STANDARD OPERATING PROCEDURE

EIGHT

SAMPLING EQUIPMENT DECONTAMINATION

Modified from:

U.S. Environmental Protection Agency Environmental Response Team

Response Engineering and Analytical Contract

Standard Operating Procedures

Sampling Equipment Decontamination

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1.0 SCOPE AND APPLICATION

The purpose of this standard operating procedure (SOP) is to provide a description of the methods used for preventing, minimizing, or limiting cross contamination of samples due to inappropriate or inadequate equipment decontamination and to provide general guidelines for developing decontamination procedures for sampling equipment. This SOP does not address personnel decontamination.

The methods which are described in this SOP are standard (i.e., typically applicable) operating procedures which may be varied or changed as required, dependent upon site conditions or equipment limitations. In all instances, the procedures employed should be documented in the site logbook and associated with the final report. Mention of trade names or commercial products does not constitute endorsement or recommendation for use.

2.0 METHOD SUMMARY

Removing or neutralizing contaminants from equipment which must be reused minimizes the likelihood of sample cross contamination. It also reduces or eliminates the transfer of contaminants to clean areas and prevents the mixing of incompatible substances.

Gross contamination can be removed by physical decontamination procedures. These abrasive and nonabrasive methods include the use of brushes, air and wet blasting, and high and low pressure water cleaning. Solvents are then used to remove trace amounts of contaminants, which may still remain on the equipment.

The decontamination procedure may be summarized as follows:

1. Physical removal
2. Non-phosphate detergent wash
3. Tap-water rinse
4. Distilled/deionized water rinse
5. Ten (10) percent nitric acid rinse (only if samples are collected for metals analyses)
6. Distilled/deionized water rinse
7. Solvent rinse (used if organic contaminants are thought to be present)
8. Air dry
9. Distilled/deionized rinse
10. Air dry

After any contaminants are physically removed by scraping or brushing the equipment, a soap and water wash is used to remove any remaining visible particulate matter and residual oils and grease. This step may be preceded by a steam or high-pressure, hot-water wash to facilitate residuals removal. Gross contamination and wash water need to be collected and properly disposed of according to the characteristics of the contamination.

The next step involves a tap-water rinse and a distilled/deionized water rinse to remove the detergent. An acid rinse provides a low pH media for trace-metals removal and is included in the decontamination process if metal samples are to be collected. It is followed by another distilled/deionized water rinse. If sample analysis does not include metals, the acid-rinse step can be omitted. Following the acid rinse is another distilled/deionized water rinse to remove any remaining acid. All rinse water needs to be collected and properly disposed of according to the characteristics of the contamination.

Next, a high purity solvent rinse is performed for trace-organics removal if organics are a concern at the site. Typical solvents used for removal of organic contaminants include acetone, hexane, or water. Acetone is typically chosen because it is an excellent solvent, miscible in water, and not a target analyte on the Priority Pollutant List. If acetone is known to be a contaminant of concern at a given site or if Target Compound List analysis (which includes acetone) is to be performed, another solvent may be substituted. The solvent must be allowed to evaporate completely and then a final distilled/deionized water rinse is performed. This removes any residual traces of the solvent. The equipment is then allowed to air dry. All rinse solutions needs to be collected and properly disposed of according to the characteristics of the contamination.

Sample collection and analysis of decontamination waste may be required before beginning proper disposal of decontamination liquids and solids generated at a site. This should be determined prior to initiation of site activities.

If a particular contaminant fraction is not present at the site, the 10 step decontamination procedure previously listed may be modified for site specificity. For example, the nitric-acid rinse may be eliminated if metals are not of concern at a site. Similarly, the solvent rinse may be eliminated if organics are not of concern at a site. Modifications to the standard procedure should be documented in the site specific quality assurance work plan or subsequent report.

3.0 INTERFERENCES AND POTENTIAL PROBLEMS

The use of distilled/deionized water commonly available from commercial vendors may be acceptable for decontamination of sampling equipment provided it has been verified by laboratory analysis to be analyte free (specifically for the contaminants of concern).

