

Washington State Department of Ecology

Environmental Assessment Program

Standard Operating Procedure for Obtaining Freshwater Sediment Samples

Version 1.0

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Signatures on File

Please note that the Washington State Department of Ecology's Standard Operating Procedures (SOPs) are adapted from published methods, or developed by in-house technical and administrative experts. Their primary purpose is for internal Ecology use, although sampling and administrative SOPs may have a wider utility. Our SOPs do not supplant official published methods. Distribution of these SOPs does not constitute an endorsement of a particular procedure or method.

Any reference to specific equipment, manufacturer, or supplies is for descriptive purposes only and does not constitute an endorsement of a particular product or service by the author or by the Department of Ecology.

Although Ecology follows the SOP in most instances, there may be instances in which Ecology uses an alternative methodology, procedure, or process.

Environmental Assessment Program

Standard Operating Procedure for Obtaining Freshwater Sediment Samples

1.0 Purpose and Scope

1.0 This document is the Environmental Assessment Program (EAP) Standard Operating Procedure (SOP) for obtaining freshwater sediment samples with a grab sampler. This SOP covers collection of sediment for chemistry or bioassay analyses using equipment currently available at the EAP Operations Center, including Petite Ponar, Ponar, Ekman, and Van Veen designs. It is not intended to serve as a comprehensive review of other samplers and equipment which can also be used but are not currently owned by EAP. For information on other types of samplers, see, for example, EPA (2001).

2.0 Applicability

2.1 This SOP should be followed for all freshwater sediment collection activities performed with grab samplers by Ecology's Environmental Assessment Program to obtain samples for chemistry or bioassay analyses. The SOP does not apply to the collection of freshwater benthic invertebrates. The use of core samplers with freshwater sediments is covered by a separate SOP (Ecology, 2008).

2.2 This SOP does not apply to sample collection in marine or estuarine waters, which should generally conform with recommendations in Puget Sound Protocols (PSEP, 1997a) and Ecology recommendations (Ecology, 2003). An SOP is available for Puget Sound Assessment and Monitoring Program (PSAMP) Marine Sediment Component collection activities performed by Ecology's Marine Monitoring Unit (Ecology, 2007).

3.0 Definitions

3.1 Grab Sample – surficial sediment obtained from slow moving waters using one of a number of samplers, including any of the following:

3.1.1 *Ponar* grab samplers (section 5.2) come in two sizes (*standard* and *petite*). Both samplers have a pair of weighted, tapered jaws that are held open by a catch bar which is held in place by a spring-loaded pin. The sampler is triggered by impact with the bottom, which relieves the weight on the catch bar, allowing the spring-loaded pin to eject. The upper side of the jaws is covered with a fine mesh screen that allows water to flow through the jaws during descent. This reduces the bow wave created by the sampler and disturbance of the sediment surface. After the sampler is retrieved, the mesh screen can be removed to gain access to the sediment sample. The *standard Ponar* is heavy and requires a winch. The smaller (6" × 6") *petite Ponar* can be deployed by hand but may not penetrate the sediment to the desired depth and may require multiple deployments to obtain sufficient sediment sample.

- 3.1.2 *Van Veen* grab samplers are similar in design to the Ponar grab (section 5.2) except for the mechanism for triggering the sampler. When the sampler reaches the bottom, the tension in the lowering wire slackens, releasing the small chains holding the jaws open. Pulling up on the lowering chain engages the chains attached to the jaw arms, causing them to bite into the sediments and close. As with the Ponar, the sediments screens on the jaws can be removed to gain access to the sediment sample without opening the jaws.
- 3.1.3 *Ekman* grab samplers consist of a box with hinged spring loaded scoops on the bottom that are held open with a wire attached to the tripping mechanism (section 5.2). Hinged doors on the top of the sampler open during descent to reduce pressure wave effects on surface sediments. The doors close upon retrieval preventing washout of the sample. With some models, these doors also allow access to the sediment sample without opening the bottom jaws. Unlike the Ponar and Van Veen grab samplers, the Ekman requires a messenger to close the scoops. This grab is best suited for sampling soft, fine sediment that is free from solid objects, including growing vegetation, sticks, decayed leaves, stones and other coarse debris that may prevent proper closure of the jaws. The specialized function of the Ekman is for taking samples of benthic macroinvertebrates. A Ponar or Van Veen sampler may be preferable for sampling sediments in most cases, since Blomqvist (1990) found that sediment samples are prone to redistribution and resuspension within the standard Ekman grab chamber. However, the Ekman may be useful in situations where a light-weight sampler is needed (e.g. extend sampler with pole to desired location or in unstable boat such as a canoe).
- 3.1.4 Other samplers not currently owned by Ecology include *Petersen* and *Shipek*. Descriptions of these samplers are provided in EPA (2001). This SOP will be revised to cover these or other samplers if they are acquired by Ecology in future.
- 3.2 Hydrowire – a wire to which equipment is attached so that it can be lowered over the side of the ship into the water.
- 3.3 Messenger – a weight sent down a hydrowire to activate the attached equipment.

4.0 Personnel Qualifications/Responsibilities

- 4.1 The Field Lead directing sample collection must be knowledgeable concerning all aspects of the project's Quality Assurance Project Plan (QAPP) to ensure that credible and useable data are collected. All field staff should be briefed by the Field Lead on the sampling goals and objectives prior to arriving at the site. For most projects, the Project Manager will also be the Field Lead.
- 4.2 All field staff must be familiar with the project Safety Plan, if there is one.

4.3 Sampling from an Ecology boat requires one person on board to be a qualified Boat Operator as described in Interim Ecology Policy 11-60. All other persons on board (crew) must be familiar with Chapter 3 of the EA Safety Manual, “Boating.” Responsibilities of the Boat Operator and crew for safety are described in Section 9.0 Safety.

5.0 Equipment, Reagents, and Supplies

5.1 General Equipment and Supplies

- 5.1.1 Grab sampler
 - 5.1.2 Winch, either hand-operated for Ponars or hydraulic boat winch for Van Veen.
 - 5.1.3 Ice chests with extra ice
 - 5.1.4 Deionized water
 - 5.1.5 Paper towels
 - 5.1.6 Plastic bags (Ziploc, trash)
 - 5.1.7 Aluminum foil
 - 5.1.8 Non-talc, disposable nitrile gloves
 - 5.1.9 Field logs (on Rite-in-Rain paper)
 - 5.1.10 Preprinted sample container labels, with extra blank labels
 - 5.1.11 Chain of Custody tags and forms
 - 5.1.12 Pencils, indelible ink pens (fine and regular)
 - 5.1.13 Tape (duct and masking)
 - 5.1.14 Clipboard with cover
 - 5.1.15 Maps, charts, aerial photographs
 - 5.1.16 GPS unit
 - 5.1.17 Cell phone
 - 5.1.18 Camera
 - 5.1.19 Calculator
 - 5.1.20 Ruler for measuring sediment depth
 - 5.1.21 Stainless steel scoops and mixing bowls. Preclean and wrap in aluminum foil.
 - 5.1.22 Siphon tubing (to drain overlying water from grab samples)
 - 5.1.23 Personal gear, as appropriate for the project (boots, waders, rain gear etc.)
- 5.2 *Suggested for use with the petite ponar grab:* plastic tub and block of wood. The grab can then be placed in the tub, and held upright by placing the block of wood under one side of the jaws.
- 5.3 Sediment Sample Containers – appropriate containers for project-specific analyses are listed in Table 1 of the Manchester Environmental Laboratory Lab Users Manual. The number of containers is project specific. Extra containers are required to account for breakage or contamination.

5.4 *For large volume samples (such as needed for bioassay testing), the following additional equipment may be needed:*

- 5.4.1 5-gal buckets with sealing lids
- 5.4.2 Stainless steel mixing paddle and drill
- 5.4.3 Stainless steel mixing bucket

5.5 Grab sampler

5.5.1 The Environmental Assessment Program has three types of grab samplers for field use: Petite Ponar, Ponar and Van Veen.

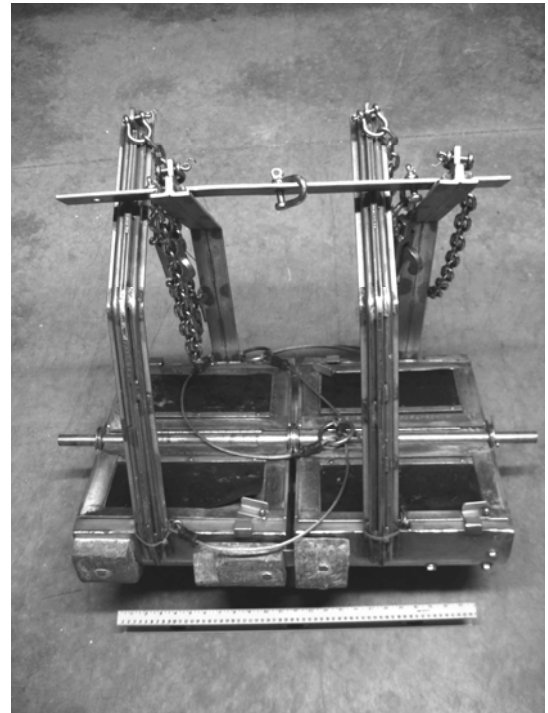


Figure 1. Above: Ponar (left) and Petite Ponar. Right: Tandem Van Veen grabs. Ruler length in both photos is 2 ft.

