracticesForCleanupsAtMethamphetamineLabs.pdf

Ohio

www.odh.ohio.gov/~media/ODH/ASSETS/Files/eh/HAS/methlabcleanup.ashx

Oklahoma

www.deq.state.ok.us/LPDnew/MethLabs/meth.htm

Oregon

www.healthoregon.org/druglab

South Dakota

denr.sd.gov/des/wm/hw/hwmeth.aspx

Tennessee

www.tn.gov/environment/dor/meth/
www.state.tn.us/environment/dor/pdf/Meth_RAP_Guidance.pdf

Utah

health.utah.gov/meth/html/RegulationsandLegislation/392-600.html

Virginia

www.dfs.virginia.gov/services/controlledSubstances/methLabs.cfm

Washington

apps.leg.wa.gov/WAC/default.aspx?cite=246-205-541

www.doh.wa.gov/Portals/1/Documents/Pubs/334-106.pdf

West Virginia

www.state.wv.us/swmb/Admn/Meth/Index.htm

www.wvdhhr.org/rtia/Meth.asp

Wisconsin

www.dhfs.state.wi.us/eh/ChemFS/fs/MethClnUp.htm

Wyoming

www.methlabcleanup.com/WY%20CLAN%20LAB%20TESTING%20AND%20REMEDIATION%20RULE

Appendix E: Acronyms

APR	Air Purifying Respirator
ASTM	American Society for Testing and Materials
ASTSWMO	Association of State and Territorial Solid Waste Management Officials
ATSDR	Agency for Toxic Substances and Disease Registry
CIH	Certified Industrial Hygienist
CNS	Central Nervous System
DEA	U.S. Drug Enforcement Administration
DEC	Drug Endangered Children
DOJ	U.S. Department of Justice
DQOs	Data Quality Objectives
DTSC	California Department of Toxic Substances Control
EPA	U.S. Environmental Protection Agency
HAZWOPER	Hazardous Waste Operations and Emergency Response
HEPA	High Efficiency Particulate Air
HVAC	Heating, Ventilation and Air Conditioning
IH	Industrial Hygienist
LGR	U.S. EPA Local Governments Reimbursement Program
NACO	National Association of Counties
NAMSDL	National Alliance of Model State Drug Laws
NIOSH	National Institute for Occupational Safety and Health
NIST	National Institute of Standards and Technology
OJP	U.S. Department of Justice Office of Justice Programs
ONDCP	White House Office of National Drug Control Policy
OSHA	Occupational Safety and Health Administration
P2P	Phenyl-2-Propanone
PID	Photoionization Detector
PPE	Personal Protective Equipment
QA/QC	Quality Assurance/Quality Control
SCBA	Self-Contained Breathing Apparatus
TSP	Trisodium Phosphate
TSP-PF	Phosphate-Free Trisodium Phosphate
USCG	U.S. Coast Guard
VOCs	Volatile Organic Compounds