The use of an untreated water supply is not an acceptable substitute for tap water. Tap water may be used from any municipal or industrial water treatment system.

If acids or solvent are utilized in decontamination, they raise health, safety, and waste disposal concerns. Protective clothing may need to be worn during the decontamination process. Any waste materials must be disposed of properly.

Damage can be incurred by acid and solvent washing of complex and sophisticated sampling equipment. Check with the equipment manufacturer to determine if acid or solvent washing will affect the equipment.

4.0 EQUIPMENT/APPARATUS

Decontamination equipment, materials, and supplies are generally selected based on availability. Other considerations include the ease of decontaminating or disposing of the equipment. Most equipment and supplies can be easily procured. For example, soft-bristle scrub brushes or long-handled bottle brushes can be used to remove contaminants. Large galvanized wash tubs, stock tanks, or pails can hold wash and rinse solutions. Children's wading pools can also be used. Large plastic garbage cans or other similar containers lined with plastic bags can help segregate contaminated equipment. Contaminated liquid can be stored temporarily in metal or plastic cans or drums.

The following standard materials and equipment are recommended for decontamination activities:

- **Decontamination Solutions**

  Nonphosphate detergent
  Selected solvents (acetone, hexane, nitric acid, etc.)
  Tap water
  Distilled/deionized water

- **Decontamination Tools/Supplies**

  Long- and short-handled brushes (preferably with plastic handles)
  Bottle brushes
  Drop cloth/plastic sheeting
  Paper towels
  Plastic or galvanized tubs or pails
  Pressurized sprayers (H_2O)
  Solvent sprayers
  Aluminum foil

- **Health and Safety Equipment**

  Appropriate personal protective equipment (i.e., safety glasses or splash shield, appropriate gloves, aprons or coveralls, boots, respirator, emergency eye wash)

- **Waste Disposal**

  Trash bags
  Trash containers
  55-gallon drums
  Metal/plastic pails/containers for storage and disposal of decontamination solutions

5.0 REAGENTS

There are no reagents used in this procedure aside from the actual decontamination solutions. Table 1 lists solvent rinses which may be required for elimination of particular chemicals. In general, the following solvents are typically utilized for decontamination purposes:

- 10% percent nitric acid is typically used for inorganic compounds such as metals. An acid rinse may not be required if inorganics are not a contaminant of concern.

- Acetone (pesticide grade), hexane (pesticide grade), or methanol are typically used if organics are a contaminant of concern.

6.0 PROCEDURES

As part of the health and safety plan, a decontamination plan should be developed and reviewed. The decontamination line should be set up before any personnel or equipment enters the areas of potential exposure. The equipment-decontamination plan should include:

- The number, location, and layout of decontamination stations

- Decontamination equipment needed

- Appropriate decontamination methods

- Methods for disposal of contaminated clothing, equipment, and solutions

- Procedures can be established to minimize the potential for contamination. This may include: (1) work practices that minimize contact with potential contaminants, (2) using remote sampling techniques, (3) covering monitoring and sampling equipment with plastic, aluminum foil, or other protective material, (4) watering down dusty areas, (5) avoiding laying down equipment in areas of obvious contamination, and (6) use of disposable sampling equipment.

TABLE 1
Solvent Rinses and Soluble Contaminants

SOLVENT[1]	EXAMPLES OF SOLVENTS	SOLUBLE CONTAMINANTS
Water	Deionized water Tap water	Low-chain hydrocarbons Inorganic compounds Salts Some organic acids Some polar compounds
Dilute Acids	Citric acid Acetic acid Boric acid	Amines Hyrazines
Dilute Bases	Sodium bicarbonate	Acidic compounds Phenols Thiols Some nitro compounds
Organic Solvents[2]	Alcohols Ethers Ketones Aromatics Hexane Petroleum products	Nonpolar compounds
Organic Solvents[2]	Hexane	PCB's

[1] Material safety data sheets are required for all decontamination solvents or solutions as required by the Hazard Communication Standard.
[2] Some organic solvents can degrade protective clothing.