5.5.2 Van Veen grabs can be used singly or as a tandem pair (for synoptic chemistry and biological sampling).

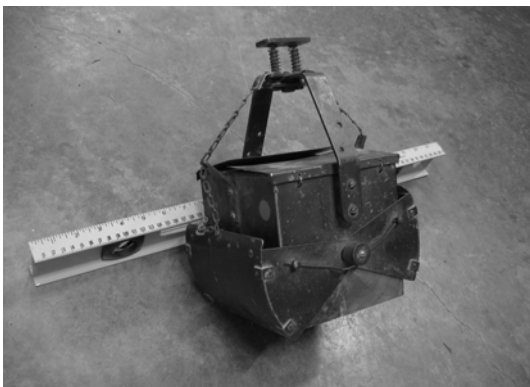


Figure 2. Above: Ekman grab.

5.5.3 The following table can be used in selecting the appropriate sampler for a particular project.

Table 1. Comparison of currently available EAP grab samplers.

Grab sampler	Construction materials	Sample area	Approx. weight (lb)	Penetration depth (cm)	Sample volume (L)	Advantages	Disadvantages
Petite ponar	Stainless steel and neoprene rubber	6 in x 6 in (0.02 meter ²)	22 lb	0 to 10	1.0	<ul style="list-style-type: none"> • Portable, can be used without winch or crane • Adequate for most substrates that are not compacted 	<ul style="list-style-type: none"> • May not penetrate sediment to desired depth, especially in consolidated sediments. • Susceptible to incomplete closure and loss of sample. • Requires more casts to obtain sufficient sample if many analyses needed.
Ponar		9 in x 9 in (0.05 meter ²)	51 lb	0 to 10	7.25	<ul style="list-style-type: none"> • Most universal grab sampler • Adequate on most substrates • Large sample obtained intact, permitting subsampling • Good for coarse and firm bottom sediments 	<ul style="list-style-type: none"> • Heavy; requires winch
Van Veen (single)	Stainless steel; neoprene straps; zinc-plated chain	11 in x 14 - 1/8 in (0.1 meter ²)	100 lb	18	20	<ul style="list-style-type: none"> • Adequate on most substrates that are not compacted • Large sample obtained intact, permitting subsampling • A yolked, double sampler is available for synoptic chemistry and biological sampling 	<ul style="list-style-type: none"> • Very heavy; requires use of RV Skookum with winch and table, or similarly equipped vessel

Adapted in part from EPA (2001) and Tetra Tech (2003). Specifications for these samplers vary and the descriptions listed here are only for equipment currently owned by Ecology.

5.6 Decontamination Equipment

5.6.1 Pre-sampling cleaning

5.6.2 Liquinox (or Alconox) soap

5.6.3 *When sampling for organic compounds:* acetone and hexane (both pesticide grade)

5.6.4 *When sampling for metals:* 10% nitric acid solution

- 5.7. Field decontamination
 - 5.7.1 Scrub brush. For most sampling applications, rinsing the equipment with site water is normally sufficient (PSEP, 1997a), using a scrub brush to remove any sediment that does not rinse off easily. Rinsing can be performed by dipping the grab in the water or using pumped water.
 - 5.7.2 *If sampling from stations that could be heavily contaminated, a site water rinse might not be sufficient to minimize cross-contamination of samples among stations and the following equipment list may be used:*
 - 5.7.2.1 Wash bottles labeled for Liquinox (or Alconox)
 - 5.7.2.2 Liquinox or Alconox soap
 - 5.7.3 *If sampling for organics:*
 - 5.7.3.1 Pesticide grade acetone
 - 5.7.3.2 Wash bottle for acetone
 - 5.7.4 *If sampling for metals or other inorganic compounds:*
 - 5.7.4.1 Nitric acid – 10 percent solution
 - 5.7.4.2 Wash bottle for 10 percent nitric acid solution
 - 5.7.4.3 Small funnel to pour acetone or nitric acid solution into wash bottles
 - 5.7.4.4 Plastic tub to collect excess rinsate and plastic waste container for storage
- 5.8 Safety Equipment
 - 5.8.1 Life-vests and other boat safety equipment (see "Boat Checklist" in the EA Safety Manual)
 - 5.8.2 Safety goggles
 - 5.8.3 First aid kit
 - 5.8.4 Steel toed boots
 - 5.8.5 Gloves
 - 5.8.5.1 For information on selecting appropriate gloves for protection from specific chemicals, consult the table posted in the Ecology Headquarters Cleaning Room. This information is also available at <http://www.des.umd.edu/ls/gloves.html>
 - 5.8.5.2 Heavy gloves may also be necessary for handling rope or wire used to lower and retrieve grab samplers.
 - 5.8.6 Hard hats (required for deck work on the RV Skookum)
 - 5.8.7 Drinking water
 - 5.8.8 Communications equipment (cell phone or radio)

5.8.9 Other items for manual sampling with Petite Ponar:

5.8.9.1 Waders

5.8.9.2 Rope

6.0 Summary of Procedure

6.1 Grab samplers are normally operated from a boat platform therefore, the following summary is based on this scenario. For some projects, sampling must be conducted without a winch to lower and retrieve the grab sampler (Petite Ponar only), and requirements relating to boat use are then not applicable.

6.2 Pre-sampling Trip Preparation

6.2.1 Reserve a boat and make arrangements for participation of a qualified Boat Operator.
6.2.2 Complete and submit Preliminary Analysis and Bottle Request forms to Manchester Environmental Lab.

6.2.3 Get lab sample numbers from Manchester Environmental Lab.

6.2.4 Prepare all sample containers, ice chests, and buckets.

6.2.5 Pre-clean stainless steel tools that will come in direct contact with the sediment samples, using the following procedure. (This applies, for example, to spoons or scoops used to remove sediment from the grab sampler, and to mixing bowls used to homogenize sediment samples.)

6.2.5.1 Wash using Liquinox detergent

6.2.5.2 Rinse three times with tap water

6.2.5.3 Wash with 10% nitric acid (*required only if samples will be analyzed for metals*)

6.2.5.4 Rinse with deionized water

6.2.5.5 In fume hood, rinse with acetone, then hexane. This step is intended to remove trace organics from the sampling equipment, although EPA (2001) also recommends it for field samples of "unknown composition". Many sources, including EPA (2001), recommend only an acetone rinse. Because the acetone molecule has both polar and non-polar components it is a good solvent for a broad range of chemicals. It is miscible in water and readily evaporates, serving as a drying agent. Hexane is also a good solvent for organic compounds and is recommended here for thoroughness, particularly for analyses of dioxins and PCBs.

6.2.5.6 Air dry in fume hood and wrap with aluminum foil (shiny side of foil facing out)

6.2.6 Pre-clean the grab sampler with tap water and Liquinox, then rinse with pesticide grade acetone.

6.2.7 Prepare all labels. Labels will have project name, sample number, analysis type, date, and laboratory sample number.

- 6.2.8 Reserve a vehicle for personnel and sample transport.
- 6.2.9 Solicit volunteer crew members if necessary.
- 6.2.10 Get any needed maps and charts.
- 6.2.11 File a 'Field Work Plan and Contact Person Form.'
- 6.2.12 File an 'Ecology Float Plan' (if sampling from a boat).

- 6.3 Decontamination Procedures
 - 6.3.1 Use precleaned implements, wrapped in aluminum foil, if they will come in direct contact with sampled sediment. This includes, for example, stainless steel spoons or scoops used to remove sediment from the grab. If there are not enough and they must be decontaminated for reuse at another sampling station, use the precleaning procedures described in section 6.1.
 - 6.3.2 Rinse the grab sampler with site water between deployments, using a scrub brush to dislodge any adhering sediment. This level of decontamination is adequate provided the following procedures are followed:
 - 6.3.2.1 Sample from the least contaminated station to most contaminated, if possible.
 - 6.3.2.2 *When removing sediment samples from the grab, avoid including any sediment in direct contact with the sides of the grab (section 6.5)*
 - 6.3.2.3 More thorough decontamination may be needed for highly contaminated sediment, for example, if there is oily liquid that is not readily removed with rinsing. Scrub the grab with site water and Liquinox, then rinse with pesticide grade acetone.