6.1 Decontamination Methods

All samples and equipment leaving the contaminated area of a site must be decontaminated to remove any contamination that may have adhered to equipment. Various decontamination methods will remove contaminants by flushing or other physical action or chemical complexing to inactivate contaminants by neutralization, chemical reaction, disinfection, or sterilization.

Physical decontamination techniques can be grouped into two categories: abrasive methods and nonabrasive methods.

6.1.1 Abrasive-Cleaning methods

Abrasive-cleaning methods work by rubbing and wearing away the top layer of the surface containing the contaminant. The mechanical abrasive cleaning methods are most commonly used at hazardous waste sites. Several abrasive methods are available.

- **Air Blasting**

  Air blasting equipment uses compressed air to force abrasive material through a nozzle at high velocities. The distance between nozzle and surface cleaned, air pressure, time of application, and angle at which the abrasive strikes the surface will dictate cleaning efficiency. Disadvantages of this method are the inability to control the amount of material removed and the large amount of waste generated.

- **Wet Blasting**

  Wet blast cleaning involves use of a suspended fine abrasive. The abrasive water mixture is delivered by compressed air to the contaminated area. By using a very fine abrasive, the amount of materials removed can be carefully controlled.

6.1.2 Non-abrasive Cleaning methods

Non-abrasive cleaning methods work by forcing the contaminant off a surface with pressure. In general, the equipment surface is not removed using non-abrasive methods.

- **Low Pressure Water**

  This method consists of a container, which is filled with water. The user pumps air out of the container to create a vacuum. A slender nozzle and hose allow the user to spray in hard-to-reach places.

- **High Pressure Water**

  This method consists of a high-pressure pump, an operator controlled directional nozzle, and a high-pressure hose. Operating pressure usually ranges from 340 to 680 atmospheres and flow rates usually range from 20 to 140 liters per minute. High-pressure washers may supply heated water.

- **Ultra-High-Pressure Water**

  This system produces a water jet that is pressured from 1,000 to 4,000 atmospheres. This ultra high pressure spray can remove tightly adhered surface films. The water velocity ranges from 500 meters/second (1,000 atmospheres) to 900 meters/second (4,000 atmospheres). Additives can be used to enhance the cleaning action. Ultra high pressure washers may supply heated water.

- **Rinsing**

  Contaminants are removed by rinsing through dilution, physical attraction, and solubilization.

- **Damp-Cloth Removal**

  In some instances, it is not necessary to conduct extensive decontamination especially if the equipment is sensitive and not waterproof. For example, air-sampling pumps hooked

on a fence, placed on a drum, or wrapped in plastic bags are not likely to become heavily contaminated. A damp cloth should be used to wipe off contaminants, which may have adhered to equipment through airborne contaminants or from surfaces upon which the equipment was set.

- **Disinfection/Sterilization**

  Disinfectants are a practical means of inactivating infectious agents. Unfortunately, standard sterilization methods are impractical for large equipment. This method of decontamination is typically performed off-site.

6.2 Field Sampling Equipment Decontamination Procedures

The decontamination line is set up so the first station is used to remove most of the contamination. It progresses to the last station where any remaining contaminants should be removed. The spread of contaminants is further reduced by separating each decontamination station by a minimum of three (3) feet. Ideally, the contamination should decrease as the equipment progresses from one station to another farther along in the line.

The size of the decontamination area depends on the number of stations in the decontamination process, overall dimensions of the work zones, and amount of space available at the site. Whenever possible, it should be a straight line.

Anyone in the decontamination area should be wearing the level of protection designated for the decontamination crew. Another area may be necessary for the entry and exit of heavy equipment. Sampling and monitoring equipment and sampling supplies are all maintained outside of the decontamination area. Personnel don their equipment away from the decontamination area and enter the area through regulated access areas. One person (or more) dedicated to decontaminating equipment is recommended.

6.2.1 Decontamination setup

Starting with the most contaminated station, the decontamination setup should be as follows:

- **Station 1: Segregate Equipment Drop**

  Place plastic sheeting or other appropriate material on the ground. Size will depend on amount of equipment to be decontaminated. Provide containers lined with plastic or other appropriate material if equipment is to be segregated. Segregation may be required if sensitive equipment or mildly contaminated equipment are used at the same time as equipment which is likely to be heavily contaminated.

- **Station 2: Physical Removal With A High Pressure Washer (Optional)**

  A high-pressure wash may be required for compounds, which are difficult to remove by washing with brushes. High-pressure washers require electricity and commonly heat the water. The elevated temperature of the water from the high-pressure washers is excellent at removing greasy/oily compounds.

  A decontamination pad, which can be placed inside a tent, may be required for the high-pressure wash area. An example of a wash pad may consist of an approximately

1-foot deep basin lined with plastic or other appropriate material and the basin is filled with gravel or shell. The sump is also lined with plastic sheeting and a barrel is placed in the hole to prevent collapse. A sump pump is used to remove the water from the sump for transfer into a drum.

Typically, heavy machinery is decontaminated at the end of the day unless site sampling requires that the machinery be decontaminated frequently. A separate decontamination pad may be required for heavy equipment.

- **Station 3: Physical Removal With Brushes And A Wash Basin**

Prior to setting up Station 3, place plastic sheeting on the ground to cover areas under Station 3 through Station 10.

Fill a wash basin, a large pail, or child's swimming pool with non-phosphate detergent and tap water. Several bottle and bristle brushes to physically remove contamination should be dedicated to this station. Approximately 10 to 50 gallons of water may be required initially depending upon the amount of equipment to decontaminate and the amount of gross contamination.

- **Station 4: Water Basin**

Fill a wash basin, a large pail, or child's swimming pool with tap water. Several bottle and bristle brushes should be dedicated to this station. Approximately 10 to 50 gallons of water may be required initially depending upon the amount of equipment to decontaminate and the amount of gross contamination.

- **Station 5: Low Pressure Sprayers**

Fill a low-pressure sprayer, such as those commonly found in hardware stores, with distilled/deionized water. Provide a 5-gallon pail or basin to contain the water during the rinsing process. Approximately 10 to 20 gallons of water may be required initially depending upon the amount of equipment to decontaminate and the amount of gross contamination.

- **Station 6: Nitric-Acid Sprayers**

Fill a plastic spray bottle with 10 percent nitric acid. An acid rinse may not be required if inorganics are not a contaminant of concern. The amount of acid will depend on the amount of equipment to be decontaminated. Provide a 5-gallon pail or basin to collect acid during the rinsing process.

- **Station 7: Low Pressure Sprayers**

Fill a low-pressure sprayer with distilled/deionized water. Provide a 5-gallon pail or basin to collect water during the rinsate process.

- **Station 8: Organic-Solvent Sprayers**

Fill a plastic spray bottle with an organic solvent. After each solvent rinse, the equipment should be allowed to air dry, then it should be rinsed with distilled/deionized

water and allowed to air dry a final time. Amount of solvent will depend on the amount of equipment to decontaminate. Provide a 5-gallon pail or basin to collect the solvent during the rinsing process.

Solvent rinses may not be required unless organics are a contaminant of concern and may be eliminated from the station sequence.

- **Station 9: Low Pressure Sprayers**

Fill a low-pressure sprayer with distilled/deionized water. Provide a 5-gallon pail or basin to collect water during the rinsate process.

- **Station 10: Clean Equipment Drop**

Lay a clean piece of plastic sheeting or other appropriate material on the ground. Provide aluminum foil, plastic, or other protective material to wrap clean equipment.

6.2.2 Decontamination procedures

- **Station 1: Segregate Equipment Drop**

Deposit equipment used onsite (i.e., tools, sampling devices and containers, monitoring instruments, radios, clipboards, etc.) on the plastic drop cloth/sheet or in different containers with plastic liners. Each will be contaminated to a different degree. Segregation at the drop reduces the probability of cross contamination. Loose leaf sampling data sheets or maps can be placed in plastic Ziplock® bags if contamination is evident.