- 6.4 Station Positioning
 - 6.4.1 Proper station positioning is a critical component of sampling and data collection. Successful station positioning allows samples or data to be precisely collected from predetermined locations as well as allowing repeated sampling or data collection at the same location over time. Station locations for sediment sampling should generally be accurate to within ± 3 m (Ecology, 2003). Detailed descriptions of station positioning methodologies and techniques are addressed in the document Recommended Protocols for Station Positioning in Puget Sound (PSEP, 1998).

- 6.5 Deploying and Retrieving the Grab Sampler
 - 6.5.1 Petite Ponar
 - 6.5.1.1 Where it is not possible to sample from a boat, the Petite Ponar may be lowered from a bridge to collect samples. Safety requirements for sampling are described in the EAP Safety Manual (Working near Traffic and from Bridges). Lower the grab gently into the sediment. Allow a little slack in the line after contact with the sediment, to allow the spring-loaded pin to eject. Slowly pull the Ponar until no longer in contact with

sediments to allow jaws to properly close and collect sample. Maintain a consistent retrieval to avoid jerking rope or causing slack that could result in loss of sample or for sample to be rejected due to disturbance of the surface. After retrieving the grab, confirm that the rubber flaps over the mesh screen are down. The flaps protect the sediment from washing out as the grab is raised.

- 6.5.1.2. Where sampling from a bridge is not possible, samples can be collected in shallow water by wading with the grab sampler. Be careful not to contaminate the sample location with disturbed sediment.
- 6.5.2 Ponar
 - 6.5.2.1 Two EAP boats can be used as a platform for operating the Ponar with a winch: the Jet Sled (Wooldridge 16 Xtra Plus) and the RV Skookum.
- 6.5.3 Van Veen
 - 6.5.3.1. The Van Veen grab can only be operated from the RV Skookum or a comparably equipped non-Ecology vessel.
 - 6.5.3.2. Personnel deploying the grab will wear life vests and protective helmets any time the grab is suspended from the deck or at the water's surface.
 - 6.5.3.3. The grab sampler is deployed and retrieved with a hydraulic winch to control rate of descent and ascent. All samples are collected in depths of 2 meters or more, the operating limit of the sampling vessel.
 - 6.5.3.4. The sampler is lowered at a controlled speed of approximately 4 feet per second with the hydrowire perpendicular to the surface of the water (i.e. ensure that the cable is not angled). Under no circumstances should the grab sampler be allowed to free fall to the bottom as this may result in premature triggering, an excessive bow wake, or improper orientation upon contact with the bottom. As the sampler descends, water should be able to pass freely through the closed upper screened doors to minimize the bow wake. Descent speed should be slowed to about 1 foot per second as the sampler nears the bottom to minimize disturbance of the surface sediments. The winch operator should be supplied with bottom depth information so that s/he knows when to reduce winch speed. Once the sampler reaches the bottom, the hydrowire should not be allowed to slack. (PSEP, 1997a)
 - 6.5.3.5. When retrieved from the water, the grab is immediately placed upon the grab stand and properly secured.
 - 6.5.3.6. When using a tandem pair of Van Veen grab samplers for synoptic chemistry and biological analyses, see sections 6.5 – 6.7 of the PSAMP marine sampling SOP (Ecology, 2007).

- 6.6 Collecting Sediment from the Sampler
- 6.6.1 After retrieving the grab, check the sample for acceptability. A sample is considered acceptable if it is not over-filled with sediment, overlying water is present and not excessively turbid, the sediment surface is relatively flat, and the desired depth penetration has been achieved.
- 6.6.2 If the sample is acceptable, the overlying water should be siphoned off or otherwise removed. Unacceptable samples should be dumped overboard at a location away from the station.
- 6.6.3 Sample material for volatile organic or sulfide compound analysis must be collected out of the grab sampler from the first successful deployment and sample containers must be filled immediately, prior to any homogenization. Sample containers for volatile analyses should have no headspace.
- 6.6.4 Once the volatile subsamples have been removed, remove the top layer not in contact with the sidewalls of the sampler with a precleaned stainless steel spoon and transfer it to a stainless steel container (beaker or bowl). Homogenize the sample by stirring with a stainless steel spoon until a uniform color and texture are achieved. After homogenization, transfer aliquots with a stainless steel utensil to appropriate containers and store in coolers on ice for the duration of the sampling period. Samples that will be stored frozen require a minimum of 2 cm of head space in the sample container.
- 6.6.5 Top layer depth. For stratified sediments, it may be important to define the depth of the top layer to be removed from the grab sampler. The top 2 cm and top 10 cm have both been used in different EAP freshwater sediment studies. The choice should be guided by project objectives. The top 2 cm is appropriate for studies focusing on recent deposition. A deeper layer may be appropriate for studies evaluating impacts on benthic communities. These distinctions may not apply for well-mixed sediments where the sample is homogeneous throughout the grab. Although if sub-sampling it is recommended that the sample depth is less than the penetration depth to avoid using sample in contact with grab sampler.
- 6.7 Disposal of Contaminated Sediments
- 6.7.1 In most sediment investigations, it is generally considered acceptable practice to return excess sediments collected and not needed for analysis to the water at the station where they were collected. Sediments with visible evidence of contamination (e.g., oily droplets, sheen, paint chips, sandblast grit, other wastes) should not be returned to the water, but instead they should be retained in a watertight drum on board the vessel for later disposal onshore. In addition, in some cases sediments may be brought to shore for compositing and subsampling and it may not be practical to return any excess sediments to the station where they were collected. In such cases, the excess sediments should also be retained for appropriate disposal onshore. Decisions regarding the appropriate disposal for excess sediments may have to await receipt of the results of

chemical analyses of the sediments. Sediments will only very rarely be sufficiently contaminated to require handling and disposal as dangerous or hazardous wastes, but provisions must be made for proper disposal if that were to be the case. (Ecology, 2003)

7.0 **Records Management**

- 7.1 Complete the field log for each station sampled. Include a visually descriptive assessment of each acceptable sample, together with any unusual characteristics such as odor.
- 7.2 Acceptable samples will have station information and a number of visually descriptive assessments and measurements made (i.e. salinity, sediment temperature, odor, etc.) and recorded on the field logs.
- 7.3 Close out the Float plan with the designated contact at the end of the sampling work.
- 7.4 Commonly used forms can be obtained from the EAP Intranet site <http://aww.ecology.ecy.wa.gov/programs/eap/forms/index.html>
- 7.5 The Field Work Plan & Contact Person Form and Float Plan Form can be obtained at EAP's SharePoint Site <http://ecywblcyadxd0/sites/eap/Field%20Schedules/Forms/AllItems.aspx>
- 7.6 There are three forms for ordering laboratory services from Manchester Environmental Laboratory (MEL): Three forms are used for ordering laboratory services:
 - 7.6.1 Pre-Sampling Notification (PSN) form
 - 7.6.1.1 This form is used to give the laboratory an idea of where, what, and when you are planning to collect and submit samples. This allows the lab to plan for your samples and helps ensure that they will be processed in a timely manner. You can copy this form from the MEL Laboratory Manual and use it for submittal.
 - 7.6.2 Laboratory Analyses Required (LAR) form
 - 7.6.2.1 The LAR is the formal request of the sampler for specific analytical work, and this form must accompany all samples entering the laboratory. **The LAR also serves to document the chain-of-custody.** This form is to be filled out in triplicate. Request these forms from the Sample Management unit.
 - 7.6.3 Sample Container Request (SCR) form
 - 7.6.3.1 This form is used to order sample containers needed for your sampling event(s), and is usually submitted along with the Pre-Sampling Notification form. You can copy this form from the MEL Laboratory Manual and use it for submittal.

7.7 The Laboratory Manual also includes instructions for filling out these forms and can be downloaded at the following link
<http://aww.ecology.ecy.wa.gov/programs/eap/forms/labmanual.pdf>

8.0 Quality Control and Quality Assurance Section

8.1 Chain-of-custody procedures should follow those recommended by the PSEP (1997b). They should be initiated when the first sample is collected and followed until all samples are relinquished to the analytical laboratory. Chain-of-Custody forms should provide an unbroken trail of accountability that ensures the physical security of samples, data, and records. Laboratory Analyses Required (LAR) form will serve as the Chain-of-Custody Form. At the end of each day all sample containers should be checked against the Chain-of-Custody forms. It is important to verify the station identification number, collection date, collection time, and if applicable, lab numbers as part of the QA/QC procedures.

9.0 Safety

9.1 **Never compromise your personal safety or that of a field partner to collect a sample.** Always plan ahead to avoid falling and drowning hazards. Always wear appropriate safety gear such as life vests. When working with winches, cables and similar machinery, gloves, hard hats, safety glasses and steel-toed boots are also important safety items.

9.2 When deploying the grab from an overhead crane (as on the RV Skookum), wear a life vest and protective helmet any time the grab is suspended from the deck or at the water's surface. Do not touch the cable while the grab is being raised or lowered.

9.3 Knowledge of the contents of this standard operating procedure is required.

9.4 The following forms must be completed to document field personnel, sampling locations, overnight lodging, itinerary, contact person(s), and emergency contacts:

9.4.1 Float plan

9.4.2 Contact person designation

9.4.3 Field Sampling Notification

9.5 Boat Safety

9.5.1 A qualified EA boat operator will be required for all sampling from a boat. Boat operations will conform to all requirements in Chapter 3 (Boating) of the EA Safety Manual. It is the responsibility of the boat operator to brief the crew on their responsibilities for the safe operation of the boat and use of its sampling gear. Crew members must have current First Aid/CPR certification.

9.6 Manual Sampling

- 9.6.1 For projects requiring manual sampling (without a winch, using a Petite Ponar), there may be special safety considerations. Sampling from a bridge, for example, will be conducted in accordance with requirements of Chapter 1 of the EA Safety Manual ("Working near Traffic and from Bridges").


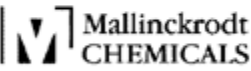

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Attachment 1. MSDS for Acetone from J.T. Baker
<http://www.jtbaker.com/msds/englishhtml/A0446.htm>

MSDS Number: **A0446** * * * * * *Effective Date: 02/01/07* * * * * * *Supersedes: 05/20/04*

	24 Hour Emergency Telephone: 908-859-2151 CHEMTREC: 1-800-424-9300
	National Response in Canada CANUTEC: 613-996-6666
From: Mallinckrodt Baker, Inc. 222 Red School Lane Phillipsburg, NJ 08865	 
NOTE: CHEMTREC, CANUTEC and National Response Center emergency numbers to be used only in the event of chemical emergencies involving a spill, leak, fire, exposure or accident involving chemicals.	
All non-emergency questions should be directed to Customer Service (1-800-582-2537) for assistance.	

ACETONE

1. Product Identification

Synonyms: Dimethylketone; 2-propanone; dimethylketal

CAS No.: 67-64-1

Molecular Weight: 58.08

Chemical Formula: (CH₃)₂CO

Product Codes:

J.T. Baker: 5008, 5018, 5356, 5580, 5965, 5975, 9001, 9002, 9003, 9004, 9005, 9006, 9007, 9008, 9009, 9010, 9015, 9024, 9036, 9125, 9254, 9271, A134, V655

Mallinckrodt: 0018, 2432, 2435, 2437, 2438, 2440, 2443, 2850, H451, H580, H981

2. Composition/Information on Ingredients

Ingredient	CAS No	Percent	Hazardous
----- Acetone	----- 67-64-1	----- 99 - 100%	----- Yes

3. Hazards Identification

Emergency Overview

DANGER! EXTREMELY FLAMMABLE LIQUID AND VAPOR. VAPOR MAY CAUSE FLASH FIRE. HARMFUL IF SWALLOWED OR INHALED. CAUSES IRRITATION TO SKIN, EYES AND RESPIRATORY TRACT. AFFECTS CENTRAL NERVOUS SYSTEM.

SAF-T-DATA^(tm) Ratings (Provided here for your convenience)

Health Rating: 2 - Moderate

Flammability Rating: 3 - Severe (Flammable)

Reactivity Rating: 0 - None

Contact Rating: 3 - Severe

Lab Protective Equip: GOGGLES & SHIELD; LAB COAT & APRON; VENT HOOD; PROPER GLOVES; CLASS B EXTINGUISHER

Storage Color Code: Red (Flammable)

Potential Health Effects

Inhalation:

Inhalation of vapors irritates the respiratory tract. May cause coughing, dizziness, dullness, and headache. Higher concentrations can produce central nervous system depression, narcosis, and unconsciousness.

Ingestion:

Swallowing small amounts is not likely to produce harmful effects. Ingestion of larger amounts may produce abdominal pain, nausea and vomiting. Aspiration into lungs can produce severe lung damage and is a medical emergency. Other symptoms are expected to parallel inhalation.

Skin Contact:

Irritating due to defatting action on skin. Causes redness, pain, drying and cracking of the skin.

Eye Contact:

Vapors are irritating to the eyes. Splashes may cause severe irritation, with stinging, tearing, redness and pain.

Chronic Exposure:

Prolonged or repeated skin contact may produce severe irritation or dermatitis.

Aggravation of Pre-existing Conditions:

Use of alcoholic beverages enhances toxic effects. Exposure may increase the toxic potential of chlorinated hydrocarbons, such as chloroform, trichloroethane.

4. First Aid Measures

Inhalation:

Remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention.

Ingestion:

Aspiration hazard. If swallowed, vomiting may occur spontaneously, but DO NOT INDUCE. If vomiting occurs, keep head below hips to prevent aspiration into lungs. Never give anything by mouth to an unconscious person. Call a physician immediately.

Skin Contact:

Immediately flush skin with plenty of water for at least 15 minutes. Remove contaminated clothing and shoes. Get medical attention. Wash clothing before reuse. Thoroughly clean shoes before reuse.

Eye Contact:

Immediately flush eyes with plenty of water for at least 15 minutes, lifting upper and lower eyelids occasionally. Get medical attention.

5. Fire Fighting Measures

Fire:

Flash point: -20C (-4F) CC

Autoignition temperature: 465C (869F)

Flammable limits in air % by volume:

l_{el}: 2.5; u_{el}: 12.8

Extremely Flammable Liquid and Vapor! Vapor may cause flash fire.

Explosion:

Above flash point, vapor-air mixtures are explosive within flammable limits noted above. Vapors can flow along surfaces to distant ignition source and flash back. Contact with strong oxidizers may cause fire. Sealed containers may rupture when heated. This material may produce a floating fire hazard. Sensitive to static discharge.

Fire Extinguishing Media:

Dry chemical, alcohol foam or carbon dioxide. Water may be ineffective. Water spray may be used to keep fire exposed containers cool, dilute spills to nonflammable mixtures, protect personnel attempting to stop leak and disperse vapors.

Special Information:

In the event of a fire, wear full protective clothing and NIOSH-approved self-contained breathing apparatus with full facepiece operated in the pressure demand or other positive pressure mode.

6. Accidental Release Measures

Ventilate area of leak or spill. Remove all sources of ignition. Wear appropriate personal protective equipment as specified in Section 8. Isolate hazard area. Keep unnecessary and unprotected personnel from entering. Contain and recover liquid when possible. Use non-sparking tools and equipment. Collect liquid in an appropriate

container or absorb with an inert material (e. g., vermiculite, dry sand, earth), and place in a chemical waste container. Do not use combustible materials, such as saw dust. Do not flush to sewer! If a leak or spill has not ignited, use water spray to disperse the vapors, to protect personnel attempting to stop leak, and to flush spills away from exposures. US Regulations (CERCLA) require reporting spills and releases to soil, water and air in excess of reportable quantities. The toll free number for the US Coast Guard National Response Center is (800) 424-8802.

J. T. Baker SOLUSORB® solvent adsorbent is recommended for spills of this product.

7. Handling and Storage

Protect against physical damage. Store in a cool, dry well-ventilated location, away from any area where the fire hazard may be acute. Outside or detached storage is preferred. Separate from incompatibles. Containers should be bonded and grounded for transfers to avoid static sparks. Storage and use areas should be No Smoking areas. Use non-sparking type tools and equipment, including explosion proof ventilation. Containers of this material may be hazardous when empty since they retain product residues (vapors, liquid); observe all warnings and precautions listed for the product.

8. Exposure Controls/Personal Protection

Airborne Exposure Limits:

Acetone:

-OSHA Permissible Exposure Limit (PEL):

1000 ppm (TWA)

-ACGIH Threshold Limit Value (TLV):

500 ppm (TWA), 750 ppm (STEL) A4 - not classifiable as a human carcinogen

Ventilation System:

A system of local and/or general exhaust is recommended to keep employee exposures below the Airborne Exposure Limits. Local exhaust ventilation is generally preferred because it can control the emissions of the contaminant at its source, preventing dispersion of it into the general work area. Please refer to the ACGIH document, *Industrial Ventilation, A Manual of Recommended Practices*, most recent edition, for details.

Personal Respirators (NIOSH Approved):

If the exposure limit is exceeded and engineering controls are not feasible, a half-face organic vapor respirator may be worn for up to ten times the exposure limit, or the maximum use concentration specified by the appropriate regulatory agency or respirator supplier, whichever is lowest. A full-face piece organic vapor respirator may be worn up to 50 times the exposure limit, or the maximum use concentration specified by the appropriate regulatory agency or respirator supplier, whichever is lowest. For emergencies or instances where the exposure levels are not known, use a full-face piece

positive-pressure, air-supplied respirator. WARNING: Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.