- **Station 2: Physical Removal With A High Pressure Washer (Optional)**

Use high-pressure wash on grossly contaminated equipment. Do not use high-pressure wash on sensitive or non-waterproof equipment.

- **Station 3: Physical Removal With Brushes And A Wash Basin**

Scrub equipment with soap and water using bottle and bristle brushes. Only sensitive equipment (i.e., radios, air monitoring, and sampling equipment) which is waterproof should be washed. Equipment which is not waterproof should have plastic bags removed and wiped down with a damp cloth. Acids and organic rinses may also ruin sensitive equipment. Consult the manufacturers for recommended decontamination solutions.

- **Station 4: Equipment Rinse**

Wash soap off equipment with water by immersing the equipment in the water while brushing. Repeat as many times as necessary.

- **Station 5: Low Pressure Rinse**

Rinse sampling equipment with distilled/deionized water with a low-pressure sprayer.

- **Station 6: Nitric-Acid Sprayers (required only if metals are a contaminant of concern)**

  Using a plastic spray bottle, rinse sampling equipment with nitric acid. Begin spraying (inside and outside) at one end of the equipment allowing the acid to drip to the other end into a 5-gallon pail. A rinsate blank may be required at this station. Refer to Section 7 of this SOP.

- **Station 7: Low Pressure Sprayers**

  Rinse sampling equipment with distilled/deionized water with a low-pressure sprayer.

- **Station 8: Organic-Solvent Sprayers**

  Rinse sampling equipment with a solvent. Begin spraying (inside and outside) at one end of the equipment allowing the solvent to drip to the other end into a 5-gallon pail. Allow the solvent to evaporate from the equipment before going to the next station. A quality control rinsate sample may be required at this station.

- **Station 9: Low Pressure Sprayers**

  Rinse sampling equipment with distilled/deionized water with a low-pressure sprayer.

- **Station 10: Clean Equipment Drop**

  Lay clean equipment on plastic sheeting. Once air-dried, wrap sampling equipment with aluminum foil, plastic, or other protective material.

6.2.3 Post-Decontamination procedures

1. Collect high-pressure pad and heavy equipment decontamination area liquid and waste and store in appropriate drum or container. A sump pump can aid in the collection process.

2. Collect high-pressure pad and heavy equipment decontamination area solid waste and store in appropriate drum or container.

3. Empty soap and water liquid wastes from basins and pails and store in appropriate drum or container.

4. Empty acid-rinse waste and place in appropriate container or neutralize with a base and place in appropriate drum. Neutralization must be confirmed with pH paper or other suitable pH test.

5. Empty solvent-rinse sprayer and solvent waste into an appropriate container.

6. Rinse the basins and brushes using low-pressure sprayers. Place liquid generated from this process into the wash water rinse container.

7. Empty low-pressure sprayer water onto the ground.

8. place all solid-waste materials generated from the decontamination area (i.e., gloves and plastic sheeting, etc.) in an approved Department of Transportation drum.

9. Write appropriate labels for waste and make arrangements for disposal.

7.0 QUALITY ASSURANCE/QUALITY CONTROL

A rinsate blank is one specific type of quality-control sample commonly associated with the field-decontamination process. This sample will provide information on the effectiveness of the decontamination processes employed in the field. Rinsate blanks are samples obtained by running certified analyte free water over decontaminated sampling equipment to test for residual contamination. The blank water is collected in sample containers for handling, shipment, and analysis. These samples are treated identically as samples collected that day. A rinsate blank is used to assess cross contamination brought about by improper decontamination procedures. If sampling equipment requires the use of plastic tubing, the tubing should be disposed of as contaminated and replaced with clean tubing before additional sampling occurs. All data associated with sampling must be documented at the time of collection in the site log books. For more information on standard operating procedures on quality assurance/quality control see SOP 6.