Skin Protection:

Wear impervious protective clothing, including boots, gloves, lab coat, apron or coveralls, as appropriate, to prevent skin contact.

Eye Protection:

Use chemical safety goggles and/or a full face shield where splashing is possible. Maintain eye wash fountain and quick-drench facilities in work area.

9. Physical and Chemical Properties

Appearance:

Clear, colorless, volatile liquid.

Odor:

Fragrant, mint-like

Solubility:

Miscible in all proportions in water.

Specific Gravity:

0.79 @ 20C/4C

pH:

No information found.

% Volatiles by volume @ 21C (70F):

100

Boiling Point:

56.5C (133F) @ 760 mm Hg

Melting Point:

-95C (-139F)

Vapor Density (Air=1):

2.0

Vapor Pressure (mm Hg):

400 @ 39.5C (104F)

Evaporation Rate (BuAc=1):

ca. 7.7

10. Stability and Reactivity

Stability:

Stable under ordinary conditions of use and storage.

Hazardous Decomposition Products:

Carbon dioxide and carbon monoxide may form when heated to decomposition.

Hazardous Polymerization:

Will not occur.

Incompatibilities:

Concentrated nitric and sulfuric acid mixtures, oxidizing materials, chloroform, alkalis, chlorine compounds, acids, potassium t-butoxide.

Conditions to Avoid:

Heat, flames, ignition sources and incompatibles.

11. Toxicological Information

Oral rat LD50: 5800 mg/kg; Inhalation rat LC50: 50,100mg/m³; Irritation eye rabbit, Standard Draize, 20 mg severe; investigated as a tumorigen, mutagen, reproductive effector.

-----\Cancer Lists\-----			
Ingredient	---NTP Carcinogen---		IARC Category
	Known	Anticipated	
Acetone (67-64-1)	No	No	None

12. Ecological Information**Environmental Fate:**

When released into the soil, this material is expected to readily biodegrade. When released into the soil, this material is expected to leach into groundwater. When released into the soil, this material is expected to quickly evaporate. When released into water, this material is expected to readily biodegrade. When released to water, this material is expected to quickly evaporate. This material has a log octanol-water partition coefficient of less than 3.0. This material is not expected to significantly bioaccumulate. When released into the air, this material may be moderately degraded by reaction with photochemically produced hydroxyl radicals. When released into the air, this material may be moderately degraded by photolysis. When released into the air, this material is expected to be readily removed from the atmosphere by wet deposition.

Environmental Toxicity:

This material is not expected to be toxic to aquatic life. The LC50/96-hour values for fish are over 100 mg/l.

13. Disposal Considerations

Whatever cannot be saved for recovery or recycling should be handled as hazardous waste and sent to a RCRA approved incinerator or disposed in a RCRA approved waste facility. Processing, use or contamination of this product may change the waste management options. State and local disposal regulations may differ from federal disposal regulations. Dispose of container and unused contents in accordance with federal, state and local requirements.

14. Transport Information

Domestic (Land, D.O.T.)

Proper Shipping Name: ACETONE
Hazard Class: 3
UN/NA: UN1090
 Packing Group: II
Information reported for product/size: 188L

International (Water, I.M.O.)

Proper Shipping Name: ACETONE
Hazard Class: 3
UN/NA: UN1090
 Packing Group: II
Information reported for product/size: 188L

15. Regulatory Information

-----\Chemical Inventory Status - Part 1\-----

Ingredient	TSCA	EC	Japan	Australia
Acetone (67-64-1)	Yes	Yes	Yes	Yes

-----\Chemical Inventory Status - Part 2\-----

Ingredient	Korea	DSL	--Canada-- NDSL	Phil.
Acetone (67-64-1)	Yes	Yes	No	Yes

-----\Federal, State & International Regulations - Part 1\-----

Ingredient	-SARA 302-		-----SARA 313-----	
	RQ	TPQ	List	Chemical Catg.
Acetone (67-64-1)	No	No	Yes	No

-----\Federal, State & International Regulations - Part 2\-----

Ingredient	CERCLA	-RCRA- 261.33	-TSCA- 8(d)
Acetone (67-64-1)	5000	U002	No

Chemical Weapons Convention: No TSCA 12(b): No CDTA: Yes
 SARA 311/312: Acute: Yes Chronic: No Fire: Yes Pressure: No
 Reactivity: No (Pure / Liquid)

Australian Hazchem Code: 2[Y]E

Poison Schedule: None allocated.

WHMIS:

This MSDS has been prepared according to the hazard criteria of the Controlled Products Regulations (CPR) and the MSDS contains all of the information required by the CPR.

16. Other Information

NFPA Ratings: Health: **1** Flammability: **3** Reactivity: **0**

Label Hazard Warning:

DANGER! EXTREMELY FLAMMABLE LIQUID AND VAPOR. VAPOR MAY CAUSE FLASH FIRE. HARMFUL IF SWALLOWED OR INHALED. CAUSES IRRITATION TO SKIN, EYES AND RESPIRATORY TRACT. AFFECTS CENTRAL NERVOUS SYSTEM.

Label Precautions:

Keep away from heat, sparks and flame.
Keep container closed.
Use only with adequate ventilation.
Wash thoroughly after handling.
Avoid breathing vapor.
Avoid contact with eyes, skin and clothing.

Label First Aid:

Aspiration hazard. If swallowed, vomiting may occur spontaneously, but DO NOT INDUCE. If vomiting occurs, keep head below hips to prevent aspiration into lungs. Never give anything by mouth to an unconscious person. Call a physician immediately. If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. In case of contact, immediately flush eyes or skin with plenty of water for at least 15 minutes. Remove contaminated clothing and shoes. Wash clothing before reuse. In all cases, get medical attention.

Product Use:

Laboratory Reagent.

Revision Information:

No Changes.

Disclaimer:

Mallinckrodt Baker, Inc. provides the information contained herein in good faith but makes no representation as to its comprehensiveness or accuracy. This document is intended only as a guide to the appropriate precautionary handling of the material by a properly trained person using this product. Individuals receiving the information must exercise their independent judgment in determining its appropriateness for a particular purpose. MALLINCKRODT BAKER, INC. MAKES NO REPRESENTATIONS OR WARRANTIES, EITHER EXPRESS OR IMPLIED, INCLUDING WITHOUT LIMITATION ANY WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE WITH RESPECT TO THE INFORMATION SET FORTH HEREIN OR THE

**PRODUCT TO WHICH THE INFORMATION REFERS. ACCORDINGLY,
MALLINCKRODT BAKER, INC. WILL NOT BE RESPONSIBLE FOR
DAMAGES RESULTING FROM USE OF OR RELIANCE UPON THIS
INFORMATION.**

Prepared by: Environmental Health & Safety
Phone Number: (314) 654-1600 (U.S.A.)

Attachment 2. MSDS for Hexane from J.T. Baker
<http://www.jtbaker.com/msds/englishhtml/H2379.htm>

MSDS Number: **H2379** * * * * * *Effective Date: 06/13/07* * * * * * *Supersedes: 05/07/07*



From: Mallinckrodt Baker, Inc.
 222 Red School Lane
 Phillipsburg, NJ 08865



24 Hour Emergency Telephone: 908-859-2151
 CHEMTREC: 1-800-424-9300

National Response in Canada
 CANUTEC: 613-996-6666

Outside U.S. And Canada
 Chemtrec: 703-527-3887

NOTE: CHEMTREC, CANUTEC and National Response Center emergency numbers to be used only in the event of chemical emergencies involving a spill, leak, fire, exposure or accident involving chemicals.

All non-emergency questions should be directed to Customer Service (1-800-582-2537) for assistance.

HEXANES

1. Product Identification

Synonyms: Normal Hexane; Hexyl Hydride

CAS No.: 110-54-3 (n-hexane)

Molecular Weight: 86.18

Chemical Formula: CH₃(CH₂)₄CH₃ n-hexane

Product Codes: 9277, 9306, 9309, 9367, N169

2. Composition/Information on Ingredients

Ingredient	CAS No	Percent	Hazardous
Hexane	110-54-3	> 95%	Yes
Methylcyclopentane	96-37-7	1 - 2%	Yes
2-Methylpentane	107-83-5	1 - 2%	No
3-Methylpentane	96-14-0	1 - 2%	No
Pentane	109-66-0	0 - 2%	No

3. Hazards Identification

Emergency Overview

DANGER! EXTREMELY FLAMMABLE LIQUID AND VAPOR. VAPOR MAY CAUSE FLASH FIRE. HARMFUL OR FATAL IF SWALLOWED. HARMFUL IF INHALED. CAUSES IRRITATION TO SKIN, EYES AND RESPIRATORY TRACT. AFFECTS THE CENTRAL AND PERIPHERAL NERVOUS SYSTEMS.

SAF-T-DATA^(tm) Ratings (Provided here for your convenience)

Health Rating: 3 - Severe (Life)

Flammability Rating: 4 - Extreme (Flammable)

Reactivity Rating: 2 - Moderate

Contact Rating: 2 - Moderate

Lab Protective Equip: GOGGLES & SHIELD; LAB COAT & APRON; VENT HOOD; PROPER GLOVES; CLASS B EXTINGUISHER

Storage Color Code: Red (Flammable)

Potential Health Effects

The health hazards addressed are for the major component: n-hexane.

Inhalation:

Inhalation of vapors irritates the respiratory tract. Overexposure may cause lightheadedness, nausea, headache, and blurred vision. Greater exposure may cause muscle weakness, numbness of the extremities, unconsciousness and death.

Ingestion:

May produce abdominal pain, nausea. Aspiration into lungs can produce severe lung damage and is a medical emergency. Other symptoms expected to parallel inhalation.

Skin Contact:

May cause redness, irritation, with dryness, cracking.

Eye Contact:

Vapors may cause irritation. Splashes may cause redness and pain.

Chronic Exposure:

Repeated or prolonged skin contact may defat the skin and produce irritation and dermatitis. Chronic inhalation may cause peripheral nerve disorders and central nervous system effects.

Aggravation of Pre-existing Conditions:

Persons with pre-existing skin disorders or eye problems or impaired respiratory function may be more susceptible to the effects of the substance. May affect the developing fetus.

4. First Aid Measures

Inhalation:

Remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Call a physician.

Ingestion:

Aspiration hazard. If swallowed, DO NOT INDUCE VOMITING. Give large quantities of water. Never give anything by mouth to an unconscious person. Get medical attention immediately.

Skin Contact:

Remove any contaminated clothing. Wipe off excess from skin. Wash skin with soap and water for at least 15 minutes. Get medical attention if irritation develops or persists.

Eye Contact:

Immediately flush eyes with plenty of water for at least 15 minutes, lifting lower and upper eyelids occasionally. Get medical attention immediately.

Note to Physician:

BEI=2,5-hexadione in urine, sample at end of shift at workweeks end, 5 mg/g creatine. Also, measure n-hexane in expired air. Analgesics may be necessary for pain management, there is no specific antidote. Monitor arterial blood gases in cases of severe aspiration.

5. Fire Fighting Measures

Fire:

Flash point: -21C (-6F) CC

Autoignition temperature: 224C (435F)

Flammable limits in air % by volume:

lcl: 1.1; ucl: 7.5

Extremely Flammable Liquid and Vapor! Vapor may cause flash fire. Dangerous fire hazard when exposed to heat or flame.

Explosion:

Above flash point, vapor-air mixtures are explosive within flammable limits noted above. Contact with oxidizing materials may cause extremely violent combustion. Explodes when mixed @ 28C with dinitrogen tetroxide. Sensitive to static discharge.

Fire Extinguishing Media:

Dry chemical, foam or carbon dioxide. Water may be ineffective.

Special Information:

In the event of a fire, wear full protective clothing and NIOSH-approved self-contained breathing apparatus with full facepiece operated in the pressure demand or other positive pressure mode. Water spray may be used to keep fire exposed containers cool. Vapors can flow along surfaces to distant ignition source and flash back. Vapor explosion hazard exists indoors, outdoors, or in sewers.

6. Accidental Release Measures

Ventilate area of leak or spill. Remove all sources of ignition. Wear appropriate personal protective equipment as specified in Section 8. Isolate hazard area. Keep unnecessary and unprotected personnel from entering. Contain and recover liquid when possible. Use non-sparking tools and equipment. Collect liquid in an appropriate container or absorb with an inert material (e. g., vermiculite, dry sand, earth), and place in a chemical waste container. Do not use combustible materials, such as saw dust. Do not flush to sewer! If a leak or spill has not ignited, use water spray to disperse the vapors, to protect personnel attempting to stop leak, and to flush spills away from exposures. US Regulations (CERCLA) require reporting spills and releases to soil, water and air in excess of reportable quantities. The toll free number for the US Coast Guard National Response Center is (800) 424-8802.

J. T. Baker SOLUSORB® solvent adsorbent is recommended for spills of this product.

7. Handling and Storage

Protect against physical damage. Store in a cool, dry well-ventilated location, away from direct sunlight and any area where the fire hazard may be acute. Store in tightly closed containers (preferably under nitrogen atmosphere). Outside or detached storage is preferred. Inside storage should be in a standard flammable liquids storage room or cabinet. Separate from oxidizing materials. Containers should be bonded and grounded for transfers to avoid static sparks. Storage and use areas should be No Smoking areas. Use non-sparking type tools and equipment. Containers of this material may be hazardous when empty since they retain product residues (vapors, liquid); observe all warnings and precautions listed for the product.

8. Exposure Controls/Personal Protection

Airborne Exposure Limits:

N-Hexane [110-54-3]:

-OSHA Permissible Exposure Limit (PEL): 500 ppm (TWA)

-ACGIH Threshold Limit Value (TLV): 50 ppm (TWA), Skin
other isomers of hexane

-ACGIH Threshold Limit Value (TLV): 500 ppm (TWA), 1000ppm (STEL)

Ventilation System:

A system of local and/or general exhaust is recommended to keep employee exposures below the Airborne Exposure Limits. Local exhaust ventilation is generally preferred because it can control the emissions of the contaminant at its source, preventing dispersion of it into the general work area. Please refer to the ACGIH document, *Industrial Ventilation, A Manual of Recommended Practices*, most recent edition, for details.

Personal Respirators (NIOSH Approved):

If the exposure limit is exceeded and engineering controls are not feasible, wear a supplied air, full-facepiece respirator, airtight hood, or full-facepiece self-contained breathing apparatus. Breathing air quality must meet the requirements of the OSHA respiratory protection standard (29CFR1910.134).

Skin Protection:

Wear impervious protective clothing, including boots, gloves, lab coat, apron or coveralls, as appropriate, to prevent skin contact.

Eye Protection:

Use chemical safety goggles and/or a full face shield where splashing is possible. Maintain eye wash fountain and quick-drench facilities in work area.

9. Physical and Chemical Properties

The following properties are for n-hexane, the major component.

Appearance:

Clear, colorless liquid.

Odor:

Gasoline-like odor.

Solubility:

Insoluble in water.

Specific Gravity:

0.66

pH:

No information found.

% Volatiles by volume @ 21C (70F):

100

Boiling Point:

ca. 68C (ca. 154F)

Melting Point:

ca. -95C (ca. -139F)

Vapor Density (Air=1):

3.0

Vapor Pressure (mm Hg):

150 @ 25C (77F)

Evaporation Rate (BuAc=1):

9

10. Stability and Reactivity

Stability:

Stable under ordinary conditions of use and storage. Heat will contribute to instability.

Hazardous Decomposition Products:

May produce acrid smoke and irritating fumes when heated to decomposition.

Hazardous Polymerization:

Will not occur.

Incompatibilities:

Strong oxidizers.

Conditions to Avoid:

Heat, flames, ignition sources and incompatibles.

11. Toxicological Information

N-Hexane: Oral rat LD50: 28710 mg/kg. Irritation eye rabbit: 10 mg mild. Investigated as a tumorigen, mutagen and reproductive effector.

Ingredient	---NTP Carcinogen---		IARC Category
	Known	Anticipated	
Hexane (110-54-3)	No	No	None
Methylcyclopentane (96-37-7)	No	No	None
2-Methylpentane (107-83-5)	No	No	None
3-Methylpentane (96-14-0)	No	No	None
Pentane (109-66-0)	No	No	None

12. Ecological Information**Environmental Fate:**

When released into the soil, this material may biodegrade to a moderate extent. When released into the soil, this material is not expected to leach into groundwater. When released into the soil, this material is expected to quickly evaporate. When released into water, this material may biodegrade to a moderate extent. When released to water, this material is expected to quickly evaporate. When released into the water, this material is expected to have a half-life between 1 and 10 days. This material has an estimated bioconcentration factor (BCF) of less than 100. This material has a log octanol-water partition coefficient of greater than 3.0. This material is not expected to significantly bioaccumulate. When released into the air, this material is expected to be readily degraded by reaction with photochemically produced hydroxyl radicals. When released into the air, this material is expected to have a half-life between 1 and 10 days.

Environmental Toxicity:

No information found.

13. Disposal Considerations

Whatever cannot be saved for recovery or recycling should be handled as hazardous waste and sent to a RCRA approved incinerator or disposed in a RCRA approved waste facility. Processing, use or contamination of this product may change the waste management options. State and local disposal regulations may differ from federal disposal regulations. Dispose of container and unused contents in accordance with federal, state and local requirements.

14. Transport Information

Domestic (Land, D.O.T.)

Proper Shipping Name: HEXANES
Hazard Class: 3
UN/NA: UN1208
 Packing Group: II
Information reported for product/size: 215L

International (Water, I.M.O.)

Proper Shipping Name: HEXANES
Hazard Class: 3
UN/NA: UN1208
 Packing Group: II
Information reported for product/size: 215L

15. Regulatory Information

-----\Chemical Inventory Status - Part 1\-----

Ingredient	TSCA	EC	Japan	Australia
Hexane (110-54-3)	Yes	Yes	Yes	Yes
Methylcyclopentane (96-37-7)	Yes	Yes	No	Yes
2-Methylpentane (107-83-5)	Yes	Yes	Yes	Yes
3-Methylpentane (96-14-0)	Yes	Yes	Yes	Yes
Pentane (109-66-0)	Yes	Yes	Yes	Yes

-----\Chemical Inventory Status - Part 2\-----

Ingredient	Korea	--Canada--		
		DSL	NDSL	Phil.
Hexane (110-54-3)	Yes	Yes	No	Yes
Methylcyclopentane (96-37-7)	Yes	Yes	No	Yes
2-Methylpentane (107-83-5)	Yes	Yes	No	Yes
3-Methylpentane (96-14-0)	Yes	Yes	No	Yes
Pentane (109-66-0)	Yes	Yes	No	Yes

-----\Federal, State & International Regulations - Part 1\-----

Ingredient	-SARA 302-		-----SARA 313-----	
	RQ	TPQ	List	Chemical Catg.
Hexane (110-54-3)	No	No	Yes	No
Methylcyclopentane (96-37-7)	No	No	No	No
2-Methylpentane (107-83-5)	No	No	No	No
3-Methylpentane (96-14-0)	No	No	No	No
Pentane (109-66-0)	No	No	No	No

-----\Federal, State & International Regulations - Part 2\-----			
Ingredient	CERCLA	-RCRA-	-TSCA-
-----	-----	-----	-----
Hexane (110-54-3)	5000	No	No
Methylcyclopentane (96-37-7)	No	No	No
2-Methylpentane (107-83-5)	No	No	No
3-Methylpentane (96-14-0)	No	No	No
Pentane (109-66-0)	No	No	Yes

Chemical Weapons Convention: No TSCA 12(b): Yes CDTA: No
 SARA 311/312: Acute: Yes Chronic: Yes Fire: Yes Pressure: No
 Reactivity: No (Mixture / Liquid)

Australian Hazchem Code: 3[Y]E

Poison Schedule: None allocated.

WHMIS:

This MSDS has been prepared according to the hazard criteria of the Controlled Products Regulations (CPR) and the MSDS contains all of the information required by the CPR.

16. Other Information

NFPA Ratings: Health: **1** Flammability: **3** Reactivity: **0**

Label Hazard Warning:

DANGER! EXTREMELY FLAMMABLE LIQUID AND VAPOR. VAPOR MAY CAUSE FLASH FIRE. HARMFUL OR FATAL IF SWALLOWED. HARMFUL IF INHALED. CAUSES IRRITATION TO SKIN, EYES AND RESPIRATORY TRACT. AFFECTS THE CENTRAL AND PERIPHERAL NERVOUS SYSTEMS.

Label Precautions:

Keep away from heat, sparks and flame.
 Keep container closed.
 Use only with adequate ventilation.
 Wash thoroughly after handling.
 Avoid breathing vapor or mist.
 Avoid contact with eyes, skin and clothing.

Label First Aid:

Aspiration hazard. If swallowed, vomiting may occur spontaneously, but DO NOT INDUCE. If vomiting occurs, keep head below hips to prevent aspiration into lungs. Never give anything by mouth to an unconscious person. Call a physician immediately. If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. In case of contact, immediately flush eyes or skin with plenty of water for at least 15 minutes. In all cases call a physician.

Product Use:

Laboratory Reagent.

Revision Information:

MSDS Section(s) changed since last revision of document include: 3.

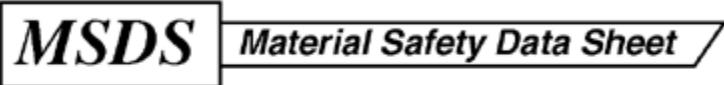

Disclaimer:

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Prepared by: Environmental Health & Safety
Phone Number: (314) 654-1600 (U.S.A.)

Attachment 3. MSDS for Nitric Acid from J.T. Baker
<http://www.jtbaker.com/msds/englishhtml/N3660.htm>

MSDS Number: **N3660** * * * * * *Effective Date: 05/06/05* * * * * * *Supersedes: 07/02/02*

	24 Hour Emergency Telephone: 908-859-2151 CHEMTREC: 1-800-424-9300
	National Response in Canada CANUTEC: 613-996-6666
From: Mallinckrodt Baker, Inc. 222 Red School Lane Phillipsburg, NJ 08865	
<small>All non-emergency questions should be directed to Customer Service (1-800-582-2537) for assistance.</small>	Outside U.S. and Canada Chemtrec: 703-527-3887
	NOTE: CHEMTREC, CANUTEC and National Response Center emergency numbers to be used only in the event of chemical emergencies involving a spill, leak, fire, exposure or accident involving chemicals.

NITRIC ACID, 50-70%

1. Product Identification

Synonyms: Aqua Fortis; Azotic Acid; Nitric Acid 50%; Nitric Acid 65%; nitric acid 69-70%

CAS No.: 7697-37-2

Molecular Weight: 63.01

Chemical Formula: HNO₃

Product Codes:

J.T. Baker: 5371, 5796, 5801, 5826, 5856, 5876, 5896, 9597, 9598, 9600, 9601, 9602, 9603, 9604, 9606, 9607, 9608, 9610, 9616, 9617, 9670

Mallinckrodt: 1409, 2704, 2705, 2716, 6623, H862, H988, H993, H998, V077, V650

2. Composition/Information on Ingredients

Ingredient	CAS No	Percent	Hazardous
Nitric Acid	7697-37-2	50 - 70%	Yes
Water	7732-18-5	30 - 50%	No

3. Hazards Identification

Emergency Overview

POISON! DANGER! STRONG OXIDIZER. CONTACT WITH OTHER MATERIAL MAY CAUSE FIRE. CORROSIVE. LIQUID AND MIST CAUSE SEVERE BURNS TO ALL BODY TISSUE. MAY BE FATAL IF SWALLOWED OR INHALED. INHALATION MAY CAUSE LUNG AND TOOTH DAMAGE.

SAF-T-DATA^(tm) Ratings (Provided here for your convenience)

Health Rating: 4 - Extreme (Poison)

Flammability Rating: 0 - None

Reactivity Rating: 3 - Severe (Oxidizer)

Contact Rating: 4 - Extreme (Corrosive)

Lab Protective Equip: GOGGLES & SHIELD; LAB COAT & APRON; VENT HOOD; PROPER GLOVES

Storage Color Code: White (Corrosive)

Potential Health Effects

Nitric acid is extremely hazardous; it is corrosive, reactive, an oxidizer, and a poison.

Inhalation:

Corrosive! Inhalation of vapors can cause breathing difficulties and lead to pneumonia and pulmonary edema, which may be fatal. Other symptoms may include coughing, choking, and irritation of the nose, throat, and respiratory tract.

Ingestion:

Corrosive! Swallowing nitric acid can cause immediate pain and burns of the mouth, throat, esophagus and gastrointestinal tract.

Skin Contact:

Corrosive! Can cause redness, pain, and severe skin burns. Concentrated solutions cause deep ulcers and stain skin a yellow or yellow-brown color.

Eye Contact:

Corrosive! Vapors are irritating and may cause damage to the eyes. Contact may cause severe burns and permanent eye damage.

Chronic Exposure:

Long-term exposure to concentrated vapors may cause erosion of teeth and lung damage. Long-term exposures seldom occur due to the corrosive properties of the acid.

Aggravation of Pre-existing Conditions:

Persons with pre-existing skin disorders, eye disease, or cardiopulmonary diseases may be more susceptible to the effects of this substance.

4. First Aid Measures

Immediate first aid treatment reduces the health effects of this substance.

Inhalation:

Remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Call a physician.

Ingestion:

DO NOT INDUCE VOMITING! Give large quantities of water or milk if available. Never give anything by mouth to an unconscious person. Get medical attention immediately.

Skin Contact:

In case of contact, immediately flush skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Wash clothing before reuse. Thoroughly clean shoes before reuse. Get medical attention immediately.

Eye Contact:

Immediately flush eyes with plenty of water for at least 15 minutes, lifting lower and upper eyelids occasionally. Get medical attention immediately.

5. Fire Fighting Measures

Fire:

Not combustible, but substance is a strong oxidizer and its heat of reaction with reducing agents or combustibles may cause ignition. Can react with metals to release flammable hydrogen gas.

Explosion:

Reacts explosively with combustible organic or readily oxidizable materials such as: alcohols, turpentine, charcoal, organic refuse, metal powder, hydrogen sulfide, etc. Reacts with most metals to release hydrogen gas which can form explosive mixtures with air.

Fire Extinguishing Media:

Water spray may be used to keep fire exposed containers cool. Do not get water inside container.

Special Information:

Increases the flammability of combustible, organic and readily oxidizable materials. In the event of a fire, wear full protective clothing and NIOSH-approved self-contained breathing apparatus with full facepiece operated in the pressure demand or other positive pressure mode.

6. Accidental Release Measures

Ventilate area of leak or spill. Wear appropriate personal protective equipment as specified in Section 8. Isolate hazard area. Keep unnecessary and unprotected personnel from entering. Contain and recover liquid when possible. Neutralize with alkaline material (soda ash, lime), then absorb with an inert material (e. g., vermiculite, dry sand, earth), and place in a chemical waste container. Do not use combustible materials, such as saw dust. Do not flush to sewer! US Regulations (CERCLA) require reporting spills and releases to soil, water and air in excess of reportable quantities. The toll free number for the US Coast Guard National Response Center is (800) 424-8802.

J. T. Baker NEUTRASORB® acid neutralizers are recommended for spills of this product.

7. Handling and Storage

Store in a cool, dry, ventilated storage area with acid resistant floors and good drainage. Protect from physical damage. Keep out of direct sunlight and away from heat, water, and incompatible materials. Do not wash out container and use it for other purposes. When diluting, the acid should always be added slowly to water and in small amounts. Never use hot water and never add water to the acid. Water added to acid can cause uncontrolled boiling and splashing. Containers of this material may be hazardous when empty since they retain product residues (vapors, liquid); observe all warnings and precautions listed for the product.

8. Exposure Controls/Personal Protection

Airborne Exposure Limits:

-OSHA Permissible Exposure Limit (PEL):

2 ppm (TWA), 4 ppm (STEL)

-ACGIH Threshold Limit Value (TLV):

2 ppm (TWA); 4 ppm (STEL)

Ventilation System:

A system of local and/or general exhaust is recommended to keep employee exposures below the Airborne Exposure Limits. Local exhaust ventilation is generally preferred because it can control the emissions of the contaminant at its source, preventing dispersion of it into the general work area. Please refer to the ACGIH document, *Industrial Ventilation, A Manual of Recommended Practices*, most recent edition, for details.

Personal Respirators (NIOSH Approved):

If the exposure limit is exceeded, wear a supplied air, full-facepiece respirator, airtight hood, or full-facepiece self-contained breathing apparatus. Nitric acid is an oxidizer and should not come in contact with cartridges and canisters that contain oxidizable materials, such as activated charcoal. Canister-type respirators using sorbents are ineffective.

Skin Protection:

Wear impervious protective clothing, including boots, gloves, lab coat, apron or coveralls, as appropriate, to prevent skin contact.

Eye Protection:

Use chemical safety goggles and/or a full face shield where splashing is possible. Maintain eye wash fountain and quick-drench facilities in work area.

9. Physical and Chemical Properties

Appearance:

Colorless to yellowish liquid.

Odor:

Suffocating, acrid.

Solubility:

Infinitely soluble.

Specific Gravity:

1.41

pH:

1.0 (0.1M solution)

% Volatiles by volume @ 21C (70F):

100 (as water and acid)

Boiling Point:

122C (252F)

Melting Point:

-42C (-44F)

Vapor Density (Air=1):

2-3

Vapor Pressure (mm Hg):

48 @ 20C (68F)

Evaporation Rate (BuAc=1):

No information found.

10. Stability and Reactivity

Stability:

Stable under ordinary conditions of use and storage. Containers may burst when heated.

Hazardous Decomposition Products:

When heated to decomposition, emits toxic nitrogen oxides fumes and hydrogen nitrate. Will react with water or steam to produce heat and toxic and corrosive fumes.

Hazardous Polymerization:

Will not occur.

Incompatibilities:

A dangerously powerful oxidizing agent, concentrated nitric acid is incompatible with most substances, especially strong bases, metallic powders, carbides, hydrogen sulfide, turpentine, and combustible organics.

Conditions to Avoid:

Light and heat.

11. Toxicological Information

Nitric acid: Inhalation rat LC50: 244 ppm (NO₂)/30M; Investigated as a mutagen, reproductive effector. Oral (human) LDLo: 430 mg/kg.

Ingredient	---NTP Carcinogen---		IARC Category
	Known	Anticipated	
Nitric Acid (7697-37-2)	No	No	None
Water (7732-18-5)	No	No	None

12. Ecological Information

Environmental Fate:

No information found.

Environmental Toxicity:

No information found.

13. Disposal Considerations

Whatever cannot be saved for recovery or recycling should be managed in an appropriate and approved waste facility. Although not a listed RCRA hazardous waste, this material may exhibit one or more characteristics of a hazardous waste and require appropriate analysis to determine specific disposal requirements. Processing, use or contamination of this product may change the waste management options. State and local disposal regulations may differ from federal disposal regulations. Dispose of container and unused contents in accordance with federal, state and local requirements.

14. Transport Information

Domestic (Land, D.O.T.)

Proper Shipping Name: NITRIC ACID

Hazard Class: 8

UN/NA: UN2031

Packing Group: II

Information reported for product/size: 6.5GL

International (Water, I.M.O.)

Proper Shipping Name: NITRIC ACID (WITH NOT MORE THAN 70% NITRIC ACID)

Hazard Class: 8

UN/NA: UN2031

Packing Group: II

Information reported for product/size: 6.5GL

15. Regulatory Information

-----\Chemical Inventory Status - Part 1\-----				
Ingredient	TSCA	EC	Japan	Australia
Nitric Acid (7697-37-2)	Yes	Yes	Yes	Yes
Water (7732-18-5)	Yes	Yes	Yes	Yes

-----\Chemical Inventory Status - Part 2\-----				
Ingredient	Korea	--Canada--		
		DSL	NDSL	Phil.
Nitric Acid (7697-37-2)	Yes	Yes	No	Yes
Water (7732-18-5)	Yes	Yes	No	Yes

-----\Federal, State & International Regulations - Part 1\-----				
Ingredient	-SARA 302-		-----SARA 313-----	
	RQ	TPQ	List	Chemical Catg.
Nitric Acid (7697-37-2)	1000	1000	Yes	No
Water (7732-18-5)	No	No	No	No

-----\Federal, State & International Regulations - Part 2\-----			
Ingredient	CERCLA	-RCRA-	-TSCA-
		261.33	8(d)
Nitric Acid (7697-37-2)	1000	No	No
Water (7732-18-5)	No	No	No

Chemical Weapons Convention: No TSCA 12(b): No CDTA: No
 SARA 311/312: Acute: Yes Chronic: Yes Fire: Yes Pressure: No
 Reactivity: No (Mixture / Liquid)

Australian Hazchem Code: 2PE

Poison Schedule: S6

WHMIS:

This MSDS has been prepared according to the hazard criteria of the Controlled Products Regulations (CPR) and the MSDS contains all of the information required by the CPR.

16. Other Information

NFPA Ratings: Health: 3 Flammability: 0 Reactivity: 0 Other: **Oxidizer**

Label Hazard Warning:

POISON! DANGER! STRONG OXIDIZER. CONTACT WITH OTHER MATERIAL MAY CAUSE FIRE. CORROSIVE. LIQUID AND MIST CAUSE SEVERE BURNS TO ALL BODY TISSUE. MAY BE FATAL IF SWALLOWED OR INHALED. INHALATION MAY CAUSE LUNG AND

TOOTH DAMAGE.

Label Precautions:

- Do not get in eyes, on skin, or on clothing.
- Do not breathe vapor or mist.
- Use only with adequate ventilation.
- Wash thoroughly after handling.
- Keep from contact with clothing and other combustible materials.
- Do not store near combustible materials.
- Store in a tightly closed container.
- Remove and wash contaminated clothing promptly.

Label First Aid:

In case of contact, immediately flush eyes or skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Wash clothing before reuse. If swallowed, DO NOT INDUCE VOMITING. Give large quantities of water. Never give anything by mouth to an unconscious person. If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. In all cases get medical attention immediately.

Product Use:

Laboratory Reagent.

Revision Information:

No Changes.

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